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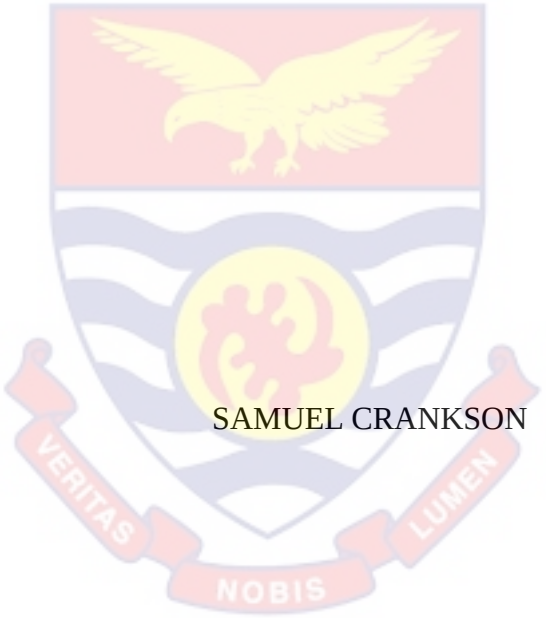
FEMALE PRE-SERVICE TEACHERS' PERCEPTION AND ATTITUDES TOWARDS MATHEMATICS



SAMUEL CRANKSON

2024

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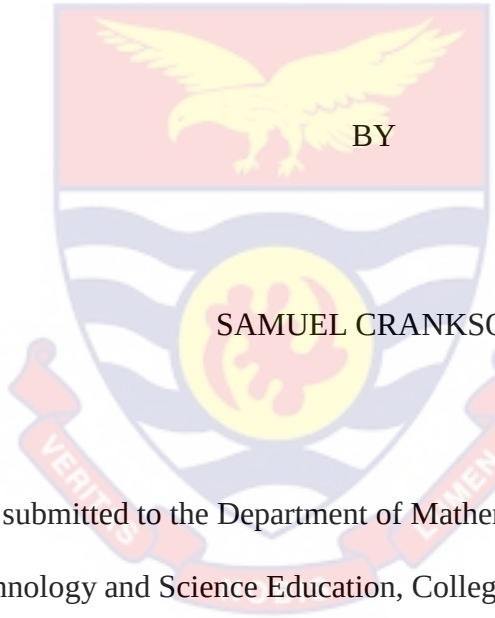

BY

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

FEBRUARY, 2024

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DECLARATION

Candidate's Declaration

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

Signature: …… Date……

Candidate's Name:

Supervisor's Declaration

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

Signature: ……..…….…… Date:……..……

Supervisors' Name:

ABSTRACT

The study focused on female teacher trainees' perceptions and attitudes towards mathematics in some selected colleges of education in Ghana's Western and Central regions. A descriptive research design was used in this study. A purposive sampling technique was used to select 293 female students to participate in the study. The questionnaire was used to collect data from the research participants. The data was analysed using inferential statistics such as the Pearson Moment Product Correlation Coefficient test, t-test and descriptive statistics involving means and standard deviations. Data sources from the open ended items in the questionnaire were analysed using thematic analysis and presented as narrative descriptions with some illustrative examples. The findings from the study showed that female teacher trainees had a favourable perception of cohesiveness, tutor support, involvement, co-operation, and equity as far as the teaching and learning of mathematics at the college level of education. Again, the result indicated a positive disposition towards the affect, behaviour and cognition of female teacher trainees in learning mathematics. Consequently, a significant positive correlation between perception and attitude was revealed in the current study. Finally, the perception and attitude of students from mixed CoEs were more favourable than those in single-sex CoEs. It is recommended that GTEC consider reorienting mathematics curriculum planners to emphasise a sense of equity, inclusivity, equal treatment, cohesiveness, and cooperation to create a positive and supportive mathematics learning environment. Implications of the study for policy, practice and further research have been discussed.

KEYWORDS

Female Pre-service teacher's

Perception

Attitudes

Mathematics

Colleges of Education

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DEDICATION

To my Family

TABLE OF CONTENTS

CONTENTS **PAGE**

LIST OF TABLES

TABLES **PAGE**

CHAPTER ONE

INTRODUCTION

Overview

Mathematics is a way of life since it enables us to organize experiences and use them in life. Furthermore, it helps to prepare the students to live a life that is beneficial to him or her and society; it is a means of communication through the use of various symbols, numbers and operations; it shapes the minds; and it prepares the students for various fields of study. Besides, mathematics enable students to think logically, creatively, and independently. As a result, all students should be given the opportunity and necessary support to learn mathematics indepth and with understanding (Kane & Mertz, 2012)

Background to the Study

The critical role mathematics plays in this technological era cannot be underestimated. This is because mathematics underpins most technological inventions in the global community. Due to the importance of mathematics for the socioeconomic development of nations, the subject has become key in the school curriculum. According to Ngussa and Mbuti (2017), the mathematics curriculum is intended to provide students with essential knowledge and skills in the changing technological world. There has, therefore, never been a greater need to be mathematically literate than in a rapidly expanding society and economy. Mathematics is therefore studied as mandatory and a core subject for both basic and second-cycle levels of education in Ghana. It is a requirement for progression from basic to secondary school in Ghana. A pass in mathematics is also required for admission to many of the prestigious courses at the tertiary level in Ghana.

Despite its importance, students' performance in mathematics has never escaped past and current researchers (Anokye-Poku & Ampadu, 2020). Mireku (2012) has reported the extent to which National large-scale assessments like the National Education Association (NEA), Early Grade Reading Assessment (EGRA) Early Grade Mathematics Assessments (EGMA), and Basic Education Certificate Examination (BECE) and West African Senior School Certificate Examination (WASSCE) which are national 2003 (AnamuahMensah, Mereku and Asabere-Ameyaw, 2004), the 47th out of 48 countries examinations as well as international examinations like Trends in International Mathematics and Science Study (TIMSS) have unearthed the poor performance of Ghanaian students in mathematics in recent times. In particular, the low mean score of 276 placed Ghana 45th out of 46th position in the TIMSS in 2007 with the lowest mean scale scores of 130 and 430 as compared to 500 and 800 (Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008) and 42nd out of the 42 countries in 2011. In a more recent study, TIMSS (2023) further indicated that Ghanaian students' performance has not attained the peak of perfection. Hence, this attests to the poor performance, as argued. In the discourse of this poor mathematics performance shown by students, the attitudes and perceptions of students have been identified to be crucial (Michael, 2015) and, therefore, the need to kindle a change in students' attitudes and perception towards mathematics (Chief Examiner's Report, 2020). This narrative draws the attention of the relevant stakeholders to review the variables that necessitate such performance, particularly in the Ghanaian context.

Students who lack the competence to study mathematics will find many doors leading to a productive and successful future closed. On the contrary,

those who understand and can-do mathematics will have significantly enhanced opportunities and options to open doors to a productive future. The demystification of the perceived difficulty of mathematics continues to attract the attention of researchers whose interest is to encourage students to learn mathematics. To this end, many researchers have found various factors affecting students' mathematics achievement. Students' Perceptions and attitudes have been identified in the literature as crucial (Asomah, Wilmot & Ntow, 2018; Farooq & Shah, 2008).

Generally, perceptions and attitudes significantly influence students' learning outcomes. Research has shown that students' attitudes towards a specific subject, such as math, can impact their learning and achievement. For instance, a positive attitude towards math has been associated with higher math achievement, reflecting students' value, self-confidence, enjoyment, motivation, and anxiety related to the subject (Kennedy, 2019). Similarly, students' perceptions of learning, knowledge, attitudes, and skills are crucial in determining the quality of learning outcomes. A study on Indonesian economics found that students' attitudes and skills in economics were lower than their knowledge, highlighting the importance of addressing attitudes and perceptions to improve learning outcomes (Hairunisya, 2020).

The relationship between attitudes and learning outcomes is bidirectional, with attitude impacting achievement and vice versa. Stronger self-efficacy beliefs and positive attitudes have been linked to better task motivation and task performance, ultimately influencing learning outcomes (Giannoulas & Stampoltzis, 2021). While positive attitudes have been associated with higher academic achievement, it is important to note that not all educational

experiences positively predict learning outcomes, emphasizing the need for continuous improvement in education (Kleebbua & Siriparp, 2016). Students' attitudes and perceptions towards learning and their educational experiences can significantly influence their learning outcomes, highlighting the importance of addressing and understanding these factors in the educational context (Moussa & Saali, 2022).

The perceptions and attitudes of students towards mathematics have an impact on mathematics education. Negative attitudes and perceptions about mathematics can be changed only as students become knowledgeable about mathematics and are prepared to become lifelong learners and users of mathematics (Daud *et al*., 2020). Students with a positive attitude toward mathematics tend to enjoy the subject, understand its value, and have confidence in it; thus, they are likely to prioritise the study of mathematics (Kiwanuka, Van Damme, Van den Noortgate & Reynolds, 2020; Mullis, Martin, Foy, Kelly & Fishbein, 2020), which could lead to high performance in the same (Chouinard, Karsenti & Roy, 2007; Guo, Marsh, Parker, Morin & Yeung, 2015; Wigfield, Tonks & Klauda, 2016).

The performance of males and females in mathematics seems to have gained currency in recent research (Efa & Frimpong, 2023; Wrigley-Asante *et al*., 2023). Whereas some studies put males as performing better than females (e.g., Preckel, Goetz, Pekrun, & Kleine, 2012; Skaalvik & Skaalvik, 2004), others put females ahead of males (e.g., Stevens, Wang, Olivarez, & Hamman, 2007). Further, some studies have found no difference between males and females (Mohamed & Waheed, 2011; Lindberg, Hyde, Petersen, & Linn, 2013). Thus, it is worth noting that gender differences invariably have an attendant

effect on achievement in mathematics and continue to attract major attention in research. Battey (2013) argues that as part of the effects of learning mathematics, gender continues to be a dividing factor for researchers.

Further, Griffith (2010) argued that though gender disparities in the study of mathematics start in infancy, they worsen as one gets to the college level. He attributes such huge disparities between males and females to their experiences with mathematics in the early years through to high school, which reduces female interest in pursuing it at the tertiary levels especially. El Yacoubi (2015) also alluded to this by confirming that despite the equity in education in most developed countries, female enrolment in mathematics is largely low.

In particular, it has been observed that in elective mathematics courses at the post-compulsory years of schooling at the tertiary level, female participation rates have persistently remained lower than males (Forgasz & Murimo, 2014). Moreover, with the decades of the researcher's experience as an examiner and chief team leader at the Institute of Education (University of Cape Coast), it is gainsaying that female teacher trainees' poor performance in mathematics cannot be over-emphasised. Hence, the current study examines the effect of female students' attitude and perceptions in mathematics, especially at the college level, since their performance has been dwindling. With the advent of a heightened national interest in female educational excellence in mathematics, scholarly attention has been focused on the success of females in Mathematics (Rameli & Kosnin, 2016).

In light of the continuous report on the abysmal performances of the students and, in particular, the female teacher trainees at the College level (Chief Examiner's Report, 2021; 2022; 2023), the conduct of this current study to

examine the effect of the female students' attitudes and perceptions towards the teaching and learning of mathematics with the view to improving their performance cannot be understated.

Statement of the Problem

It is worth noting that gender differences in attitudes and perceptions in mathematics continue to attract researchers' attention (Anokye-Poku & Ampadu, 2020). Battey (2013) highlights how gender has continued to be a dividing status for researchers and, as a result, its effect on the study of mathematics. Attitudes and perceptions have been researched to affect students' mathematics achievement (Asomah et al., 2019; Devine et al., 2012), which could lead to high performance in mathematics (Moreno-Guerrero et al., 2020). To this end, Charlesworth and Banaji (2019) highlight how researchers continue to be divided on the effect of gender concerning their attitudes and perceptions in learning mathematics. In a more recent study, Anokye-Poku and Ampadu (2020) also highlight gender-based attitudes and perceptions as problematics across the breadth and length of academic education, especially when studying mathematics. As a result, there have been varying results regarding who performs better. Some studies put males as performing better than females (Okafor & Egbon, 2011), while others put females as performing better than males (Banjong, 2014). In contrast, some studies have shown no difference between male and female performance in mathematics (Devine *et al.,* 2012).

Despite the various efforts by stakeholders, researchers and governments to improve the teaching and learning of mathematics. Mathematics is seen as the most difficult subject in many parts of the world (Ignacio, Nieto & Barona, 2006; Langoban, 2020), and Ghana is not exempt. In general, the continued

trend of poor performance in mathematics raises concerns to the public on whether or not the current education system can produce graduates who possess the essential skills needed to match the ever-evolving technological society (Hamilton, Mahera, Mateng'e & Machumu, 2010) on account of these problems that militate against the learning of mathematics, further research that seeks to characterise and understand the various factors that may influence students' performance in mathematics. In particular, the performance of female teacher trainees in the CoEs continues to be highlighted as a weakness in mathematics. The Course Coordinators' report 2019 sums up this observation for the first-semester as 'was generally not good'; consequently, it reported further that in the second-semester the female teacher trainee's performance as 'below average' (Institute of Education (IoE), 2019). The trend analysis on first year pre-service female teachers' performance also suggests weak performance in mathematics (IoE, 2016, 2017, 2019). These reports further highlight, particularly in the public CoEs in Ghana's Central and Western Regions, that the number of female students pursuing mathematics has been declining since 2017.

For instance, in 2017, female students enrolled in public CoEs in the Central Region were 118. This number reduced to 106 in 2018 and 97 in 2019. The poor performance in mathematics is affirmed in literature among females in mathematics schools in many countries (Jameel & Ali, 2016; VaraidzaiMakondo & Makondo, 2020). This results in the underrepresentation of female students in the top ability band and fewer girls pursuing mathematics when it ceases to be a compulsory part of the curriculum (Public CoEs Report, 2017). Literature is rare with regards to the effect of perception and attitudes on female student's achievement in mathematics especially at the colleges of

education level (Kiwanuka, Van Damme, Van den Noortgate, & Reynolds, 2020; Mullis, Martin, Foy, Kelly, & Fishbein, 2020), which if properly corrected could lead to some deficit in female teacher trainees' performance in the mathematics (Chouinard, Karsenti, & Roy, 2007). Thus, attitude and perception are fundamental factors in students' performance in mathematics. To this end, this study seeks to investigate female teacher trainees' perceptions and attitudes towards the learning of mathematics particularly in the western and central regions in Ghana.

Purpose of the Study

This study is aimed at determining female teacher trainees' perceptions and attitudes towards their mathematics classroom learning environment. Further, the correlation between perceptions and attitudes of female Pre-service teachers at the colleges of education were investigated.

Research Questions

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

1. What are the female Pre-service teachers' attitudes towards the learning of mathematics?
2. What are the female Pre-service teacher' perception towards the learning of mathematics?
3. What is the relationship between the female Pre-service teachers' perception and attitude towards the learning of mathematics?
4. What is the relationship between perception and attitudes of students from Mixed CoE and Single Sex CoE towards mathematics? Null Hypothesis:

There is no significant difference in perceptions and attitudes of students from Mixed CoE and Single Sex CoE towards mathematics?

Significance of Study

The study's results would provide additional information regarding the attitudes and perception of female students in public CoEs in the Central Western Regions of Ghana. The findings may shed some light on possible reasons for female students' perceived difficulty in studying Mathematics in public CoEs. This will provide information for Guidance Co-ordinators in the CoEs to design guidance programmes and counselling sessions.

The outcome of the study may help educational policy formulators, implementers, and curriculum developers adopt appropriate strategies that will make the study of mathematics more attractive to female students in public CoEs.

Finally, since female Pre-service teachers' attitudes and perception towards the learning of mathematics were the main focus of the study, its findings will offer a greater understanding of the culture of Ghanaian mathematics teaching practice from a teacher trainee perspective.

Limitations

Despite the efforts of the researcher to ensure the validity and reliability of the findings of this study, a limitation of this study had to do with classifying all the female teacher trainees as one 'big' unit for purposes of analysis although the participants are sourced from different CoEs on the western and Central Regions of Ghana. This was due to logistical constraints which made it impossible to carry out the analysis using individual CoEs as unit of analysis. However, this was not expected to affect the results obtained significantly since

the CoEs used for this study were being handled by the same mathematics Tutors for each of the CoEs and these Tutors are expected to portray consistent pattern of behaviour irrespective of the CoEs they found themselves in facilitating the teaching and learning of mathematics.

Delimitations

The study was explicitly be restricted to only public CoEs in the Central and Western Regions of Ghana. Again, although there are 48 private and public CoEs in Ghana, it was confined to only two single-sex CoEs in the Western and Central Regions. The study focused on measuring perception and attitude towards mathematics among female Pre-service teachers'. The relationship between female Pre-service teachers' perception and attitude towards mathematics was also assessed.

Organisation of the Study

The rest of the thesis was organised in four parts. Chapter Two provided a review of the theoretical framework that underpinned this study, influence perceptions have on the learning of mathematics, empirical findings of students' attitude and perception in mathematics, attitude of students towards mathematics and findings of studies that combined perception and attitude. It ended with a summary of the findings from the review and its implications as far as this study is concerned. The third chapter dealt with the research design, instruments development, how reliabilities and validity of the instruments were ensured and the statistical tools used in analysing the data gathered. Chapter Four discussed the findings from this study research question by research question as well as the hypotheses that were formulated and tested. Chapter Five highlighted the major findings from this study, conclusions that were drawn,

their implications to educational practice and recommendations made and suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the review of the literature related to the study. The review covers three broad areas namely conceptual review, theoretical review and empirical review. The conceptual review includes review of the literature on the key constructs, that is, attitudes and perceptions. The theoretical reviewed include the review of the ABC Model of Attitude with emphasis on the three separate measurable components: affect (A), behaviour (B), and cognition (C), and the influence of student's perception towards mathematics with particular attention to the effect of the theory of reasoned action, attribution and goal. Finally, the empirical review of past research studies related to the theme of the present study is presented.

Conceptual Review

Attitude references a learned tendency of a person to respond positively or negatively towards an object, situation, concept or another person (Sarmah & Puri, 2014). Attitudes can change and develop with time (Syyeda, 2016), and once a positive attitude is formed, it can improve students' learning. On the other hand, a negative attitude hinders effective learning and consequently affects the learning outcomes resulting in poor performance (Joseph, 2013). Therefore, attitude is a fundamental factor that cannot be ignored. The effect of attitude on students' performance in mathematics might be positive or negative depending on the individual student.

Ajzen, (1993) and Syyeda (2016) argues that attitude has three main components: affect, cognition and behaviour. The components are interrelated and involve several aspects contributing to the overall attitude towards learning

mathematics. The Affective, Behavioural and Cognitive (ABC) model propounded by Ajzen, (1993) is therefore drawn in the current study to investigate the students' attitude towards the learning of mathematics. In particular, from the female perspectives.

Definition of Attitude Towards Mathematics

Attitudes are a complex combination of things we tend to call personality, beliefs, values, behaviours, and motivations. An attitude includes three elements: an affect (a feeling), cognition (a thought or belief), and behaviour (an action) (Pickens, 2005). Moreover, Attitude has been defined in several ways by different researchers in the field. Asomah (2015) defined attitude towards mathematics as "the individual's propensity towards mathematics as a discipline that has been acquired consciously or unconsciously through his or her interaction and which through a well-informed deliberate process could be reversed". Further, he averred that, these weaknesses may be an attestation to one's perception of the learning environment and its consequent affect (emotions) attached to the study of mathematics. In his review of attitudinal studies, Reid (2006) reports that there are as many definitions of the term "attitude" as there are researchers. This situation he attributed to the difficulty associated with attempts aimed at providing a concise definition of the term "attitude" which has proved quite elusive. Koballa and Glynn (2007) define attitude as "a general and enduring positive or negative feeling about some person, object, or issue" (p.6). This definition implies that attitude is always formed towards something or a person based upon how an individual perceives it and can be towards a subject of study or a teacher as in a classroom situation. In a more related studies, Schunk (1996) defined attitude as internal

beliefs that influence personal actions which is learned through one's experience. This has to do with a disposition to act or react in a particular way as the individual responds to a situation (Amoo & Rahman, 2004). Again, Hannula (2002) looked at two basic approaches to defining attitude towards mathematics:

1. A "simple'' definition describes it as the degree of affect associated with mathematics; that is, attitude is the emotional disposition towards mathematics. This definition looks at attitude in terms of affect (emotions) ignoring other aspects of the term such as one's perceptions, emotions, etc.
2. The second definition looks at attitude in terms of three components; emotional response, beliefs, and behaviour as components of attitude. Attitude towards mathematics has been studied with regard to finding associations between the construct and other variables of interest such as anxiety and achievement. Implicit in much of this research is the assumption that positive affect might lead to positive achievement and behaviour (McLeod, 1992). Attitude towards mathematics is defined as the emotions a student associates with mathematics and how he or she behaves (Hart, 1989). Attitude formation is a result of learning, modelling other and our experiences with people or situations (Pickens, 2005). Further, Attitude refers to a learned tendency of a person to respond positively or negatively towards an object, situation, a concept, or a person. It is also regarded as a belief held by individuals that reflects their opinions and feelings and can be sometimes manifested in behaviour (Joseph, 2013). Attitudes, behaviour, and feelings are

interrelated in such a way that people's attitudes determine their behaviour towards objects, situations, and people. They also influence the relationships that exist among these variables with themselves (Joseph, 2013). Consequently, a persons' attitude to an idea or object determines what the person thinks, feels and how the person would like to behave towards that idea or objects. Attitude is a hypothetical construct that cannot be observed directly, but can be inferred from measurable reactions to the attitude object (Ajzen, 1993), as it is the case in this study.

Definition of Perception

Perception is the mental pictures created which influence our construction of reality. Allport (1968); Moreno-Guerrero *et al.*, (2020) described perception as the way people judge others with whom they are in contact. There is evidence suggesting that students' perceptions about mathematics are crucial in the sense of success and competence they develop (Fullarton *et al*., 2003). Another point to consider is the relations between attitudes, perceptions and students' learning outcomes. Perceptions are part of attitudes and specifically relate to the cognitive dimensions of attitudes (Georgas, 2005). Again, perceptions, as concrete ideas, coupled with a variety of emotions that arise in parallel with them, but also with expression of specific behaviour, come together with attitude (Pickens, 2005). The relation between attitudes and learning outcomes is bidirectional. Female college of education students' attitude and disposition towards mathematics can affect their overall achievement in courses applying mathematical concepts and techniques (Morgan, 1990). In related studies, it has been revealed in some research that

older students and females experience higher levels of anxiety towards mathematics than younger students and men (Dew & Gallasi, 1983). To this end, this study conceptualises perception as the way female pre-service teachers' place judgement on the learning of mathematics in their classroom environment. The current study therefore investigates the female pre-service teachers' perception towards mathematics.

Perception and attitudes play a significant role in mathematics learning. Research has shown that students' mathematical attitudes, including their value, self-confidence, enjoyment, motivation, and anxiety levels, can impact their mathematical performance and academic achievement (Kennedy, 2019; Moussa & Saali, 2022). For instance, a positive attitude towards math has been associated with higher math achievement (Kennedy, 2019). The Mathematics Attitudes and Perceptions Survey (MAPS) is an instrument used to assess students' views and dispositions towards mathematics, providing insights into their attitudes and perceptions related to the subject (Code *et al*., 2016). Additionally, studies have indicated a positive relationship between attitudes toward math and students' academic achievement (Moussa & Saali, 2022). Therefore, fostering positive attitudes and perceptions towards mathematics is crucial for promoting effective learning and improving students' performance in the subject.

Theoretical Frameworks

This section discusses the various theories in relation to the attitudes and perceptions that underpinned the conduct of this study. To this end, special consideration is given to the ABC Model of perceptions and Attitude. Also considered is the theory of reasoned action, attribution and goal. Again, the

causes of gender differences in attitudes towards mathematics, female student perception towards mathematics are discussed within the context of the study.

The ABC Model of Attitude

The ABC Attitude Model is also called a Tripartite Model. It serves as a useful theoretical framework for developing mathematics attitude measures. The ABC Model of Attitude is based on a Hierarchical Model described in Ajzen (1993) who conceptualises an attitude as an amalgam of three separate measurable components: affect (A), behaviour (B) and cognition (C). Affect is the emotional component consisting of feelings and emotions that are associated with an attitude object (in the current study mathematics). The behaviour is the action component consisting of predispositions to act in a particular way towards the attitude object. Cognition is a mental component that consists of belief and perceptions people hold about the attitude object. These three components must be present before we say that an attitude exists. A particular attitude may consist a positive emotion that is, feeling happy in a mathematics classroom (affect), intend to learn more mathematics (behaviour) and belief that mathematics is easy to learn (cognition). Students may form a favourable or an unfavourable attitude towards mathematics. Students acquire attitudes over time through direct experience of learning mathematics or by receiving information about the mathematics subject. Students use the learned attitudes as a guide to their overt behaviour with respect to mathematics learning, resulting in consistently favourable or unfavourable patterns of reactions towards the subject.

Attitudes are assumed to be precursors of mathematics learning behaviour. In predicting behaviour based on a particular attitude, Ajzen and

Fishbein (1977) postulate that there should be a correspondence between measures of attitude and those of behaviour. Students' attitude to mathematics represents their evaluation of learning mathematics as a subject. Attitudes can be verbal or non-verbal actions (Ajzen, 1993). Several researchers have attempted to measure attitude using different instruments. Ajzen (ibid) proposes three measures of behaviour. They include observable actions performed by the subjects that are recorded by the investigator, individual commitment to perform the behaviours, and self-reported behaviour. However, the last two measures can only be considered if it becomes difficult to make direct observations of certain behaviours. High correspondence between attitude and behaviour measures can be achieved through standard scaling measures like Likert scale (Ajzen & Fishbein, 1977) which has been adopted in this study. In accordance with Syeda (2016), attitude is multidimensional. It takes into account three components: affect, cognition, and behaviour. Affect is composed of emotions, beliefs, and vision of the subject. Emotions are the feelings of enjoyment or pleasure in learning the subject or seeing it as boring, difficult, and dull (Eshun, 2000). Beliefs are related to students' confidence in their abilities to learn the subject. Vision represents students' perception regarding mathematics. Cognition represents the students' perceived usefulness of the subject. Conversely, behaviour is connected to students' motivation to learn that is reflected with student's actions, commitment, and performance in class. Using these components to understand the students' attitude towards mathematics, the current study measures the following aspects: a) Selfconfidence, anxiety, enjoyment (affect) b) Intrinsic motivation (behaviour) c) Perceived usefulness (cognition)

Components of ABC Model

The components under each of the three key areas of the ABC model namely Affect, Behaviours and Cognition are presented below:

Affect

Self-confidence: Self-confidence in mathematics refers to student perceptions of self as a mathematics learner that include beliefs about one's own ability to learn and perform well in mathematics (Adelson & McCoach, 2011). The result of Hannula, Maijala, and Pehkonen (2004) shows that selfconfidence is an important factor that influences students' learning which in turn affects their performance in mathematics. Van der Bergh (2013) argues that students with high self-confidence believe in their abilities that they can be successful in learning mathematics, thus overcoming the fear of failing. These students are ready to take mathematical challenges which in turn increase their academic achievement; otherwise, students with low self-confidence do not believe in themselves, thus tend to avoid taking mathematics challenges (Adelson & McCoach, 2011). Therefore, this leads into minimising the chances of expanding their mathematical skills and success. Hence, it is desirable to study the students' attitude towards their own confidence and how it relates to performance.

Mathematics anxiety: Mathematics anxiety is defined as a condition of emotional response towards mathematics whereby students experience negative reactions to mathematical concepts and testing (Zakaria & Nordin, 2008). Accordingly, mathematics anxiety is a feeling of tension, helplessness and distress that impede the ability to concentrate and consequently affects learning of mathematics (Zakaria & Nordin, 2008). Mathematics anxiety is believed to

have an impact on attitude and motivation to learn mathematics, consequently on students' achievement (Getahun, Adamu, Andargie, & Mebrat, 2016). It was established in the study by Hoorfar and Taleb, (2015) that mathematics anxiety is negatively correlated with metacognitive knowledge which is the ability to reflect, understand, and control one's learning. This means that the more anxious the students are, the less metacognitive knowledge they possess that in the long run hampers their performance. A comparative study conducted in Malaysia and Tanzania by Mohamed and Tarmizi (2010) in higher education institutions reveals a negative correlation between mathematics anxiety and achievement, and that anxiety has a significant impact on achievement. Since anxiety is related to students' attitudes and achievement in mathematics, it is worth examining the level of anxiety of students at all levels of education.

Enjoyment of mathematics: Enjoyment of mathematics is the extent to which the students enjoy doing and learning mathematics (Kupari & Nissinen, 2013). Students' enjoyment while learning can influence their behaviour or cognitive aspect of attitude (Syyeda, 2016). They further posit that interest and enjoyment affect both the degree and continuity of engagement in learning and the depth of understanding. This means that the more students enjoy doing mathematics the more they are likely to engage in problem-solving thus enhancing their learning and performance. Since enjoyment, students' learning and performance are related, it is worth evaluating the students' status of mathematics enjoyment in order to keep track of students' learning and performance.

Behaviour

Intrinsic motivation. Intrinsic motivation in this study is related to both interest and the desire to learn mathematics (Guy, Cornick, & Beckford, 2015). Students are intrinsically motivated to learn mathematics if they have the desire to do so after finding learning of mathematics interesting. It is believed that motivation is the driving force for learning (Yunus & Ali, 2009). Therefore, studying motivational variables as related to attitude and achievement is crucial.

Cognition

Perceived usefulness. Perceived usefulness refers to students' perception about the importance of mathematics in the present everyday life and in the future (Adelson & McCoach, 2011). Perceived usefulness of mathematics is believed to have an influence on students' attitude towards the subject. If students recognise the importance of mathematics in their lives, they will become motivated to study, practice, and learn the subject (Syyeda, 2016). This study also reveals that despite the fact that the majority of students had negative emotions towards mathematics they demonstrated positive cognition towards mathematics. This indicates students' recognition of the value of mathematics in their lives and future careers. The study by Guy et al. (2015) found that mathematics usefulness is a positive predictor of success. Thus, it is worth studying the relationship between mathematics value, attitudes, and performance in the CoEs with particular focus on the female context as well.

Theory of Reasoned Action, Attribution and Goal

How individuals perceive an object, a person or the environment in which they find themselves has quite often tended to influence their subsequent behaviour. Attribution Theorists for instance are of the view that how an

individual perceives causality have consequences on the individual's perceptions (Webster & Fisher, 2003). Attribution theory seeks to explain how an individual understands and reacts to personal achievement, that is, the factors that the individual judges to have influenced him or her be it internal or external.

Furthermore, Webster and Fisher (2003) noted that "the social ecological setting in which students' function can affect their attitudes and moods, their behaviour and self-concept and general sense of well-being" (p.311). These findings give an indication that how an individual perceives the learning of mathematics may have certain consequences on the individual's subsequent behaviour. Furthermore, according to the Theory of Reasoned Action (Ilevbare, 2008), "attitude is an independent measure of affect for or against the attitude object, which is a function of belief, strength and evaluative aspect associated with each attribute" (p.123). What this means is that any attempt to improve students' achievement in mathematics must take into account the students' appreciation of the subject matter (mathematics) since that subject matter can serve as an attitudinal object. Additionally, Goal Theorists indicate that the subject matter can have influence on learning goals and targets and assessment procedures as far teaching and learning is concerned. Goal theorists' postulate that instructional practices, and the nature of educational tasks and assignments, can promote either mastery or helpless motivational patterns, which can have profound influence on student achievement (Mucherah, 2008). The net effect of this theory is that whether the subject matter is perceived as either positive or negative may influence the participants in the learning environment.

In effect, the study conceptualised the various theories that grounded the female pre-service teachers' attitudes and perception towards the teaching and learning of mathematics. The highlighted the related empirical studies of the effect of attitudes and perceptions towards mathematics from the perspective of female students. Moreover, some related theories were also reviewed. In particular, the female trainees' attitudes towards mathematics were underpinned by the ABC model of attitude. Thus, it served as a useful theoretical framework for developing the female teacher trainees' mathematics attitude measures in this study. The ABC Model of Attitude is based on a Hierarchical Model described in Ajzen (1993) who conceptualises an attitude as an amalgam of three separate measurable components: affect (A), behaviour (B) and cognition (C). Moreover, the causes of gender differences in attitudes towards mathematics was equally discussed. This was to identify scholarly works that attributed some factors other than the attitudes and perceptions as the cause of poor performance in mathematics. Again, the chapter two afforded the study various definitions of perception as elucidated by several authors. In this way, the topic was positioned to be reflective of particular definition that informed the current study. It ends on the female student perception towards mathematics as well as related theories of perceptions that informs female students towards mathematics as discussed within the context of the study.

Empirical Review of Attitude and Perceptions towards Mathematics

Lack of interests and negative attitudes towards mathematics were problems that should be encountered by students in learning mathematics, because mathematics is regarded as a difficult subject and obscure (Ganal & Guiab, 2014). According to Hart (Zan & Di Martino, 2007), student's attitudes

towards mathematics is defined as the emotional response either positive or negative associated to mathematics, confidence to succeed in studying mathematics, and strategies in coping with mathematical problems. Previous studies on mathematics reported that attitudes towards mathematics have important role in determining learning achievement on mathematics, and students with positive attitudes towards mathematic will have high scores in mathematics achievement (Tapia & Marsh, 2004; Zan & Di Martino, 2007; Guner, 2012). Yet, studies also reported that many students have poor attitudes towards mathematics (Goodykoontz, 2008). In the study of Hamid, Shahrill, Matzin, Mahalle and Mundia (2013), mathematics achievement correlated with mathematics anxiety, self-esteem, proactive coping, and test stress.

Attitudes of the students affect their cognitive activities. By having a positive attitude towards mathematics, the students will feel that mathematics is important so that they will try to improve their mathematics learning achievement. Students who have negative attitudes tend to be difficult to pay attention in math. According Eshun and Zan, Mata, Monteiro, & Peixoto (2012), negative attitudes associated with negative emotional disposition. The disposition of these emotions has an impact on student behaviour consider the useful of mathematics, and do not enjoy math. Therefore, a positive attitude is necessary for students to learn to voluntarily and obtain benefits.

Student Perception Towards Mathematics

Perception is the primary form of cognitive awareness about the person, place, thing, and event through the sensory organs around the person. All conceptual knowledge is based on or derived from this primary form of awareness. Perception is the quality of being aware, the ability to see, hear, or become

aware of something through the senses, the way in which something is regarded (Efron, 1969). It is the process of identification, organization, and interpretation of sensory information in order to represent and understand the environment. In this study, the term 'perception' towards mathematics is conceptualised as a mental representation or view of mathematics, apparently constructed as a result of social experiences, mediated through interactions at school, or the influence of parents, teachers, peers, or mass media. Students' perceptions have behavioural consequences on the learning approaches they adopt, which in turn influence their learning outcomes (Ferreira & Santoso, 2008). Positive perceptions have been associated with deep learning approaches (Jackling, 2005), whereas negative perceptions are associated with the surface learning approach (Prosser & Trigwell, 1999). The deep approach has resulted in higher academic performance and the surface approach resulted in lower performance (Biggs, 1996). Negative perceptions are likely to cause negative feelings towards learning that decline in motivation and cognitive processing thus declining in the learner's performance (Isen, 2004). It is widely claimed that negative perceptions and myths of mathematics are widespread among students, especially in the developed countries (Ernest, 1995; Gadanidis, 2012). Sam (1999) claimed that many students are scared of mathematics and feel powerless in the presence of mathematical ideas. They regard mathematics as difficult, cold, abstract, and in many cultures, largely masculine (Ernest, 1995). The relationship between perception toward mathematics and achievement in mathematics had traditionally been a major concern in mathematics education research (Ma & Kishor, 1997). According to McLeod (1989), students' perception of mathematics teaching and learning plays an important role in

mathematics education. The learning outcomes of students are strongly related to their perceptions of mathematics (Leder *et al*., 2002; Thompson, 1992). In fact, the poor performance of students globally in mathematics is mostly linked to perception than any other variable (Royster *et al*., 1999). It is not just a concern for particular countries but has become a global concern over the years (Hagan *et al*., 2020). However, most of the female students in the Colleges of Education are still found failing in mathematics at the school level of education. Thus, it can be argued that the students' perceptions may be one of the causes of the low achievement and there have not been dearth of studies focusing on the female pre-service students' perceptions towards mathematics at the CoEs. In such a context, it is necessary to explore the condition of the low-performing students- perception towards mathematics in the CoEs context. Therefore, the study was conducted to find out specifically the female pre-service students' perception towards mathematics.

Perception of the majority of Ghanaians about mathematics has led to a stereotyping of the subject as a male dominated one (Yakubu, 2020). It is worth noting that, among the complexity of factors that influence Mathematics performance show that high achievement in Mathematics is a function of many interrelated variables related to students, families, and schools. Among student variables, Perceptions are regarded by several researchers, as an important/key factor to be taken into account when attempting to understand and explain variability in student performance in Mathematics (Mohamed &, Waheed 2011). According to Asomah *et al*., (2018) students' perception towards Mathematics teaching and learning plays an important role in Mathematics

education. The learning outcomes of students are strongly related to their perceptions towards Mathematics (Addai & Agyei, 2018). Some students view Mathematics as their waterloo; as result, students perform poorly in Mathematics. These perceptions toward Mathematics and Mathematics learning and their implications for Mathematics instructions have long received much attention from both Mathematics educators and mathematicians (Royster, Harris, & Schoeps, 1999). They further attributed the poor performance of students globally in Mathematics to perception than any other variable.

Students' poor achievement in Mathematics is not just a concern for particular countries, but has become a global concern over the years (Programme for International Students Assessment [PISA], 2009). In particular, the relationship between perception toward Mathematics and attitude in Mathematics had traditionally been a major concern in Mathematics education research (Asomah, Crankson, Addai & Asiedu 2022; Ma & Kishor, 1997).

Additionally, a survey by Ifamuyiwa, (2004) on the relationship between students' achievement in and attitude/perception towards secondary school Mathematics submitted that despite the different perspectives from which researchers have conceived attitude/perception, the common line of agreement was that the achievement of goals and objectives can be influenced or affected by attitude/perception and that a positive attitude/perception was more likely to engender achievement of a goal or objective (performance).On the other hand, there are studies reporting that the relationship between students perception and attitude in mathematics is not statistically significant (Asomah *et al*., 2022; Papanastasiou, 2002). Again, a study in a recent decade suggests that, there is also research evidence showing no causal relationship between perception and

attitude (Maat & Zakaria, 2010). Given this background, it is only reasonable and logical to assume that there is no consensus as to whether students' performance in Mathematics is influence by their attitude or perception. The current study is therefore aimed at finding out the attitude and perception of students towards Mathematics and whether a relationship between these two variables could be established as having an effect on academic attainment of female teacher trainees at the CoEs in the Ghanaian context.

In the field of mathematics education, research findings offer intriguing insights into students' perceptions and attitudes. Daud *et al*. (2020) discovered that respondents generally held a positive perception of mathematics. Similarly, Hagan *et al*. (2020) found that students, while acknowledging the difficulty of mathematics, maintained a positive perception due to its practical relevance. However, the relationship between perception and performance displayed a notable weakness. Turning to attitudes, Hwang and Son (2021) identified four distinct profiles ranging from very negative to positive attitudes toward mathematics. Meanwhile, Opoku (2013) reported a prevalent positive attitude among students in the selected schools, while Mohamed and Waheed (2011) found a moderately positive attitude. Notably, Mata *et al*. (2012) established a link between grade and math achievement with students' attitudes. Furthermore, research by Asomah *et al*. (2022) and Salifu and Bakari (2022) emphasised positive correlations between students' perception, attitude, and interest in mathematics, underscoring the interplay of these factors in shaping mathematics education.

Metacognitive Awareness

Metacognition first introduced by Flavell as "any knowledge or cognitive activity that takes as its object or regulates any aspect of any cognitive enterprise". Metacognition is an important element in solving problems and learning process of the students, as well as being the main factor in determining learning achievement (Bedel, 2012). Wang, Haertel and Walberg (Bedel, 2012) stated that metacognition is a powerful predictor in predicting student learning. According to Swanson (in Schraw & Dennison, 1994) metacognition is the individual's knowledge about cognitive processes as well as the ability of individuals to control the cognitive processes performed when undergoing a learning process.

While Kuiper (in Schraw & Dennison, 1994) defines metacognition as self- communication of individuals who are undergoing learning activities with respect to the requirements required by the cognitive activity and requirements for the learning tasks faced by students. Selfcommunication carried out, before the learning process, when the learning takes place, and after the learning process occurs. Thus, in metacognition thinking activities covered when learning takes place, as well as the revision of the learning process when learning is ongoing. In short, metacognition is awareness of how individuals acquire knowledge, and how to control the process in acquiring knowledge (Schraw & Dennison, 1994).

Flavell (in Schraw & Dennison, 1994; Surat, Rahman, Mahamod, & Kummin, 2014) suggests that metacognitive knowledge consists of three components, namely (1) declarative knowledge-knowledge about your own self or individuals, "knowledge about" or "knowledge concerning", (2) procedural

knowledge- knowledge of the tasks or activities; and (3) conditional knowledgeknowledge of learning strategies. Included in the declarative knowledge are facts, beliefs, views, generalizing, theories, hypothesis, and attitude toward something or someone. All this knowledge is stored in the system memory, and in the process of learning, declarative knowledge related to the question. What do you want me to know? What information will I gain by studying this learning material? What actually I already know? What information should I look for?

Procedural knowledge is knowledge of "how to" do cognitive activities and includes how to control the cognitive processes. Procedural knowledge with regard to the question, how will the information and the knowledge gained be used? What steps should I do so that I can complete a given learning task? Conditional knowledge, meanwhile, is an activity that relates to the question "when" and "why" of a strategy or procedure performed in the learning process. So conditional knowledge is knowledge of the individual will be learning strategies for specific learning materials. This means that the strategy may change in accordance with the learning materials and the learning tasks be at hand.

Metacognition, initially introduced by Flavell, encompasses cognitive awareness and regulation within the learning process. It plays a pivotal role in problem-solving and student learning, significantly impacting academic achievement. Metacognitive knowledge, as suggested by Flavell(1979), comprises declarative, procedural, and conditional components. Declarative knowledge involves personal understanding, including beliefs and attitudes toward learning. Procedural knowledge encompasses the mastery of cognitive

tasks and strategies, while conditional knowledge pertains to the adaptability of strategies to varying learning contexts. Attitudes and perceptions embedded within these components influence how individuals engage with learning tasks, select strategies, and monitor their progress, ultimately shaping learning outcomes. Encouraging positive attitudes and perceptions toward learning can enhance metacognitive abilities and optimise educational experiences.

Gender Differences in Mathematics Achievement

Based on research conducted by Pajares and Graham in 1999 (in Nicolaidou & Philippou, 2002), students of junior high school, both males and females have the same confidence in dealing with mathematics. Also, study by Scafidi and Bui (2010), found that there were gender similarities in math performance moderated by race, socioeconomic status, or math ability. However, when they are in senior high school, male students showing more confidence than the female (Tella, 2011). From the study of Frenzel, Pekrun and Goetz (2007) it was reported that less women enjoy and be proud of math. Instead, they are more prone to feelings of anxiety, shame and despair. Mathematics is often considering a male domain in terms of self-concept and attitudes associated with self-confidence of students, and can affect the learning achievement of mathematics students, especially in high school. As it is reported on Asante study (2012) with high school students in Ghana that boys get high scores on the subscales of ATMI than the girls, especially in the total scores of ATMI and on the self-confidence subscales.

Literature on gender differences in mathematics suggests that the number of female students pursuing mathematics up to the higher level reduces (Eisenberg, Martin, & Fabes, 1996). A review of literature on gender and

mathematics show that Mathematics is made to favour male learning patterns. However, what is more interesting, as argued by Mutemri and Mygweni (2005) is that the mere perception that mathematics is male-centred results in low participation from females. Attitude and perception play a crucial role in the learning of mathematics. Early research shows that males did significantly better than females at the Junior High and High School levels, as there were apparent differences in attitudes towards mathematics (Fennema & Sherman, 1977). Mohamed and Waheed (2011) examined students attitudes and how these influence their development and identified three groups of factors: students related factors (e.g., mathematical achievement, anxiety, self-efficacy and self-concept, motivation, and experiences at school); school, teacher, and teaching-related factors (e.g., teaching materials, classroom management, teacher knowledge, attitudes towards maths, guidance, beliefs), and home environment and social factors (e.g., educational background, parental expectations).

Hyde *et al*. (1990) in their research prove that gender effects, which increase among older students, led to females holding more negative attitudes. Asante (2010) also states that, when compared with boys, girls lack confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics. This posits that males generally carried more positive attitudes than females in the area of Mathematics and other science-related subjects. In their study (Mediha & Fatima, 2015) concluded that participants ascribe to attributes such as motherhood, sacrifice, fragility as feminine to female teachers whilst the features such as authority, power, leadership, discipline are accepted as masculine to male teachers. In their conclusion they considered their finding as an indicator that male teachers are

not sufficiently aware of the multiple roles and responsibilities that their female counterparts have; maybe even describe them as 'inefficient and problematic workers' and 'elegant and fragile existences' (p. 220).

In a similar study by Celeste *et al*. (2000), female teachers alluded that, they were in a field dominated by men and lamented the differential treatment encountered by both female mathematics students and teachers in schools. The direct link between self-concept and achievement may be fragile but the evidence that teacher attitude affects student performance is stronger. Midgley, Feldlaufer and Eccles (1989) visibly established that teacher effectiveness has a strong relationship with student's self-perceptions about abilities in mathematics. In effect, teacher's attitudes in mathematics may have an influence on how students perceive their own abilities to deal with mathematics. Midgley et.al. (1989) explains further that the association was found to be strongest for low achieving students who are taught by a teacher with low mathematics efficacy.

Davis and Wilmot (2010) explored primary and junior high school teachers' attitudes toward mathematics. A survey of attitudes toward mathematics of 114 primary and JHS teachers who were holders of three-year post-secondary teachers' certificate "A" from 40 basic schools in the Cape Coast Metropolis and Elmina district in the Central region of Ghana was carried out using a questionnaire. Data collected were analysed using means and standard deviations. The t-test was used to investigate whether there was significant difference between primary school and JHS teachers' attitudes toward mathematics. The results of the study revealed amongst others that both primary and JHS teachers had favourable attitudes toward mathematics. The study also

found no significant difference between the attitudes of the two sets of teachers toward mathematics. However, whilst the study found no significant difference between the attitudes of upper primary and JHS teachers toward mathematics, both upper primary and JHS teachers were found to have significantly more positive attitudes toward mathematics than the lower primary teachers. Further, Uwineza *et al*. (2018) also investigating the different gender attitudes and perceptions towards mathematics education. The study employed questionnaires, interviews and classroom observations to collect data from a sample of 150 participants including 60 females, 84 males' students, as well as 6 male mathematics teachers, who were purposefully selected. The main findings from this study show, in general that, boys and girls demonstrate shared perceptions towards the importance of mathematics subjects. However, boys manifested more negative perceptions towards girls' ability to perform well in mathematics. Besides, some few females also manifested negative perceptions, which can explain their low confidence in mathematics. A particular trend which was highlighted in this study indicates the role of the teacher in shaping gender differences that are observed in mathematics learning. Hence a more longitudinal study, particularly focusing on teachers' classroom gender related practices, attitudes, beliefs with their impact on students' performance can provide more generalisable findings. Moreover, the issue of gender difference in mathematics education had been tackled in various studies (Amelink, 2009; Hall, 2012; Kiptum *et al*., 2013; Goldin, Ronsken, Torner & Masanja, 2006; Owiti, 2011; Tang, Chen & Zhang, 2010; OCDE, 2014).

While most of these research studies focused on gender issues in mathematics (Hall, 2012; Tang *et al*., 2010) or gender disparities in mathematics

(Amelink, 2009; Masanja, 2006), few studies focused on students' attitudes by gender (Owiti, 2011; LaFleur, 2011). In African countries, gender issues in mathematics education were explored in countries like Kenya (Owiti, 2011) and Tanzania (Masanja, 2006). They were also explored in other developed countries like Canada (Hall, (2012). These issues include students' enrolment, participation, performance, stereotypes, gender mainstreaming policies etc. In this regard, Owiti's (2011) study revealed that students' gender and their attitudes towards mathematics are correlated. Regarding the student's attitudes and participation in mathematics class, males substantially demonstrated more positive attitudes towards mathematics (Owiti, 2011) and higher level of participation in no-mandatory levels of mathematics than females (Owiti 2011; Hall, 2012). Gender difference in attitudes had been found to be highly linked to the developmental level (Amelink, 2009), to educational level (Masanja, 2006) and to social trends (Huggin & Randell, 2007). As Masanja (2006) has observed, gender disparity in enrolment and performance at primary may exist, but gender difference is almost non-existent at primary school levels (Amelink, 2009; MINEDUC, 2011). It rather starts emerging with adolescence and increases at advanced levels of education (Masanja, 2006).

As for the factors behind female low enrolment in mathematics, Amelink (2009) indicated that they include fear of failure, gender biased classroom practices, girls' lack of confidence in solving mathematics problems, stereotypes by students themselves or influential people, as well as gender difference in experiences in the same classroom. In contrast, in LaFleur's (2011) study, specific classroom did not show significant effects on students' participation or attitudes about mathematics. Rice, Barth, Guadagno, Smith, &

McCallum (2013) reported that the interest of students to the Science, Technology, Engineering and Mathematics (STEM) is very low due to three factors, i.e.: students' attitude towards STEM, students' perception on their ability to STEM, and social support on the development of abilities and careers in STEM. In comparison to other subject, students tend to be negative towards STEM (Rice *et al*., 2013; Goodykoontz, 2008), and perceptions of their ability in mathematics are closely linked to mathematics achievement (de Backer & Nelson, 2000; Rice *et al*., 2013). The study of Veloo, Noor, and Khalid (2015), reported that the relationship between students' attitude towards Physics and achievement in Physics was positively significant. Students who have positive attitude in Physics get good grades in Physics, and those who have negative attitude towards Physics get low grades.

Compared to female students, Asante (2012) found that male students exhibit a more positive attitude towards mathematics. Veloo *et al*. (2015) discovered a gender disparity in students' attitudes towards physics, with males showing greater interest in the subject than females. Guner's (2012) study, while indicating that gender differences did not significantly impact attitudes towards mathematics, revealed variations in attitudes among students from schools geared towards university education versus vocational training. Students from university-preparatory schools demonstrated more favourable attitudes towards mathematics than those from vocational schools.

In a related study Ajisuksmo, and Saputri (2017) examined the Influence of Attitudes towards Mathematics, and Metacognitive Awareness on Mathematics Achievements. The aim of this study was to investigate the influence of attitudes towards mathematics and metacognitive awareness on

mathematics achievement of high school students. In addition, this study interested in examining gender differences on mathematics achievement. The respondents of this study were 103 students of a senior high school in Tangerang, Indonesia. Attitudes Towards Mathematics Inventory (ATMI) was used to measure students' attitudes towards mathematics, and Metacognitive Awareness Inventory (MAI) was used to measure metacognitive ability, whereas mathematics achievement was measured from the value obtained in the school report cards of the semester when the research was being conducted. The results revealed that attitudes towards mathematics and students' mathematics achievement were significantly correlated ($r = 0.505$; $p < 0.001$). No significant correlations were shown between metacognitive skills and mathematics achievement ($r = 0.081$; $p > 0.05$), as well as between attitude towards mathematics and metacognitive skills ($r = 0.143$; $p > 0.05$). The regression model was fit in predicting the contribution of attitudes towards mathematics and metacognitive skills on mathematic achievement for 25.5%. However, looking at the p value of the t test it was shown that the attitude towards mathematics contributes to the model, but not the metacognitive skills. No significant difference was found on mathematics achievement.

Further, Anokye-Opoku (2019) highlighted on the Analysis of JHS students' attitudes toward mathematics and its effect on the academic achievement: the case of Asunafo South District. The aim of the study was to assess the attitude of Junior High School students with regard to mathematics and its impact on their academic performance, a case of Asunafo South District. Thus, the study examined the relationship between attitude of students towards mathematics and their achievement in mathematics. The study investigated

whether or not there is a connection between attitudes and learning experiences of JHS students in mathematics. Finally, it also examined differences between the gender and its impact on students' mathematical performance. The study consisted of 360 students from 24 Junior High Schools in the Asunafo South District using the triangulation mixed method approach. The quantitative data from semi-structured questionnaires and their individual test scores were analysed using descriptive and inferential statistics while the qualitative data from the interviews conducted were analysed thematically. The results of the study showed that students have a positive attitude towards mathematics learning in the selected schools and that reflected in a strong positive correlation between attitude and mathematics performance in their field of study. The study demonstrated also that the students' environment, in respect to the attitudes of mathematics teachers and their colleagues, has a greater impact on their math scores. The results again showed that there is no gender difference in respect to the study of mathematics and that both boys and girls performed same mathematically. The study recommends the development of positive attitude of students through motivational packages for performance and establishment of mathematical centres.

Students' attitudes towards mathematics can be either optimistic or pessimistic. An optimistic or positive attitude towards mathematical mirrors and a positive attitude towards the subject and a negative attitude towards mathematics (Zan and Martino, 2008). These emotional behaviours tend to affect a person's behaviour, as they are likely to perform well on a subject that someone likes, has self-confidence or finds useful. To this end, positive grades in mathematics are crucial because they can influence students' willingness to

learn and the benefits of mathematical instruction (Eshun, 2004). While some scholars limit the attitudes of mathematics to a simple like or dislike of the subject, others expand the meaning to the abilities, beliefs and relevance of mathematics. On the other hand, Zan and Martino (2007) argue that attitude towards mathematics is a simple positive or negative emotional bias towards mathematics.

A study conducted by Nicolaidou and Philippou (2003) has shown that negative attitudes are the result of daily and ongoing errors or difficulties in solving mathematical problems, and that these unfavourable attitudes can last. They also said that children are generally positive when they go to school for the first time. Unfortunately, their attitudes become less optimistic over time and generally pessimistic at school. For example, Kögce *et al*. (2009) found significant differences in the attitudes of younger and older students toward mathematics, and the attitude of the eighth graders was worse than that of Grade sixth students. To this end, Nicolaidou and Philippou (2003) posit that several factors can shed light on what accounted for the more negative attitudes about the school. Such factors indicated by Nicolaidou and the colleague include a demand to perform well, challenging tasks, unexciting lessons and lackadaisical attitudes exhibited on the part of teachers.

Fraser and Kahle (2007) have also indicated that the prevailing learning atmosphere around the home and school settings as well as within the peer group accounted greatly in variances in students' attitudes and more importantly, class ethos impacted greatly on the scores obtained in these attitudes by students. More so, a review of various studies purposed to provide an understanding on the attitudes and their consequences on development about differences among

students by Mohamed and Waheed (2011) also identified three types of factors that influenced the attitudes of students towards mathematics. These factors were students related (i.e., mathematical attainment, anxiety, motivation, self – awareness and self-efficacy among others); factors which were teacher, and teaching-induced (i.e., classroom supervision, teaching materials, guidance, teacher knowledge, beliefs among others) and factors which were from the household environment and society induced (i.e., training, parent expectations).

Causes of Gender Differences in Attitudes Towards Mathematics

Mathematics as a subject of study in schools continues to divide opinion along the lines of gender differences and students' performances thereof. Many studies have therefore sort to understand the gender dynamics when it comes to students' attitudes towards mathematics as a subject, and the causes underlying these differences. Frome and Eccles, 1998 (cited in Morrissey *et al*., 2019), established a significant gender disparity in the attitudes of students and the pursuit of maths-related careers. Interestingly, a less considerable variation was, however, seen in terms of the effect of such attitudinal differences on performance levels in mathematics. In a study conducted by Mohammed and Abdul-Razak (2018), the researchers found a rather opposing result to the widely held perception that females have an inherent phobia to mathematics as opposed to their male counterparts, and thus report higher levels of dislike for the subject. The study which aimed at exploring the effects of gender and school type on attitudes of students toward mathematics sampled 180 students from 3 different secondary schools in Malaysia. Principally, the study found near nonexistence of the perceived positive dominance (in terms of attitude) of males toward mathematics relative to females. Key among its findings is the role

school-types could play in altering the gender-related differences in attitudes towards mathematics. Female students from mixed-gender schools appeared to report lower levels of mathematics competence/self-belief than those in singlesex schools, as the latter actively perceive that mathematics is useful and do not think that mathematics is a male domain (Mohammed & Abdul-Razak, 2018). Although the study generally concluded that gender might not be a good precursor to attitudes towards mathematics, it revealed that school type could be an important factor that could moderate the gender-biased attitudes of students towards mathematics.

Elsewhere, Morrison *et al*. (2019), also identified age as a possible mediating or causative factor in the math-gender differences that may be observed among students. The study focused primarily on the implicit mathgender stereotypes that exist in both adults and adolescents in Canada, through implicit and explicit math-language gender stereotype tests. Conclusions from the study revealed that adults (sampled through voluntary subject pools) reported higher endorsements of math-gender stereotypes, compared to the adolescents involved in the study (Junior High School students). Thus, adults perceived mathematics to be a more gendered subject (favouring males) as opposed to the perceptions of adolescents (who reported less significant mathgender stereotypes). In effect, the age groups of individuals or students play a crucial role in mediating or determining the gender-based differences which may be expressed towards mathematics as a subject. Students' attitude towards mathematics is given various definitions in the literature. For example, Kibrislioglu (2016) defines attitude towards mathematics as liking or disliking of the subject; a tendency to engage in or

avoid mathematical activities; a belief that one is good or bad at mathematics; and a belief that mathematics is useful or useless. Tahar, Ismail, Zamani, and Adnan (2010) give a simpler definition. They define attitude as a positive or negative emotional disposition towards mathematics. From this, when defining attitudes towards mathematics, both aspects of beliefs and emotions should be considered. We adopt the definition by Tahar *et al*. (2010) because it looks better at students in both the cognitive and social perspectives. Several studies have demonstrated that attitudes towards mathematics are directly and significantly associated with students' performance. For instance, Mensah and Kurancie (2013) conducted a study in Ghana and found a significant positive correlation between students' attitude and performance. Similarly, Nicolaidou and Philippou (2003) found that attitude and achievement in mathematics are significantly related. In another earlier study conducted by Schofield (1982), a significant relationship between attitude and achievement was also established depicting stronger relationships in boys than in girls.

In a more recent study, Ngussa and Mbuti (2017) conducted a study in Arusha, Tanzania, involving secondary school students. They established a moderate relationship between student's attitude and performance when teachers use humour as a teaching strategy. They concluded that the enhancement of students' positive attitude can boost students' performance in mathematics. However, Joseph (2013) in his study of community secondary school students in Kagera, Tanzania found that the majority of students (55%) had a general negative attitude towards mathematics, with a positive and significant correlation between attitude and performance ($r = 0.33$). The

literature shows that students' attitude is affected by numerous factors. They include such factors as the school, peer students, home environment and society (Yang, 2013). Researchers, Yılmaz, Altun, and Olkun (2010) identify factors that include connecting mathematics with real life, using instructional materials, teachers' personality, teachers' content area knowledge, bad instructional practices, lack of commitment by students' and teachers' classroom management. Other factors include teachers' emotional support (Blazar & Kraft, 2017), teachers' affective support (Sakiz, Pape, & Hoy, 2012), class activities, subject content and amount of work, scarcity of teachers and inadequate resources (Joseph, 2013; Enu *et al*., 2015), peer and parental influence (He, 2007). Furthermore, in line with Simmers (2011) the factors also include, creating insecurities in students' mathematics ability and teacher failure to provide explanations for the mathematical concepts being taught. For most trainee teachers and fresh teachers, mathematics teaching remains more problematic than other subjects of the basic school curriculum especially at junior high school. It is considered to be more difficult and less enjoyable than Social Studies, Religious and Moral Education, Language and Art. Science and Technical Skills which are subjects largely related to mathematics are equally less attractive to female teachers.

In a study by Chionidou-Moskofoglou and Chatzivasiliadou-Lekka (2014) interviewees attributed the small number of women pursuing careers in Mathematics and Science to gender stereotypes, even though they admitted that both sexes want to perform well. Sava (2016), narrates that a female mathematics graduate reports that women are aware of the mathematics gender disparities and despite the encouragement, she remained scared throughout her

undergraduate study. Male dominance and low self-esteem of FMTs definitely impacts on their output in mathematics lessons. Gabriele (1995) implores that research, has shown that issues of gender differences in achievement in mathematics is not a biological factor, but a result of a mixture of social and cultural factors, societal expectations, personal beliefs systems and confidence levels. The self-confidence of both male and FMTs, students as well as pupils at the basic level, remain a major factor affecting mathematics teaching and participation of females. In spite of these factors a lot of improvement has been made, due to interventions implemented over the years. Gender mainstreaming, textbooks assigning equal roles to both sexes, role play and role models are some of the strategies improving mathematics gender equity in participation.

Relationship between Attitude and Achievement

Several studies have shed light on the correlation between students' attitudes toward mathematics and performance in the subject area (Mato and de la Torre, 2010; Nicolaidou and Philippou, 2003; Fraser and Kahle, 2007, Ma and Kishor, 1997; Schofield, 1982). Ma and Kishor (1997). Their meta-analysis identified a weak correlation between these recognizable variables and the relationships associated with different variables (i.e., sample size, ethnicity and grade). As regards grade, these correlations increased among older students (grade 7 to 12). However, other studies found an affirmative correlation connecting attitude of students to mathematics and their academic accomplishment. For instance, Nicolaidou and Philippou's (2003) in their study found noteworthy correlations between attitudes and performance. Thus, students with optimistic inclinations did well. Similarly, Mato and De La Torre's (2010) study with high school students revealed better academic

performance with students who had more optimistic attitudes towards mathematics than their counterparts did with pessimistic attitudes towards the subject. Zimmerman *et al*. (2004) corroborated these results in a broader study of high school students involving nine countries.

Another study by Brett- MacLean, Cave, Yiu, Kelner and Ross (2010) emphasised the relevance of attitudes in predicting school integration when he found that mathematical behaviors represented a mathematical performance difference of 25 percent to 32 percent, and that much of the difference explained was independent of mathematical skills. Nevertheless, Georgiou, Stavrinides and Kalavana *et al*. (2007) argued that if high performance could be used to predict an optimistic attitude towards mathematics, such an attitude would not have produced more power. However, they emphasised that it was important for teachers and schools to change their attitudes, and argued that better teaching techniques and teacher motivation, and reading materials could improve mathematics outcomes.

Research to evaluate academic performance was conducted by Tinio (2009) in the Philippines. In the study, a test known as the Academic Engagement Scale for Grade School (AES-GS) was conducted for 250 grade 6th and 7th in the Philippines. A total of 102 questions were in this test with three groups, thus behavioural, emotional and cognitive engagements. A Likert scale with options ranging from always to never, was used. The results indicate that all three subscales were crucial in measuring academic engagement. It was further asserted that such a scale must be constructed because it could be a means for improving the education of a student. It has further been argued that such a scale should be built, as this could be a way to improve the student's

education. In furtherance of her argument, Tinio (2009) maintains that this would also help teachers to discover the aspects that students cannot answer.

Coleman (2009) examined the link between parenting, student motivation, and performance of fifth grade students. In the end, students' motivation and academic performance were found to be positively correlated. If a student is encouraged to succeed at school, he will probably try to get better grades (Coleman, 2009). There is a reciprocal link between incentives and academic achievement. It is believed an increase in one automatically increases the other. In that case, a student who does well when motivated will continue to do well and the opposite expected (Coleman, 2009; Ellis, 2010).

In a study of the behaviour of lower secondary students in basic mathematics by Llorente-Avelino (2016) showed that students had a positive attitude towards basic mathematics taken as a whole and classified by demographic characteristics. These demographic characteristics included sex, size of the family, level of education of the parents, the professional status of parents, the level of education of teachers, the teaching experience of teachers and the continuous training of pupils in mathematics. It also revealed that students' attitudes toward basic mathematics education differed considerably when grouped according to the level of education of their teachers for students whose teachers had earned credits in postgraduate courses. Also, family income, in favour of middle- and high-income families and parents' educational performance, in favour of students whose parents were tertiary students, but not by sex, the teaching experience of the teacher, the mathematical education, the size of the family and the occupation of parents.

A key element of a student's performance depends largely on how he sees him/herself, whether he is strong or weak in a subject. Khatoon and Mahmood (2010) have argued that over time and from different sources, students develop ideas, feelings and attitudes about school problems. Students showed a positive attitude towards mathematics and science, but not so much in countries where science is taught as separate classes in grade 8. Karimi and Venkatesen (2009) viewed them as environmental impacts. Environmental impacts can come from exogenous influences such as groups and social pressures. Home orientation and attitudes towards mathematics, press variables such as friends and the pressure to learn math are some of the factors that determine students' attitudes and beliefs about this subject (Ismail and Anwang, 2009). This suggests that students who experience favourable environmental impacts are most likely to form positive attitudes toward mathematics hence higher academic performance and the exact opposite would be the case of those students who experience unfavourable impacts.

A study of 35 participants (including mathematics and postgraduate teachers enrolled in the 2014 Specialization Program in Mathematics Education at the University of Johannesburg) aimed to assess the attitudes of mathematics teachers towards this subject in relation to gender, age, and pedagogical practices of Jacobs and Spangenberg (2014) yielded positive results.

The study found that a proportion of respondents (over 90 percent) had a strong positive attitude towards mathematics inventory when considering the four dimensions and total attitudes towards considered (ATMI's). These mathematics teachers feel that the acquisition of mathematical skills is useful and necessary, that it provides mathematical solutions to problems and tasks and

that it expects a lot from a good performance in mathematics. The study also showed that they wanted to learn more and fulfil their responsibilities as mathematics teachers (Jacobs and Spangenberg, 2014). Similarly, scholars such as Ampadu (2012); Durandt and Jacobs (2013); Ismail and Anwang (2009); Maat and Zakaria (2010); Mata, Monteiro and Peixoto (2012); Quinn (1997) and Sweeting (2011) found that the quality of mathematics education and the attitudes of teachers are important for student performance and, ultimately, for their math scores. The study left out students who the researcher believes form an integral part in the attitude and achievement processes. The present study seeks to investigate into this attitude and achievement in respect to the students.

A study by Schackow (2005) investigated the attitude of primary school teachers who took an introductory course in mathematics. The purpose of the study was to determine the degree of change in teachers' attitudes towards mathematics during the course of the methods and the correlation between their initial attitude toward mathematics and their academic success at school. The study revealed significant statistical rates of change in the ATMI value of these students. In another study, Sisson (2011) examined attitudes of students towards mathematics and academic outcomes of elementary algebra in the University of Central Florida. It was shown that the general attitude of the students during the semesters had changed positively due to the improvement of the grades. Lim and Chapman (2010) have conducted another study investigating the attitudes of students toward mathematics and its relationship with academic performance in Asia. A total of 984 junior students in Singapore were recruited for this study. It was revealed that though the attitude of students towards mathematics was positive, they did not have an inherent motivation to do the subject. In this

regard, it was found that the inherent motivations and academic performance in mathematics have a very positive correlation. The author posited that, parents and teachers create endogenous motivations for students that promote high selfesteem, leading to superior academic performance. This study however failed to establish what accounted for the lack of intrinsic motivation among students for the study of mathematics.

Based on Tapia and Marshs II (2004), ATMI is considered long. Lim and Chapman (2013) have developed a shorter version that measures only four subscales to examine the relationship between students' attitudes toward mathematics and academic performance in Singapore. The four elements of the scale included the motivation for mathematics, the importance of mathematics, self-confidence in mathematics and enjoyment of mathematics. More than 1600 participants were involved in the study. The result suggests that a very high correlation (r = 0:96) was established between the enjoyment and the motivation subscales as far as mathematics was concerned. A strong correlation was also identified between this shortened version of ATMI and the original version of ATMI with a correlation mean of 0.96 indicating a high correlation between all the four factors.

Wade (2013) attempted to assess the impacts of students' attitude toward mathematics through problem-based learning (PBL). Although the study found that while PBL did not improve the mathematics attitudes of most students; their positive effects help them, determine the value of mathematics in the real world. In a similar study, Pyzdrowski, Sun, Curtis, Miller, Winn, and Hensel (2013) qualified students for their success at the university level of initiation. The analysis shows that performance of students, ATMI score and Calculus

Readiness Assessment had important positive correlations with course performance.

Jackson (2012) has studied attitude as a link between mathematical anxiety and attitudes towards mathematics. This study focused on primary school teachers, exploring the possibility of reducing mathematical fears and improving attitudes toward mathematics. In Burnes' (2014) thesis, the relationships between anxiety in mathematics, attitudes toward mathematics learning, and related learning methods were examined. The link between anxiety in mathematics, attitudes towards mathematics and their achievements has been examined in a Chong, Li and Yang (2014) thesis. The study found that adolescents from six high schools in Sarawak, East Malaysia, faced a moderate level of mathematics anxiety, have positive attitudes toward mathematics and considered themselves to have a moderate level of success in mathematics. This is indicative that the lesser the student's anxiety with mathematics, the higher their academic performance or achievement and vice-versa.

Studies were also carried out on how to enhance the attitudes of students in mathematics to improve the performance of the subject. For instance, by incorporating a teacher's diary into the instruction portfolio (Cutler and Monroe, 1999), by using a computer-based instructional mathematics simulation game (Van Eck, 2000, Touparova, 2000). Van Eck (2015) conducted a recent study regarding situated, genuine problem solving and a model that elucidates how digital games can promote transfer and perk up attitude toward mathematics. Similarly, Gamble (2011) compared mathematics attainment of 34 students in 5th grade employing conventional textbook instruction and differentiated instruction as well as whether there exists a difference as regards students'

attitude toward mathematics after the rolling out of these two different instructions. The study found a significant difference in the attitude of students towards mathematics with respect to the satisfaction component. By implication, it is most likely for students to develop positive attitudes toward mathematics if teachers adopt more innovative and practical approaches to the teaching of the subject.

Awanta (2009) conducted a study in Ghana, which explored the standpoints of students, their formations of mathematics attitudes and habits of learning mathematics and their professed complicatedness level of various mathematics topics. In this study, a random sampling method was used to sample 800 students from the Junior High and Senior High Schools in the Ashanti and Brong Ahafo Regions. A questionnaire was administered them to solicit information on the subject matter. The results showed that students' interest in attending mathematics class, and solving mathematical problems on the part of JHS decreased considerably compared to SHS, even though their general interest score in the learning of mathematics was three for all grade. In terms of confidence, it was revealed from the study that students' confidence in numerical calculations and word problem solving steadily declined. Students have observed a similar trend in the understanding of the contents of mathematics education. However, there was a slight increase in the average value of the statement, "although I know how to calculate, sometimes I do not know the reasons for the calculations." The study revealed that most JHS students took positive steps (that is, consulting teachers) to resolve their challenges and were even disinclined to surrender when they are faced with learning complications. This habit shifted at the SHS; thus, their desire to

consult their teachers reduced significantly. At this level, they preferred to seek assistance from their colleagues. To this end, Awanta proclaims that this certainly indicates that the opinion of his peers is not strong enough before the stage of puberty. As a result, student attitudes strongly influence their success in mathematics.

A study by Dowker *et al*. (2012) showed that the attitude of primary school students towards mathematics is generally positive and that their attitude tends to become "negative" as they age. In a study of 9th grade mathematics students in Malaysia, Ismail and Anwang (2009) found sex, expected academic achievement, mother tongue, family history, and home-based educational resources that influence their success. Similarly, Farooq and Shah (2008) found that optimistic attitudes towards mathematics are the key to success, while negative attitudes often have contradictory effects. Schenkel (2009) reaffirmed this in the subsequent year. Suffice it to reason that aside other factors, attitude is sine qua non to attainment or success in any course or subject of study.

The bad attitudes towards mathematics:

1. Result largely from repeated errors in mathematical work (Nicolaidos and Philippos, 2005).
2. Tend to limit learner intellect and inquisitiveness (Bragg, 2007) and
3. Offer less satisfaction and ease, as well as lower self-confidence among participants (Shrestha, 2006).

Despite overwhelming evidence of a positive correlation between the two, Hean, Craddock and O'Halloran (2009) and Mata, Monteiro and Peixoto (2012) state that behaviour does not seem to affect mathematical integration.

Gender and Mathematics Achievement

Mathematics has become one of the most important areas in which all literary sciences in the academic field are headed to. It is often considered as an area in which children perform better, thus the same is true for the attitudes and self-concepts terms (Ma and Kishor, 1997). On the contrary, performance and mathematics scores at school did not differ significantly between boys and girls (Lindberg *et al*., 2010, Scafidi and Bui, 2010). In addition, a study in which Lindberg *et al*. (2010) used a meta-analysis data covering 242 research, resulting in the selection of 1,286,350 people for the study. study showed no gender difference and almost equal differences between men and women.

DeLourdes Mata *et al*. (2012), however, intimate that there abound several conspicuous variations in the opinions of boys and girls about attitudes towards mathematics. Research findings have continually shown lower mathematics self-concept in girls than boys (Skaalvik and Skaalvik, 2004). Several research findings as regards gender variations in attitudes seem less reliable than in self-concept. Several studies have established substantial variances when attitudes of girls and boys towards mathematics are compared (Asante, 2012; Eshun, 2004; Ma and Kishor, 1997). However, a number of studies also did not identify these differences (Aydin, Delice, Dilmac and Ertekin 2009; Etsey and Snetzler, 1998; Kalavana *et al*., 2007; Mohamed and Waheed, 2011; Nicolaidou and Philippou, 2003).

De Lourdes Mata *et al*. (2012), however, noted that there are many differences in the opinions of boys and girls about attitudes towards mathematics. Research findings consistently show that girls are perceived less mathematically achievers than boys (Skaalvik and Skaalvik, 2004). Several

research findings as regards gender variations in attitudes seem less reliable than self-concept. Numerous studies have led to significant differences in the comparison of girls' and boys' attitudes towards mathematics (Asante, 2012, Eshun, 2004, Ma and Kishor, 1997). However, a number of studies also did not identify these differences (Aydin, Delice, Dilmac and Ertekin, 2009, Etsey and Snetzler, 1998, Mohamed and Waheed, 2011, Nicolaidos and Philippos, 2003). Etsey and Snetzler (1988) conducted a study using meta-analysis and considered 96 studies. The study showed the existence of gender inequalities in students' attitudes towards mathematics.

Men were more optimistic about the subject. However, most of these studies failed to point out whether or not the pessimistic attitudes of students toward mathematics were engineered by school-related, personal and social/environment-induced factors. The current study is therefore premised on this shortfall.

The surveys of primary schools show that the effect size of 0.20 favoured women and the effect size of 0.23 for grade 9 to12 favoured men. Hyde, Fennema and Lamon (1990) studies confirmed the effect of sex among older students (high school and university) with women with unconscious behaviour. Although these Meta-analyses were prepared in the 1990s, they are confirmed by the results of recent studies (Asante, 2012, Zimmerman, Sanchez and Ye, 2004) and attempt to confirm this. In this regard, it is observed that boys tend to have more confidence than girls do and consider mathematics as a male field, which makes them nervous with mathematics (Asante, 2012). A similar study conducted in North America by Zimmerman, Sanchez and Ye (2004) showed that the attitudes of eight grade students towards mathematics differ

significantly. Boys are more interested in mathematics than girls are, but girls tend to see mathematics very critically than boys do. Also, at the end of the mathematics difficulty study, girls scored higher for items with a test score.

With regard to the school environment, changes in gender identity and attitudes of teachers and parents, as well as attitudes towards mathematics, are likely to contribute to inequalities between boys and girls in mathematics. Ma and Kishor (1997) examined the impact of gender on mathematics. The study used meta-analysis, which considered 113 studies, and it concluded gender variable did not significantly affect the correlation between academic performance in mathematics and attitudes. A similar study by Kalavana *et al*. (2007) showed no difference in mathematical performance or mathematical attitude between boys and girls. Although the study revealed higher achievement in the subject by both genders, the explanation they offered to this development differed. Boys tended to ascribe their higher scores to consistency in intelligence than the girls. Similarly, in a study conducted in Pakistan with students, Farooq and Shah (2008) found no difference in the confidence of boys and girls in relation to the attitudes towards mathematics. However, they found that students' success in mathematics depends on their attitude towards the subject.

Again, Markman (2008) in his 'Psychology Today' study postulated that students of both genders receive dissimilar reactions from teachers in math from an early age. He further asserted that when boys are having difficulty, they are likely to be encouraged by the teachers to keep pushing and be reminded that math is a skill that must be acquired. Conversely, when girls have difficulties, they are often reminded of how tasking math is by their teachers and this tends

not to necessarily exude confidence in the girls' competence to appreciate the nature of mathematics. In addition, he argued that teachers could encourage children with problems to continue working for this and remember that mathematics is a skill that needs to be attained. Conversely, in case of difficulty, girls are often reminded that they go to their teachers, which does not necessarily affect their ability to appreciate the nature of mathematics. Due to these treatments, girls tend to develop a notion that mathematics is a talent, which they can only be excelled in for some time. Suffice it to maintain that often times, peers are often encouraged to understand and appreciate mathematical concepts because they see it as a skill that can only be understood by practice (Markman, 2008).

Recognition of Markman's position, Cech (2012) suggests that gender surveys have shown that the main cause of girl's problem is not the difference in the abilities of mathematical instinct, but in environments where students learn mathematics, which gives them less support and confidence. Cesh also argues that most people have false impressions and are convinced that the differences in mathematical performance between the sexes are not due to the influence of their teachers, parents or classmates, but to the girls themselves.

Cech's report is informed by Jo Boaler's (2008) viewpoint on mathematics education drawing from the research she undertook in England. He insisted that teachers believe that mathematics is a ritual journey that gives character and determination to young people (Boaler, 2008). When teachers struggle with the subject as students, they tend to believe that their students must also experience similar. Boaler's investigation further revealed that if boys and girls cooperate in learning math, they end up being more successful.

Mckeachie and Lin (1991) assessed the nexus between student sex, teachers' instructional strategies and students' performances and found that appropriate teacher instructional strategies resulted in higher mean achievement measured by grades of students. Mckeachie and Lin (1991) assessed the relationship between student gender, the teacher-education strategy, and student performance. The study found that appropriate training strategies for teachers resulted in higher average performance. Granlinski (1991) reported lower boys' anticipations in mathematics achievement than their counterparts and more importantly, girls think that they lack mathematical prowess. He further indicates that whenever girls perform abysmally in mathematics, they tend to blame it on their innate weakness in the subject. Similarly, impressions such as "like" or "smart" were found to greatly foretell attitudes of students towards Science and Mathematics (Moore, 1993). Further lending support to the above statement, Moore (1993) found boys to be more advantaged than their counterparts.

Saha (2007) found in a study titled Gender, Attitudes towards Mathematics, Cognitive Style and Mathematical Success that the three factors contribute significantly to fluctuations in mathematical performance. Similarly, Ma and Xu (2004) identified the order of causality between attitudes towards mathematics and students' mathematical achievements, sometimes showing a predominance of attitudes throughout high school. However, gender inequality has not been found in this cause-and-effect relationship, but the privileged position in mathematics has reduced this causal link.

Swetman (1995) found that girls' positive attitude towards mathematics declined with age. Swetman added that girls are more positive about

mathematics than their peers are, but as they progress, their attitudes become less positive. Based on the above, Swetman argued that to improve girls' mathematics performance, teachers needed to help them develop their productive attitude toward mathematics. Gill (1994) put forward evidence of previous results and argued that students had a positive attitude towards school, but an unfavourable attitude towards mathematics. In contrast, Fennema and Sherman (1995) found that well-educated, results-oriented and enthusiastic teachers tend to have a good attitude towards mathematics and science.

Mahanta and Islam (2012) conducted a study of students' attitudes toward mathematics and their relationship to mathematics success. Data analysis shows that 37 percent of boys view mathematics as a difficult subject, while 39.2 percent of girls view mathematics as a difficult subject. In addition, 60 percent of boys think mathematics is crucial for mental development, while 58 percent of girls share a similar opinion. The study also found that urban students showed a more positive attitude toward rural areas. It was further found that students with a high attitude score on the test scored well in mathematics and those with low attitude scores had lower scores in mathematics examination.

In a study of first- and second-year students, Cox (2010) used surveys to assess their self-esteem and gender perspective for the success of mathematics. Then, the teachers participated in tests of resistance in mathematics to check if they knew the matter well. The study found that fear of mathematics teachers tended to preoccupy girls. Thus, girls tend to experience anxiety with mathematics if their teachers are also experiencing it. Cox argues that these girls are very likely to claim that boys are successful in mathematics and that girls read successfully because teachers are unable restore girls' confidence. It was

revealed that student attitudes were found to influence their perception and performance. The more girls stereotype mathematics, the worst scores they attain in an examination.

Mathematics Learning Environment and Attitudes

Several studies have examined the role of the environment in learning mathematics. The learning environment is a critical factor in performance and learning. When the environment is strong, students can learn effectively (Ehiametor, 1990, Farrant, 1982). Students receive maximum learning as well as develop an affirmative attitude towards a subject in an environment where they are much involved; a good teacher-student relationship exists, and the teachers (Tanveer, Rizwan, Ali, Arif, Saleem and Rizvi, n.d) employ creative teaching methodologies. The relationship between the learning environment and attitudes can never be avoided by trying to focus on factors that affect students' mathematical performance. Similarly, Fraser and Fisher (1982) found the positive relationship between upshots and perceptions about attitude. This is to say that for students to receive maximum learning, an atmosphere of comfort, motivation and experimentation in the classroom should reign. The styles of teaching and content have a helpful effect on learning and success in mathematics (Rizvi *et al*., n.d). Thus, inappropriate teaching methods and inadequate understanding of mathematical concepts therefore lead to problems and make it difficult to determine the relevance of mathematics for their lives (Crespo, 2003). Flowing from the above, it is suggestive that suitable pedagogical approaches and teachers' deep mathematical insights have what it takes to help students come out of the bondage of negative attitudes toward mathematics and its resultant effects of poor academic performance.

A study by Akey (2006) established a series of elements of the school environment (teacher support, student interaction and student expectations) that are largely related to student attitudes and behaviour. This study concluded that in a class or school environment that teachers consider as encouraging, tend to foster students' sense of control and confidence in their ability to succeed. Suffice it to maintain that how students perceive teacher characteristics largely shape their attitudes towards mathematics (Maat and Zakaria, 2010). Similarly, Maat and Zakaria (2010) and Vaughan (2002) have recognised a strong correlation between the learning environment and the attitudes of students towards mathematics. As a result, students who are more in tune with the learning environment and whose teachers are more optimistic tend to adopt a more productive attitude towards mathematics (Maat & Zakaria, 2010). The results of Rawnsley and Fisher (1998) have confirmed that students tend to have a positive attitude toward mathematics when teachers feel supportive. Thus, to some extent, issues of students' adverse attitudes toward mathematics can be addressed through teachers' supportive roles in the classroom.

Home settings and social factors influence students' attitudes toward mathematics. Examples of such factors include parents' level of education, parental expectations and occupation of parents (Köğce *et al*., 2009). The concept of mathematical society, of hard, cold, abstract, theoretical and suprarational questions also influences the way students perceive it (Ernest, 2004). However, studies have shown a positive attitude of students on the subject (Tezer & Karasel, 2010; Yilmaz *et al*., 2010; Fan *et al*., 2005). Teachers with greater self-efficacy and higher goals and objectives for themselves, as well as their students, are likely to cope successfully with barriers and problems

(Ross and Bruce, 2007). There is thus the need for teachers to engage their students with practical learning as well as provide them with some real-world applications (Cady and Reardon, 2007). In support of this position, Moore (1998) argued that teachers should teach passionately because passionate teachers perform quality academic work. Several studies have also shown that students' sympathy and attitude towards mathematics is characterised by low, extraordinary, or average grades (Tapia and Marsh, 2001, Hannula, 2002). Thus, students who score higher marks in mathematics will turn to have stronger affection and attitudes towards the subject and vice-versa. In support of this, Lopez *et al*. (1997) maintained that self-efficacy of students, attitudes are correlated, and that self-efficiency in mathematics is influenced through previous grades and marks. Suggestive that students with poor previous grades would tend to be negatively influenced which would eventually translate into poor academic attainment in mathematics.

The Effect of Motivation on Attitudes

Motivation is a key element influencing the academic success of students who need to be admitted to the classroom to improve grades, as this ultimately attracts student interest (Coleman and McNeese, 2009). Lourdes Mata, Monteiro and Peixoto (2012) argue that the lack of commitment and dedication of teachers to academic work is of particular interest to teachers. Similarly, Singh, Granville, and Dika (2002) compared the impact of attitude, motivation, and academic engagement on the academic performance of mathematics and science students in the eighth grade. In this study, since 1988, 25 percent of students in the National Education Longitudinal Studies were interviewed and two mobilization factors analysed, thus a factor of academic commitment and a

factor of attitude. The results showed strong influences of motivation, optimistic behaviour and commitment to research work to succeed in mathematics and science. It was also established that for students to be successful particularly in the two subjects, they must be active in their learning. Therefore, teachers who are very relevant in the teaching and learning environment must consider motivation a serious and important catalyst in the achievement process of the students.

Motivation was found to significantly affect student performance in general and mathematics (Singh, Granville and Dika, 2002). Similarly, motivation was found to shape students' attitudes by compelling them to have more affirmative inclinations and self-confidence (Burris, Heubert, and Levin, 2004). As a result, incentives have a positive effect on their performance with both in a cycle, so one increases the other (Ellis, 2010).

Therefore, the support, expectations, and comments that students receive from others influence their cognitive crises and are the fundamental source of their emotional settings (de Lourdes Mata, Monteiro and Peixoto, 2012). Therefore, it is imperative to take into account the responsibility of these factors by incorporating the motivational attributes of the students. Wigfield (1997) asserted that behaviours deemed as the feelings of an individual towards reading could be linked to an individual's motivation involved because they affect the degree to which individuals engage in reading activities. Thus, the higher an individual felt motivated, the higher his or her performance in mathematics as a subject.

Attitudes are emotional signals that accompany behaviors caused by an incentive state (Guthrie & Knowles, 2001). Therefore, attitudes can be closely

related to motivation and provide important information for a better understanding of behaviour and processes of mobility. In the field of mathematics, few studies examine the relationship between incentives and attitudes. However, some studies have shown links. Singh, Granville and Dika, (2002) employed two types of variables to ascertain motivation, first school attendance and classes and participation and readiness for mathematics classes. Singh and his colleagues asserted that motivational factors influenced mathematics attitude because considerable direct effects of .19 and .21, of these two motivation aspects, were observed in the attitudes of students. Students who exhibited school behaviour of motivation deficiency possessed a more pessimistic attitude toward mathematics. Such behaviours included; lateness to school, avoidance of classes, attending classes without preparations and books. In addition, authors such as Hemmings and Kay 2010 and Reynolds and Walberg (1992) considered consideration effort as a parameter of motivation. By employing structural equation modelling to analyse the various factors that affect mathematics performance and attitudes with eleventh-graders, Reynolds and Walberg (1992) identified a great effect of motivation on mathematics attitudes. Similarly, a study of 10th-grade students by Hemmings and Kay (2010) confirmed a positive relatedness of effort to mathematics attitudes.

It is important for teachers to know the different aspects of motivation because they play a key role in the classroom (Eggleton, n.d.). Teachers are likely to increase student motivation by smiling, offering additional help to a task or calling a student for a good job. Therefore, Eggleton also believes that while these measures are an excellent stimulant and that the greater motivation of the teacher's personality is compared to that of his students. In addition,

students feel motivated to learn mathematics when their performance in the subject is due to their high ability. However, students who blame their poor performance in the subject on low ability or difficulty of materials will be illmotivated to study the subject. It is the duty of mathematics teachers to help enthusiastic and unconcerned students understand and appreciate that how successful a person becomes in learning of mathematics is dependent on that person's effort (Weiner, 1984).

Teachers who make sure their students understand the need to set personal learning objectives and take responsibility for learning math, increase motivation and success in the subject (De Charms, 1984). In terms of student interest and motivation, the type of response students receive from their teacher is an essential part of mathematics learning. For example, in a situation in which students view their teachers' comments as a controlling and designate goals that go beyond them, their motivation for learning mathematics and their interest in mathematics diminishes. On the other hand, students who consider the responses of their teachers as informative and that it can help enhance their proficiency will boost their intrinsic motivation to learn mathematics (Holmes, 1990).

Students must be ready to have a sense of value. Teachers should not lower the standards of some students because they feel incompetent compared to other students. A study by Vásquez (1990) showed that students who thought teachers would not reduce their standards would be willing to approach them and provide them with the necessary practical support that proved to be the highest level of leadership. Teachers should trust bad students and provide them with the support and opportunities they need to excel.

Burris, Heubert and Levin (2004) examined several high school math courses and combined them into an advanced mathematics course. In this study, students with lower or higher performance, different racial backgrounds and socioeconomic status were trained in an advanced mathematics course. Positive results were observed among the students. Based on these results, the researchers argued that not only accelerated mathematics courses and other lessons should be reserved for the most advantaged students, but also that these lessons should be available to all. Thus, by granting low-achieving students the chance to learn at a high-speed, they feel challenged, and this eventually tends to boost their confidence levels. In short, motivation is one of the greatest tools that stakeholders of education including teachers, parents among others must employ to influence students towards mathematics positively, which would later enhance their academic performances in the subject.

Similarly, there is a variety of hypothetical or experimental relationships between confidence in learning mathematics and motivation of student to excel, endogenous motivation, self-image, and self-esteem (Hart and Walker, 1993). Numerous studies have shown that attitudes are inseparable from motivation and social support (from Lourdes Mata *et al*., 2012). Confidence is very important in mathematics. This is because students with confidence can solve difficult mathematics problems as well as learn new concepts. Hart and Walker also expressed the strong belief that trust affects students' delight and concentration in mathematics through greater participation in the subject (Hart and Walker, 1993). By implication, students with higher confidence levels in mathematics tend to have the flair for mathematics with consequential higher academic performances.

Arthur, Asiedu-Addo and Assuah (2017) assessed students' perspectives and their impact on the interest of Ghanaian students in mathematics using a multivariate statistical analysis. A total of 1,263 respondents from ten (10) high schools in the Ashanti Region of Ghana, were drawn for the study. The study used questionnaires in the data collection. The study found that 58.1 percent of respondents agreed that the negative perception of mathematics in elementary school strongly affects the interest of students in mathematics as they continue their studies. However, 20.4 percent of respondents collectively denied that the negative perception of mathematics in elementary schools affected the interest of students in mathematics. It was also revealed that primary school students scored poorly with an average score of 3.6 and a standard deviation of 1.33. However, the study showed another relative value index of 0.74 as an overall score of the importance of participants. Researchers have shown that educators have taken notice of the impact of phenomenal interest of students in mathematics, which could be detrimental to their interests. The study further recommended practical teaching methods, which can adequately motivate students, as well as help, reduce bad perception to optimise interest.

Tanveer, Rizwan, Ali, Arif, Saleem, and Rizvi (n.d) examined the role of attitudes toward mathematics learning among students in the department of Management Sciences of Islamia University of Bahawalpur. In all, 108 students were drawn from undergraduates' program and were asked to respond to structured questionnaires. It was revealed that students, who obtained higher marks in mathematics, have had a good attitude and fondness towards the subject. The study also indicates that successes in mathematics create positive

attitude hence the need for teachers to focus their attention on increasing the level of achievements to foster optimistic attitudes among students.

In 2010, Mutai assessed students' attitudes towards mathematics learning and math success among high school students in the Bureti region of Kenya. In this study, a descriptive approach was adopted. The study used a structured questionnaire to gather data from the teachers and students. A total of 24 teachers and 359 students from 6 high schools in the region were selected for the study. The data obtained were coded and entered into statistical analysis of social science statistics (SPSS) for analysis. The main findings regarding attitudes toward mathematics in high schools are lack of self-confidence and lack of interest to learn mathematics and obtain good score, as reported by 45 percent of students. In addition, 24 percent of respondents expressed a lack of interest in mathematics and 56 percent of respondents agreed that mathematics is a problem. Interestingly, the same percentage (56 percent) strongly contradicts the claim that mathematical education was mind numbing. Again, 49 percent of respondents indicated that they wanted to continue mathematics after graduation. The study recommended limiting unpleasant attitudes in time before students completely give up learning and / or mathematical performance. Mathematicians have also been advised to use the available learning resources wisely to reinforce positive attitudes, neutral attitudes and to eliminate negative attitudes towards learning and mathematical performance.

In South Africa, Bayaga and Wadesango (2014) analysed student attitudes towards mathematical performance based on factor structure. The purpose of this study is to determine the number of factors (mathematical self-determination, parenting education, home history, education, school climate,

and attitudes) that represent interactions between groups of interdependent variables of student attitudes to learning mathematics. The study examined the contribution of each factor explaining the fluctuation of students' mathematical performance and the overall variation that can be explained by the given factors. An analysis of the findings was conducted by interviewing 321 randomised respondents in a research protocol. The Scree test and eigenvalues showed that more than eight factors were retained. These factors constituted 60.1 percent of the variation. The results show that seven of the eight factors in the study represent about one-fifth of the variation in mathematical success (20.7 percent). Self-concept, family background, teaching and attitudes accounted for 12.3 percent, 5.1 percent, 1.6 percent and 0.9 percent of the variation respectively. Bayaga and his colleague argue that the results are important for the South African education system, because students' understanding and attitude towards the evolution of mathematical and classroom teaching techniques is much easier to improve the factors that affect the performance of students.

In Chile, Ramírez studied the attitudes towards mathematics and academic achievement of the Grade 8 student in Chile. While carefully studying data from the 1999 International Mathematics and Science Study (TIMSS), the study showed that Chilean students enjoy mathematics, but overestimate their mathematical skills. In addition, hierarchical linear models ware employed to predict mathematics performance, both at the student and classroom levels. At both levels, the importance of students studying mathematics, expectations for continuing education and confidence in the causes of their math scores were important predictors of performance. In classes where more students liked mathematics, their averages were significantly lower. Ramírez (2005) attributed

phenomena to the demanding curriculum and the highest standards of evaluation used in the best performing classes.

Similarly, Churcher, Asiedu-Owuba and Adjabui (2015) in Ghana assessed the performance of high school students in mathematics education in Kassena-Nankana high schools. In total, there were 140 final year students from three (3) selected schools in the community. Respondents were sampled using a purposive sampling method. The study used SPSS version 16 to generate many results for the analysis. Several analyses were also generated with the use of linear regressions. Teacher performance and inadequate textbooks have been identified as the main cause of poor student performance. It has also been found that parental and extracurricular activities affect student performance. The study also shows that when assessing student performance, parameters such as the presence of students in the classroom, solving self-directed math problems, attending extra classes, students with a group study and the duration of the study outside the classroom needs to be taken into consideration.

In terms of attitude of students and its effect on achievement, Michelli (2013) conducted a study that looked at fifth grade students. Sex in the study played a key role in determining the relationship between attitude and performance. In addition, several types of traits were examined, including extraversion, awareness, self-control, and the intellectual ability to determine their impact on performance. A Likert questionnaire and a mathematical test was developed and administered for the study. The study revealed a strong link between mathematics attitudes and mathematics success. In terms of gender, it was found that men had a more positive attitude towards mathematics than their respective women did, but in the performance test, gender did not differ in the

assessment. Extroversion has also been found to be the only feature that has a significant relationship with performance, suggesting that less fit students may be able to score higher on the test. According to Michelli (2013), the findings are extremely a wake call on especially educators on how they ought to be in knowing of students' attitude and the need to improve on them to influence their performances (i.e., academic achievement) positively.

CHAPTER THREE

RESEARCH METHODS

This chapter deals with the research method used in carrying out this study. It discusses the research design, population, instruments developed and how reliabilities and validity were ensured. In order to determine female teacher trainees' perceptions and attitudes towards mathematics as well as any relationship between these two scales, two research questions and two hypotheses were formulated. The data collection and data analyses procedures were also discussed.

Research Design

The study employed descriptive research design to examine the attitude and perception of female teacher trainees towards the teaching and learning of mathematics at the CoEs. Descriptive research is the research design in which data is collected in a qualitative manner and analysed using quantitative procedures (Nassaji, 2015). Thus, the use of this design in examining the phenomenon of attitude and perception in the current study. It focuses on answering the how, what, when, and where questions of a research problem, rather than the why as was used in the study. Descriptive research refers to the scientific methodology in which observation of the sampled population is carried out in its natural surroundings (Nassaji, 2015). In particular, the current study uses the concurrent triangulation mixed method research approach to gather data using WIHIC and mathematics attitudes questionnaire (MAQ) adapted from earlier studies (Asomah et al., 2018). Thus, the collection of information from the participants in the CoEs. Moreover, the observer does not intervene in this observation process or influence any of the variables of the

study (Lambert & Lambert, 2012). This is because it centres on the premise that certain problems can be resolved and practices can be improved by observation analysis, and description (Koh & Owen, 2000). Furthermore, this form of research methodology finds its most use in studies that are exclusively restricted to facts rather than hypothetical scenarios. Hence, a major feature of descriptive research is that it is restricted to examining facts and the researcher does not make any additional attempt to find out why the reality occurs in a particular form (Jong & Voordt, 2002). The advantages in relation the employment of descriptive research design in a study could be outlined as follows: it allows you to analyse facts and helps you in developing an in-depth understanding of the research problem. Another benefit of descriptive research is that it enables you to determine the behaviour of people in a natural setting (Creswell, 2017). In such a type of investigation, you can utilise both qualitative and quantitative research methods for gathering facts. Descriptive research is cost-effective and quick. It can also be used for many different purposes, which makes it a very versatile method of gathering data. It requires less time for performing such types of research. With descriptive research, you can get rich data that is great for future studies. Use it to develop hypotheses or your research objective as well (Creswell, 2017).

Population

The target population of this study was all female pre-service teachers' in the University of Cape Coast (UCC) affiliated CoEs in Ghana. This is as result of the teaching and learning of mathematics being compulsory at the CoEs.

Demographic Data of Respondents

Table 1: Distribution of Demographic Information of Students

		N(%)	M±S.D
College of Education	Holy Child	86(29.4)	
	OLA	159(54.3)	
	Foso	48(16.4)	
Total		293(100)	22.910±6.446

Source: Field survey, 2023

The outcomes, as displayed in Table 1, indicate that the average age of the trainees is 22.9 years. The breakdown further discloses that 29.4% of the trainees originated from Holy Child College of Education, 54% from OLA College of Education, and 16% from Foso College of Education.

Sample and Sampling Procedure

The current study sampled female pre-service teachers' in the Western and Central Regions in the UCC affiliated CoEs. Thus, female teacher trainees in the 2022/2023 academic year. To this end, purposive sampling technique was employed to select the CoEs in the Western and Central Regions of Ghana for the conduct of this study. This is because the study considered CoEs affiliated to the University of Cape Coast (UCC). This decision was informed by the curricular and pedagogical orientations of the mathematics Tutors affiliated to UCC. Thus, ensuring unanimity of purpose and uniformity in how the participants received tuition in the area of mathematics. Further, the study excluded first year female teacher trainees since their experiences with the teaching and learning of mathematics were limited in scope at the CoEs and as

such lacked the requisite expertise to contribute meaningfully to the study. Again, the second and third-year students were sampled at the selected CoEs. Moreover, owing to the researcher's position as a faculty member of UCC affiliated institution, permission to conduct the current study was flexible from the authorities of the selected school. In this way, access to participants at the selected CoEs for an uninterrupted conduct of the study yielded the desired results. Hence, the employment of purposive sampling technique in this study was vital in the acquisition of the rich evidence which led to the detailed analysis of the perceptions and attitude of the female teacher trainees towards the teaching and learning of mathematics in this study.

Purposive sampling was employed in the current study to provide the researcher with the justification to make a generalization from their sample. The flexibility of purposive sampling allows researchers to save time and money while they are collecting data. It offers a process that is adaptive as circumstance change, even if it occurs in an unanticipated way. It can meet multiple needs and interests while still maintaining the foundation of a singular focal point. The purpose of this design is to give researchers an opportunity to develop as much insight as they possibly can into whatever key point is under observation or examination. Purposive sampling allows researchers to look at the averages in the data. Moreover, it can glean information from the various extremes of population groups. Purposive sampling can look at averages, but it will also help researchers to identify the extreme perspectives that are present in each population group as well. There are always outliers to consider in any project such as this, and their perspectives are just as critical at times as what the "median" person provides toward an outcome. This advantage makes it possible

to have a better understanding about behaviour patterns within a specific group, and it does not always need to be a negative perspective. This purposive technique makes it possible to prove the validity of the information immediately because no one is left out from the sampling process. Although this advantage takes more time because there is a significant amount of data to collect compared to the other types that are possible, researchers save time trying to"prove" their assertions because the material is useful in its raw form. The information collected in purposive sampling has a low margin of error. Researchers achieve a lower margin of error using the purposive sampling approach because the information they collect comes straight from the source. Each person has identifiable characteristics that place them into the same demographic. Purposive sampling can produce results that are available in realtime. Some of the disadvantages associated Purposive Sampling. Purposive sampling is highly prone to researcher bias no matter what type of method is being used to collect data. The idea that a sample is created in the first place relies on the judgment of the researcher, as well as their personal interpretation of the data. When the judgments are either poorly considered or ill-conceived, then this problem becomes a significant disadvantage that can provide roadblocks in the way of a final result. When there is elicitation, accepted criteria, or a theoretical framework in place, then this issue is minimised. Again, it may be challenging to defend the representative nature of a sample. Researchers must provide evidence that the judgment used to select the various units or individuals in the purposive sampling was appropriate for the processed used. The high levels of subjectivity cast an inevitable shadow of doubt on the results in almost every situation. Unless there is a way to defend the overall representative structures

that were implemented to generate results, there will always be readers who feel unsure about the generalizations achieved, even when the theoretical, logical, or analytical structures are present. Moreover, the participants in purposive sampling can also manipulate the data being collected.

Thus, when people know that they've been selected for a research project, then it can initiate a change in their behaviour. They might choose to act in a way that allows researchers to reach the conclusions that they expect to see, or the opposite issue can occur as well. Some participants may choose to lie to create an unwanted outcome because they have a bias of their own that they want to take public. Only the skill of the researchers can determine if there is validity in the data collected, which means there are times when the outcome being studied could be more unpredictable than anticipated. Further, it can be an ineffective method when applied to large population groups. Although total population sampling is one of the purposive methods that researchers can use when collecting data, this process is at its most effective when there are a limited number of individuals or units who possess the specific traits that are being studied. Purposive sampling relies on the presence of relevant individuals within a population group to provide useful data. Because the researchers are in charge of the selection process, their perspectives can influence the data they collect in numerous ways. Even when there is a conscious effort to set aside a bias, some may unconsciously manipulate the data that is available to create outcomes that support their preconceived notions. The advantages and disadvantages of purposive sampling offer significant levels of flexibility, but they also require a higher level of evidence-based techniques to prove to outside observers that there is relevance to the information collected.

In the initial stage of sampling, a purposive sampling technique was employed to select the colleges that would be included in the study. The researcher purposively chose Holy Child College, OLA College, and Foso College as the three colleges of education to be studied.

Within each selected college, a further purposive sampling technique was used to select specific students to participate in the study. Specifically, 86 students were selected from Holy Child College, 189 students from OLA College, and 48 students from Foso College. This approach aimed to ensure a diverse representation of students across different institutions.

Once the colleges and the predetermined number of students from each college were identified, a convenience sampling technique was employed during the administration of the questionnaires. Convenience sampling involves selecting participants based on their availability and willingness to participate. Students who were readily available during the data collection period were recruited until the pre-defined quota for each college was met.

Data Collection Instruments

Data for the study was collected using two sets of five-point Likert scale type questionnaire measuring the female teacher trainee's perception and their attitudes towards mathematics. The two instruments were sub-scaled measuring some specific traits in the study. In relation to the instrument measuring female teacher trainees' perception of the teaching and learning of mathematics. The instrument was developed based upon the seven scales of what is happening in this classroom (WIHIC) questionnaire developed by Fraser, Mcrobbie and Fisher (1996). Based on past studies, Fraser, Fisher, and McRobbie (1996) developed a new learning environmental instrument named What Is Happening

In This Class? (WIHIC) which incorporates scales that have been used and proven to be significant predictors of learning outcomes. They also included additional scales which were designed to measure current concerns in the classrooms, such as equity issues. The WIHIC consisted of 7 scales and 56 items. The seven scales are 56 Teaching & Learning 22:2 December 2001 Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity. Table 1 shows the WIHIC scales complete with a brief description of each scale and a sample item. The WIHIC has Personal and Class forms to measure the perceptions of students at the personal and class levels, and Actual and Preferred forms to measure the actual environment of the classroom and the environment preferred by the students.

Table 2: Scale Descriptions and Example Items of the WIHIC

Scale	Description	Item
Student Cohesiveness	Extent to which students are friendly and supportive of each other	I make friendships among students in this class.
Teacher Support	Extent to which the teacher helps, befriends, and is interested in students.	The teacher takes a personal interest in me.
Involvement	Extent to which students have attentive interest, participate in class and are involved with other students in assessing the viability of new ideas.	I discuss ideas in class.
Investigation	Extent to which there is emphasis on the skills and of inquiry and their use in problem solving and investigation.	I carry out investigations to test my ideas.
Cooperation	Extent to which students cooperate with each other during activities.	I cooperate with other students when doing assignment work.
Equity	Extent to which the teacher treats students equally, including distributing as to other students' distribution opportunities to be included in discussions.	The teacher gives as much attention to my questions praise, question and questions.

The original scales were limited to student cohesiveness, teacher support, involvement, co-operation and equity. This is because, the original subscales of investigation and task orientation scales on the instrument were aligned to the conditions of the practice of constructivism being employed by the mathematics Tutors in the CoEs. This condition could be ascertained hence the limitation of the seven original scales to five in the current study. Thus, the current instrument measuring the female teacher trainees' perception of the teaching and learning of mathematics to five subscales with each subscale having eight items bringing the total number of items on the instrument to forty. Again, a value of 5 indicated that the classroom practice being measured takes

place almost on a regular basis while a value of 1 was interpreted as the female teacher trainees perceiving the classroom practice to hardly take place.

Moreover, since the items on the WIHIC scale were developed based on a culturally different context, some of the items were modified to reflect the Ghanaian cultural context and make the items on it more understandable to the respondents. In particular, an original item on the WIHIC instrument was "my mathematics teacher takes interest in me" which could be interpreted in the Ghanaian cultural context as a Tutor having an illicit affair with a teacher trainee and was consequently reworded as "my Tutor maintains a healthy tutor-student relationship with me even after his/her lesson has ended". These changes were aimed at ensuring clarity and reducing all forms of ambiguities in the instrument. The finial modified version of the questionnaire was constructed using a five-point Likert-type response scale to indicate the degree to which pupils agreed with each statement made: (1) Never; (2) seldom; (3) Sometimes; (4) Often; (5) Always. A detailed description of the five modified WIHIC Subscales are presented in Table 2.

Table 3: Description and Sample Item for each Subscale in the Modified WIHIC

Subscale	Description	Sample Item
Student Cohesiveness	Extent, to which learners should know, is friendly to, and supportive of each other.	I am friend to members in my mathematics class.
Teacher Support	Extent to which tutor helps, relate to and show interest in their learners	My mathematics tutor listens to and accepts my comments on how he/she teaches
Involvement	Extent to which learners have attentive interest, participate in discussions and explain their solutions	My ideas and suggestions are used during mathematics classroom discussions
Co-operation	Extent to which learners are prepared to help each other rather than compete with each other selfishly	In my mathematics class there is high competition among us which leads to selfishness.
Equity	Extent to which learners view the treatment they receive from the teacher to be equitable	My mathematics tutor treats me the same way he/she treat other learners in this class.

The second instrument, the Mathematics Attitude Questionnaire (MAQ) was developed to measure female teacher trainees' attitude towards mathematics using the ABC Model of Attitude is based on a Hierarchical Model described in Ajzen (1993) who conceptualises an attitude as an amalgam of three separate measurable components: affect (A), behaviour (B) and cognition (C) as a guide. The finial modified versions of the two questionnaires were constructed using a five-point Likert-type with responses ranging from Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). These

responses were assigned the following values; Strongly Disagree-1, Disagree-2, Undecided-3, Agree-4 and Strongly Agree-5 for positively worded statements with the scoring being reversed for negatively worded statements to reflect the degree to which the respondents possessed that attitudinal trait being measured in that continuum. The instrument measures female teacher trainees' attitude in three areas namely; Affect, behaviour and cognition (see Appendix A).

Table 4: **Description and Sample Item for each Dimension of the Mathematics Attitude Questionnaire (MAQ)**

Dimension	Description	Sample Item
The effect of Mathematics	Extent of students' beliefs about their own ability to learn and perform well in mathematics	I am capable of learning mathematics on my own (by myself) without help from my classmates
The behaviour of students towards mathematics	Extent to which students exhibit interest and the desire to learn mathematics	The learning of mathematics is difficult
The cognition of students towards mathematics	Extent of students' perception about the importance of mathematics in the present everyday life and in the future	Mathematics is very useful in our everyday activities at home

Using these components to understand the students' attitude towards mathematics, the study measured the following aspects of the female teacher trainees: Self-confidence, anxiety, enjoyment (affect), Intrinsic motivation (behaviour) and Perceived usefulness (cognition)

Validity

The two instruments mathematics were thoroughly discussed with my two supervisors and the possible outcomes agreed on as far as the face validity of the instruments were concerned. This is because the supervisors from the Department of Mathematics and ICT Education are experts in related research that involves attitudes and perceptions towards mathematics. Moreover, tutors from the CoEs were also given the instruments to assess the items. Through this process the appropriateness of the language used was checked. Again, certain wordings which were perceived to be ambiguous were also modified as well as checking the various items to ensure that the items really measured what they were intended to measure.

Pilot Testing

The two instruments were pilot- tested in a school in the Komenda CoE (KEEA) district in the Central Region of Ghana with similar characteristics as those that were used for the actual study in the Western CoEs since the teaching and learning of mathematics is compulsory. Seventy female teacher trainees from six intact classes who were having mathematics lessons at the time of conducting the pilot-test were used. The two instruments were retrieved from the respondent immediately after completion and the data obtained analysed by computing their reliabilities and inter-item correlations. Based upon the interitem correlation, some of the items were modified.

Reliability

The reliabilities of the two instruments were estimated using the Cronbach Alpha to determine whether each item under the various subscales

was related to each other after the pilot- testing exercise and again after the actual data collection for the studies.

Data Collection Procedure

The administration of the questionnaires with closed and open -ended items occurred in the respective schools of the respondents of the study. This was to report on the subscales in relation to the perceptions and attitudes of the female teacher trainees at the colleges of education (Cohen et al., 2018). The researcher submitted official letters of permission to heads of the CoEs who in turn granted access to the academic heads, heads of mathematics departments in the selected colleges. In consultation with the heads of the mathematics departments, female mathematics students were randomly selected from different programmes offered by the colleges to participate in the study. The instruments were administered in the respective participating schools. This was to enable the researcher report on how things look like without disrupting the environment of the colleges involved in the study (Cresswell, 2020). There were two distinct phases to the data collection process. In the very first phase, quantitative information about female teacher trainees' experiences of their perceptions and attitudes towards mathematics followed by the qualitative phase. The respondents were given 1-hours to complete the three sections contained in the instruments. The completed instruments were retrieved immediately after the stipulated time period. Thereby, ensuring 100% return rate during the data collection exercises stage of this study. Further, in view of the leaner’s response to the open-ended items, some of the respondents were selected randomly for the purposes of sharing their views in the study. Thus, avoidance of redundancy and repetition of the qualitative data characterised the

choice of the students in the study (saturation point). This enabled the researcher to categorise and sanction opinions shared by the respondents.

Data Processing and Analysis

To answer research question one and two on female pre-service teachers' perception and attitude towards mathematics. The data obtained from the two instruments were scored for individuals after which individual item means and overall subscale means were calculated. In order to do this, the responses that were obtained from the data collection process were coded from 1-5 for positively worded items in that continuum. This indicated the relative standing of the individuals on the dimensions on the perception and attitude instrument. After obtaining the mean of means, those items which recorded means above and below the overall scale mean were selected and commented on in the study. Again, items which were expected to record either higher mean values or lower mean values but turned out otherwise were also commented on. Further, positively worded items from Strongly Disagree to Strongly Agree in that continuum whiles for negatively worded statements the coding was reversed. The Undecided response, which was coded 3, served as the average which was used to determine the direction of female teacher trainees' responses, that is, whether favourable or unfavourable. The third research question sought to determine the correlation between female teacher trainees' attitudes and perceptions towards mathematics. The potential relationship between the perceptions and attitudes of female teacher trainees towards mathematics was explored in alignment with research hypothesis one. In order to address these hypotheses, a Pearson Moment Product Correlation Coefficient test was employed. The MANOVA was also used to explore the perceptions and

attitudes of the research participants from mixed and single-sex colleges. The qualitative data was transcribed. Then after transcription, coding was applied to identify themes. In others the qualitative data was analysed using thematic analysis followed with narrative discussion.

Table 5: Summary of Data Collection Instruments for Research Questions

Research questions	Data source	Data analysis tool
Research questions1	Student's perception towards mathematics questionnaire	Descriptive statistics Thematic Analysis
Research questions 2	Student's attitude mathematics questionnaire	Descriptive statistics Thematic Analysis
Research questions 3	Student's perception towards mathematics questionnaire Student's attitude mathematics questionnaire	Pearson Moment Product Correlation Coefficient test
Null Hypothesis	Student's perception towards mathematics and Student's attitude mathematics questionnaire	MANOVA

CHAPTER FOUR

RESULTS AND DISCUSSION

In this chapter, the results from the study into female teacher trainees' perceptions and attitudes of the teaching and learning of mathematics and their attitude towards mathematics are presented and discussed based on the research questions and hypothesis formulated in Chapter one to guide the conduct of the study. The results are presented based on the research questions and the hypothesis, and the biographical data of the respondents is presented.

Table 5 presents the age distribution of the respondents. The majority, constituting 58.4% (171 students), falls within the 22-25 age range. The 18-21 age group follows with 97 students, making up 33.1%. The "26-29" age group represents 7.2% of 21 students, while those aged "30+" account for 1.4% with only 4 students. The majority of the students, summing the percentages of the ages between 18 and 25 years, indicate that if these student teachers are well motivated, they are likely to stay in the system to make the profession vibrant.

Table 6: Age Distribution of Respondents

		Frequency	Percent
Age (yrs)	18-21	97	33.1
	22-25	171	58.4
	26-29	21	7.2
	30+	4	1.4

Source: Field survey, 2023

Summary of the distribution of respondents across colleges of education is provided in Table 6. The results in Table 6 show that the majority of students, 54.3%, belong to "College B" with 159 students. "College A" follows with 86 respondents, representing 29.4%, and "College C" accounts for 16.4%,

comprising 48 students. The higher number of students in College B is due to the fact it is an all-female institution.

Table 7: Participants from the Colleges

College of Education	Frequency	Percent
A	86	29.4
B	159	54.3
C	48	16.4

Source: Field survey, 2023

The results of addressing the key research questions and the hypotheses are presented below.

Female Pre-service Teachers' Perception Towards the Learning of Mathematics?

This research question was posed to explore female teacher trainees' perceptions towards the learning of mathematics. In order to respond to this question, the perception was conceptualised to mean the teacher trainees' cohesiveness, Tutor support, Involvement, co-operation and equity in relation to the teaching and learning of mathematics. Consequently, each of the five subscales that underpinned the teacher trainees' perception towards the learning of mathematics is discussed:

Cohesiveness

Cohesiveness is conceptualised as the extent to which learners should know, be friendly to, and be supportive of each other during the teaching and learning of mathematics. To this end, the views of the teacher trainees on the sub-scale of cohesiveness as conceptualised in the study is presented in Table 7.

Table 8: Female Pre-service Teachers' Cohesiveness towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
It is easy to form discussion groups in my mathematics class	3.26	1.10		
Never			24	8.2
Seldom			29	9.9
Sometimes			135	46.1
Often			58	19.8
Always			47	16.0
I am not afraid to respond to mathematics questions asked by my teacher during mathematics lessons.	3.41	1.18		
Never			21	7.2
Seldom			32	10.9
Sometimes			118	40.3
Often			49	16.7
Always			73	24.9
I am friendly to members in my mathematics class	4.39	0.94		
Never			2	.7
Seldom			11	3.8
Sometimes			48	16.4
Often			43	14.7
Always			189	64.5
I enjoy being in the mathematics class	3.93	1.13		
Never			11	3.8
Seldom			13	4.4
Sometimes			94	32.1
Often			43	14.7
Always			132	45.1
I am able to study well with other colleague mathematics students in my class.	3.82	1.10		
Never			7	2.4
Seldom			24	8.2
Sometimes			92	31.4
Often			63	21.5
Always			107	36.5
I help other colleagues in this class who are having difficulty with their studies in mathematics.	3.14	1.11		
Never			25	8.5

Seldom			41	14.0
Sometimes			140	47.8
Often			42	14.3
Always			45	15.4
In my mathematics class, strict rules are needed to maintain discipline	2.95	1.35		
Never			57	19.5
Seldom			49	16.7
Sometimes			93	31.7
Often			40	13.7
Always			54	18.4
When I have difficulty in studying mathematics, I get help from other students in the mathematics class.	3.97	1.00		
Never			2	.7
Seldom			15	5.1
Sometimes			90	30.7

Source: Field survey, 2023

The results as presented in Table 7 indicate that students have a high level of cohesiveness (M = 3.61, SD = 0.60) towards the learning of mathematics. Out of the eight items that were used to measure this construct, more than four had favourable response (reflecting positive perceptions). For example, the majority (64.5%) of the students indicated “always” to the item; “I am friendly to members in my mathematics class” (M = 4.39, SD = 0.94). However, the students scored quite low on a few of the items. For example, more than a third (36.2%) of the students indicated “never” or “seldom” to the item, “In my mathematics class, strict rules are needed to maintain discipline” (M = 2.97, SD = 1.35). This means that although the students perceive a high level of cohesiveness, they do not think that strict rules are needed to maintain discipline in mathematics class.

The results from the analysis of the open-ended items in the question also supported the high level of cohesiveness perceived by students:

Student 1 *"I assist my colleague students in simplifying mathematics problems using calculator"*

Student 3 *"I assist her to solve mathematics questions she does not understand"*

Tutor support

Tutor support was conceptualised as the extent to which tutors help, relate to and show interest in their learner activities while teaching and learning mathematics. The views of the teacher trainees concerning the support they received from the Tutors in the colleges are presented in Table 8.

Table 9: Female Pre-service Teachers' Tutor Support towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
My mathematics teacher takes a personal interest in my studies in mathematics.	3.24	1.30		
Never			35	11.9
Seldom			44	15.0
Sometimes			101	34.5
Often			42	14.3
Always			71	24.2
My mathematics teacher listens to and accepts my comments on how he/she teaches.	3.77	1.26		
Never			16	5.5
Seldom			37	12.6
Sometimes			66	22.5
Often			54	18.4
Always			120	41.0

My mathematics teacher is willing to explain things again when asked to do so by any student during mathematics lessons.	4.48	0.94		
Never			5	1.7
Seldom			8	2.7
Sometimes			39	13.3
Often			32	10.9
Always			209	71.3
My mathematics teacher helps me when I have a difficulty in studying mathematics	4.05	1.13		
Never			8	2.7
Seldom			26	8.9
Sometimes			54	18.4
Often			59	20.1
Always			146	49.8
I take part (participate) in class discussions during mathematics lessons.	4.03	1.06		
Never			1	.3
Seldom			26	8.9
Sometimes			74	25.3
Often			53	18.1
Always			139	47.4
My mathematics teacher maintains a friendly studentteacher relationship with me even after his/her lesson has ended.	3.61	1.32		
Never			26	8.9
Seldom			31	10.6
Sometimes			83	28.3
Often			42	14.3
Always			111	37.9
My mathematics teacher talks happily about mathematics as a subject, which encourages me and other students to study mathematics.	4.41	0.952		
Never			4	1.4
Seldom			11	3.8
Sometimes			40	13.7
Often			45	15.4

Always			193	65.9
My mathematics teacher motivates me to bring out the best in me in mathematics.	4.25	1.10		
Never			9	3.1
Seldom			19	6.5
Sometimes			37	12.6
Often			54	18.4
Always			174	59.4
Overall	3.98	0.74		

Source: Field survey, 2023

In terms of their perception towards tutor support, the students scored a high-level perception (M=3.98, SD=0.74). Students demonstrated a high level of perception in all the items assessing the tutor. It is observed that three of the items recorded higher levels of perception. For instance, 71.3% of the students indicated "always" for the item "My mathematics teacher is willing to explain things again when asked to do so by any student during mathematics lessons" (M=4.48, SD=0.94). Additionally, 65.9% of the students indicated "always" for the item "My mathematics teacher talks happily about mathematics as a subject, which encourages me and other students to study mathematics" (M=4.41, SD=0.95). Finally, 59.4% of them indicated "always" for the item "My mathematics teacher motivates me to bring out the best in me in mathematics" (M=4.25, SD=1.10). This suggests that when mathematics teachers are willing to explain things again when asked by any student when they talk happily about mathematics as a subject, it encourages me and other students to study mathematics, and when they motivate students to bring out the best in themselves in mathematics, it greatly contributes to the overall perception of students towards teacher support. The following statements brace this high level of tutor support:

Student 5 *"The tutor helps when I don't understand a concept in the topic he or she is teaching."*

Student 7 *"My mathematics teacher helps me when I have a difficulty in studying mathematics"*

Involvement

Involvement was conceptualised as the extent to which learners have attentive interest, participate in discussions and explain their solutions. Given this, the views as expressed by the teacher trainees are presented in Table 9.

Table 10: Female Pre-service Teachers' Involvement towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
My mathematics class teacher asks me questions during the lessons	3.69	1.02		
Never			6	2.0
Seldom			23	7.8
Sometimes			108	36.9
Often			75	25.6
Always			81	27.6
I make suggestions during mathematics lessons.	3.15	1.05		
Never			21	7.2
Seldom			43	14.7
Sometimes			136	46.4
Often			57	19.5
Always			36	12.3
My mathematics teacher involves me in making decisions concerning mathematics.	2.84	1.26		
Never			56	19.1
Seldom			56	19.1
Sometimes			95	32.4
Often			52	17.7
Always			34	11.6

My ideas and suggestions are used during mathematics classroom discussions.	2.95	1.08		
Never			31	10.6
Seldom			57	19.5
Sometimes			131	44.7
Often			45	15.4
Always			29	9.9
I explain my ideas in mathematics to other students in the mathematics class.	3.27	1.09		
Never			21	7.2
Seldom			34	11.6
Sometimes			126	43.0
Often			66	22.5
Always			46	15.7
I ask my mathematics class teacher questions when I have difficulty following a lesson	3.79	1.13		
Never			9	3.1
Seldom			26	8.9
Sometimes			93	31.7
Often			56	19.1
Always			109	37.2
I get help from other students when I have difficulty in solving mathematics questions.	3.96	1.04		
Never			7	2.4
Seldom			12	4.1
Sometimes			85	29.0
Often			71	24.2
Always			118	40.3
I am asked to explain how I solve mathematics problems.	3.04	1.12		
Never			34	11.6
Seldom			41	14.0
Sometimes			133	45.4
Often			50	17.1
Always			35	11.9
Overall	3.34	0.717		

Source: Field survey, 2023

Concerning Involvement, the students scored high level of perception (M=3.34, SD=0.72) and the majority of the items are in line with the overall

perception towards Involvement. The results however indicated that the students scored low in the following items: a significant portion (38.2%) of the students indicated "never" and "seldom" to the item "My mathematics teacher involves me in making decisions concerning mathematics" (M=2.84, SD=1.26). Additionally, the majority (74.8%) of the students indicated "never", "seldom" and "sometimes" to the item "My ideas and suggestions are used during mathematics classroom discussions" (M=2.95, SD=1.08). This indicates that while students have a positive perception towards their Involvement in mathematics, they do not think that their mathematics teacher involves them in making decisions concerning mathematics and also their ideas and suggestions are not used during mathematics classroom discussions. The following statements supported the positive perception towards their Involvement in mathematics:

Student 2 *"During the lessons, I participate in class discussions hence it motivates me to learn mathematics"*

Student 4 *"Understanding the concept in learning mathematics boosts my morale to learn it more"*

Co-operation

Co-operation was conceptualised as how learners are prepared to help each other rather than compete selfishly. In view of this, the female teacher trainees" response on relation to the items that underpinned this sub-scale is presented in Table 11.

Table 11: Female Pre-service Teachers' Co-operation towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
I co-operate with other mathematics students when doing mathematics assignment.	3.85	1.00		
Never			4	1.4
Seldom			17	5.8
Sometimes			97	33.1
Often			77	26.3
Always			98	33.4
I share my books and other education materials with other colleague students when doing mathematics assignment.	3.45	1.17		
Never			20	6.8
Seldom			34	11.6
Sometimes			105	35.8
Often			63	21.5
Always			71	24.2
When studying mathematics in the form of group discussions with other students in my class, there is team work.	4.10	1.09		
Never			11	3.8
Seldom			15	5.1
Sometimes			50	17.1
Often			75	25.6
Always			142	48.5
In my mathematics class there is high competition among us which leads to selfishness.	3.48	1.39		
Never			37	12.6
Sometimes			67	22.9
Often			55	18.8
Always			98	33.4
I learn from other mathematics students in my class.	3.90	0.10		
Never			3	1.0
Seldom			17	5.8
Sometimes			93	31.7
Often			74	25.3
Always			106	36.2
I work happily with other students in my mathematics class.	3.85	1.04		

Never			5	1.7
Seldom			22	7.5
Sometimes			86	29.4
Often			78	26.6
Always			102	34.8
The other members of my mathematics teacher respond to any concern I have on their work.	3.26	1.16		
Never			24	8.2
Seldom			45	15.4
Sometimes			108	36.9
Often			64	21.8
Always			52	17.7
Other members of my mathematics class help me in my studies so that I can perform better in my mathematics.	3.65	1.10		
Never			11	3.8
Seldom			24	8.2
Sometimes			107	36.5
Often			66	22.5
Always			85	29.0
Overall	3.69	0.62		

The results also revealed that the students exhibit a good level of cooperation (M=3.69, SD=0.62). Although all items under this category were highly rated, the item "When studying mathematics in the form of group discussions with other students in my class, there is teamwork" (M=4.10, SD=1.10) received the highest rating, with 48.5% of the students indicating "always" for this item. This implies that students perceive teamwork, especially in the context of group discussions, as one of the crucial aspects of cooperation. The following statements supported the high level of co-operation among students:

Student 6 *"I co-operate with other mathematics students when we are doing mathematics assignment"*

Student 9 *"I co-operate with my colleagues through group discussion so that we all share ideas on the methods to use"*

Equity

Equity was also conceptualised as the extent to which learners view the treatment, they receive from the Tutors to be equitable. The views as expressed by the female pre-service teachers' are presented in Table 11.

Table 12: Female Pre-service Teachers' Equity towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
My mathematics teacher gives as much attention to my question as he/she gives to other students.	3.82	1.21		
Never			18	6.1
Seldom			24	8.2
Sometimes			67	22.9
Often			69	23.5
Always			115	39.2
get the same amount of help from my mathematics class teacher as the other students in this class	3.84	1.16		
Never			10	3.4
Seldom			32	10.9
Sometimes			69	23.5
Often			67	22.9
Always			115	39.2
have the same amount of say in the mathematics class as the other students.	3.88	1.15		
Never			12	4.1
Seldom			24	8.2
Sometimes			67	22.9
Often			74	25.3
Always			116	39.6
My mathematics class teacher treats me the same way as he/she treats other students in class.	4.33	1.01		
Never			8	2.7
Seldom			10	3.4
Sometimes			39	13.3
Often			56	19.1
Always			180	61.4
receive the same encouragement as the other mathematics students in this class.	4.27	0.96		
Never			2	.7
Seldom			15	5.1
Sometimes			48	16.4
Often			64	21.8
Always			164	56.0

Seldom			25	8.5
Sometimes			93	31.7
Often			56	19.1
Always			98	33.4
I get the same opportunity to answer questions during mathematics lessons as the other students in the class.	4.10	1.05		
Never			5	1.7
Seldom			18	6.1
Sometimes			62	21.2
Often			65	22.2
Always			143	48.8
My mathematics teacher trusts me to get a work in mathematics done just as he/she trusts the other mathematics students in this class.	3.79	1.20		
Never			15	5.1
Seldom			28	9.6
Sometimes			73	24.9
Often			65	22.2
Always			112	38.2
Overall	3.96	0.81		

Source: Field survey, 2023

The majority of items measuring equity received high ratings from the students, reflecting in their overall perception score towards equity (M=3.96, SD = 0.81). Specifically, the following items were highly rated by the students: "My mathematics class teacher treats me the same way as he/she treats other students in class" (M = 4.33, SD = 1.01), with 61.4% of the students indicating "always" for this item; "I receive the same encouragement as the other mathematics students in this class" (M = 4.27, SD = 0.96), with 56% of the students indicating "always" for this item; and "I get the same opportunity to answer questions during mathematics lessons as the other students in the class" (M = 4.10, SD = 1.05), with 48.8% of the students indicating "always" for this

item. These results suggest that, for equity to be established, students perceive that equal treatment, encouragement, and opportunities, among other factors, should be provided to all students during mathematics class. The following statements buttressed the good perception towards learning mathematics:

Student 8 *"Our mathematics teacher always gives us attention during teaching and learning.*

"Student 3 *"During class sessions, my mathematics teacher always prompts us to focus in class and often calls me to answer question"*

On the whole however, the female teacher trainees have a good perception towards learning mathematics (M=3.72, SD=0.57) with Cohesiveness (M=3.61, SD=0.595), Teacher Support (M=3.98, SD=0.74), Co-operation (M=3.69, SD=0.62), Involvement (M= 3.34, SD = 0.712) and Equity (M=3.96, SD=0.81) being the highest. It could therefore be deduced, that the female teacher trainees' perception towards the learning of mathematics is positive.

Female Pre-service Teachers" Attitudes Towards the Learning of Mathematics?

This research question explored female teacher trainees" attitude towards the learning of mathematics. Effect of mathematics, behaviour of students towards mathematics and cognition of students towards mathematics were used as indicators of the attitude of students towards learning of mathematics. Accordingly, each of the indicators that underpinned the teacher trainees" attitude towards the learning of mathematics is discussed:

Effect of Mathematics

The effect of mathematics was conceptualised as the extent to which students" beliefs about their own ability to learn and perform well in mathematics. These beliefs as expressed by the teacher trainees are presented in table 13.

Table 13: Effect of Mathematics on Students" Perception towards the Learning of Mathematics

Items	M	SD	Frequency	Percent
I am capable of learning mathematics on my own (by myself) without help from my classmates	3.23	1.17		
Disagree			97	33.1
Undecided			43	14.7
Agree			153	52.2
I have the capacity to understand lessons taught in mathematics	3.86	0.88		
Disagree			27	9.2
Undecided			39	13.3
Agree			227	77.5
I can perform well in mathematics without help from my classmates	3.24	1.15		
Disagree			95	32.4
Undecided			51	17.4
Agree			147	50.2
I have confidence in my ability to learn mathematics	3.96	0.93		
Disagree			25	8.5
Undecided			29	9.9
Agree			239	81.6
I can overcome challenges in the learning of mathematics	3.90	0.96		
Disagree			32	10.9
Undecided			34	11.6
Agree			227	77.5
There should be more mathematics lessons each week.	4.13	1.07		
Disagree			28	9.6
Undecided			24	8.2
Agree			241	82.2

I would rather agree with the other mathematics students in this class as to the solution to a problem than investigate it myself.	3.04	1.29		
Disagree			122	41.6
Undecided			43	14.7
Agree			128	43.7
Mathematics is one of the most interesting school subjects.	3.70	1.19		
Disagree			51	17.4
Undecided			47	16.0
Agree			195	66.6
It is better to ask my mathematics class teacher the answer to a mathematics problem than to find out by trying a mathematics problem.	2.94	1.28		
Disagree			131	44.7
Undecided			45	15.4
Agree			127	39.9
I really enjoy mathematics lesson periods.	3.78	1.07		
Disagree			40	13.7
Undecided			51	17.4
Agree			202	68.9
The topics covered in mathematics lesson are not interesting.	3.57	1.16		
Disagree			60	20.5
Undecided			57	19.5
Agree			176	60.0
I really expect more mathematics lessons.	3.69	1.12		
Disagree			45	15.4
Undecided			47	16.0
Agree			201	68.6
Overall	3.58	0.61		

Source: Field survey, 2023

The overall results for this analysis indicate that students' attitudes towards the impact of mathematics on them were positive (M=3.58, SD=0.61). Most students desired more mathematics lessons each week, with 82.2% agreeing with the statement “There should be more mathematics lessons each week” (M=4.13, SD=1.07). However, a low score was recorded for the item “It

is better to ask my mathematics class teacher the answer to a mathematics problem than to find out by trying a mathematics problem" (M=2.94, SD=1.28), with a significant 44.7% of students disagreeing. This suggests a tendency towards self-reliance among students, indicating a preference for attempting to solve mathematics problems independently rather than seeking immediate answers from their teachers. Overall, the impact of mathematics on students was positive, with the desire for more lessons each week being a strong indicator of this effect. The following statements support these results:

Student 1 *"mathematics helps to think and reason logically so it makes me confident in the learning of it."*

Student 9 *"I get confident in learning mathematics by practicing what we learn in class everyday"*

Overall, the results point to a positive impact of mathematics on students, with their eagerness for additional lessons and preference for independent problem-solving demonstrating an engaged and motivated attitude.

Behaviour of students towards mathematics

The behaviour of students towards mathematics was conceptualised as the extent to which students exhibit interest and the desire to learn mathematics. Their responses are presented in Table 14.

Table 14: Female Pre-service Teachers' Behavior towards Learning Mathematics

Items	M	SD	Frequency	Percent
I really expect more mathematics lessons.	3.69	1.12		
Disagree			45	15.4
Undecided			47	16.0
Agree			201	68.6
I would enjoy school more if there were no mathematics lessons.	3.28	1.43		
Disagree			99	33.8
Undecided			38	13.0
Agree			156	53.2
I am interested in the learning of mathematics	3.70	1.11		
Disagree			46	15.7
Undecided			49	16.7
Agree			198	67.6
I feel motivated to study mathematics	3.87	0.96		
Disagree			28	9.6
Undecided			48	16.4
Agree			217	74.0
The learning of mathematics is difficult	3.18	1.34		
Disagree			109	37.2
Undecided			42	14.3
Agree			142	48.5
Overall	3.55	0.82		

Source: Field survey, 2023

The results also indicate that students' behaviour towards mathematics was generally positive (M=3.55, SD=0.822). This positive behaviour is reflected in most of the items that measured it. However, one item, "I feel motivated to study mathematics" (M=3.87, SD=0.96), stood out among the items, with an overwhelming 74% of the students agreeing to it. This suggests that feeling motivated to study mathematics is highly valued by the students and, consequently, could contribute significantly to improving their behaviour

towards learning mathematics. The following statements support this positive behaviour among students:

Student 4 *"I am always interested in learning mathematics because mathematics can be applied in our daily activities and it has an impact in our future activities."*

Student 7 *"The encouragement I get from the teacher and colleagues makes it more interesting"*

In summary, student attitudes and behaviors toward mathematics were positive, with strong motivation and interest in more lessons. Students value independent problem-solving and real-life applications, supported by teacher and peer encouragement. Motivation, relevance, and social support significantly enhance engagement, fostering confidence and proactive learning in mathematics.

Cognition of students towards mathematics

Students" Cognition towards mathematics was also conceptualised as the extent to which students" perception about the importance of mathematics in the present everyday life and in the future. Their responses are presented in Table 15.

Table 15: Female Pre-service Teachers' Cognition towards Learning Mathematics

Items	M	SD	Frequency	Percent
I prefer to have more mathematics lessons in the school	3.54	1.22		
Disagree			66	22.5
Undecided			45	15.4
Agree			115	62.1
The learning of mathematics enables you to think logically	4.29	0.85		
Disagree			13	4.4
Undecided			21	7.2
Agree			259	88.4
Mathematics serves as the foundation for technological advancement	3.95	1.06		
Disagree			35	11.9
Undecided			34	11.6
Agree			224	76.5
The teaching and learning of mathematics enable you to pursue to higher education	4.04	1.07		
Disagree			36	12.3
Undecided			29	9.9
Agree			228	77.8
Mathematics is very useful in our everyday activities at home	4.39	0.94		
Disagree			17	5.8
Undecided			13	4.4
Agree			263	89.8
Overall	4.04	0.74		

Source: Field survey, 2023

The results also indicate that students' cognition towards mathematics was high (M=4.04, SD=0.74). Among the items assessing students' cognition towards mathematics, two stood out with a very high level of agreement: "The learning of mathematics enables you to think logically" (M=4.29, SD=0.85) and "Mathematics is very useful in our everyday activities at home" (M=4.39, SD=0.94), with an overwhelming 88.4% and 89.8% of students agreeing, respectively. This indicates that students believe, cognitively, that learning

mathematics enables logical thinking and is highly useful in their everyday activities at home. The following statements support this positive behaviour among students:

Student 2 *"Mathematics helps us to think logically and critically which helps us to solve problems"*

Student 6 *"In future, mathematics will help me in managing my daily expenses, how to budget my things and manage my business"*

The overall score indicates that female teacher trainees have a good attitude towards learning mathematics (M=3.68, SD=0.59) and the cognition of students towards mathematics (M=4.04, SD=0.74) extremely contributes to the overall attitude towards learning mathematics among female teacher trainees. This could also mean that the cognition of the students could improve their attitude towards learning mathematics.

Female Pre-service Teachers' Perception and Attitude Towards the Learning of Mathematics

Research question three sought to examine the relationship between the female teacher trainees' perception and attitude towards the learning of mathematics. The finding in relation to this are presented in table 16.

Table 16: Correlation Analysis for Relationship between Perception and Attitude towards the Learning of Mathematics of Female Teacher Trainees'

	Perception	Attitude
Perception	1	.601**
Attitude	.601**	1

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

A Pearson correlation coefficient was calculated to assess the association between perception and attitude. The analysis demonstrated a significant positive correlation between perception and attitude, with a coefficient of r (291) = .601, $p < .01$. These findings lead to the rejection of the null hypothesis in favour of the alternative hypothesis. This outcome indicates that a favourable perception of learning mathematics among female teacher trainees may contribute to an enhanced attitude towards the subject, and conversely, a positive attitude could also influence their perception of mathematics learning.

Null Hypothesis: There is no Significant Difference in Perceptions and Attitudes of Students from Mixed CoE and Single Sex CoE Towards Mathematics

Research Question four sough to find out the effect of CoEs attended by teacher trainees' perceptions and attitudes towards mathematics. A t-test was employed in analysis of the data. All assumptions underlying normality and homogeneity have been met (Tabachnick & Fidell, 2013).The findings are presented in table 17.

Table 17: Effect of College of Education (CoEs) Attended on Teacher Trainees' Perceptions and Attitudes towards Mathematics

	College of Education (CoEs)						
	Mixed CoE		Single sex CoE				
	M	SD	M	SD	T	df	p
Perception	3.88	.43	3.57	.53	3.82	291	.000
Attitude	4.07	.49	3.75	.50	4.06	291	.000

The results show that female teacher trainees from mixed CoEs have higher mean perception scores (M = 3.88, SD =.43) compared to those from single-sex CoEs (M = 3.57, SD = .53), t (291) = 3.82, p< .001. The results also shows that teacher trainees from mixed CoEs exhibit more positive attitudes towards mathematics, as indicated by higher mean attitude scores (M=4.07, SD=.49) compared to those from single-sex CoEs (M=3.75, SD=.50), t (291) = 4.06, p< .001. Female teacher trainees attending mixed CoEs tend to have more positive perceptions and attitudes towards mathematics compared to those attending single-sex CoEs. This suggests that factors related to the type of CoE, such as gender composition, may influence teacher trainees' perceptions and attitudes towards mathematics.

Discussion of Findings

Cohesiveness

The study findings indicate a high level of student cohesiveness, with participants reporting a strong sense of connection and camaraderie within the mathematics class. This positive result highlights a classroom environment that fosters collaboration and mutual support. Additionally, the findings reveal that female preservice students hold positive attitudes toward mathematics. These outcomes align with Davis and Wilmot's (2010) research, which examined primary and junior high school teachers' attitudes toward mathematics in the

Cape Coast Metropolis and Elmina district in Ghana. Their study found that both primary and JHS teachers had favorable attitudes toward mathematics.

Similarly, the findings are consistent with Asante's (2012) study, which indicated a positive attitude toward mathematics among participants. Furthermore, the current study suggests that students perceive themselves as responsible and self-disciplined, capable of maintaining a conducive learning atmosphere without requiring strict external controls.

However, the positive perceptions toward mathematics observed in this study contrast with the findings of Uwineza *et al*. (2018). Their research, which explored gender-based attitudes and perceptions toward mathematics education, revealed that boys often held negative perceptions about girls' ability to excel in mathematics. Additionally, a minority of female students also exhibited negative perceptions, which could explain lower confidence levels in mathematics among some female learners.

Tutor support

The study results indicate that the support students receive from their tutors during the teaching and learning of mathematics plays a significant role in shaping their experiences. Tutors' responsiveness to students' questions and concerns reflects an approachable and attentive attitude toward individual learning needs. This finding aligns with the work of Asomah *et al*. (2018), who argued that such behavior fosters a supportive learning environment and builds students' confidence in seeking help when they face difficulties.

Moreover, students' positive perceptions of tutor support are closely tied to the teacher's enthusiasm for discussing mathematics. When teachers actively encourage students to study mathematics and demonstrate genuine interest in

their academic progress, it can enhance students' motivation and engagement with the subject. This heightened motivation, in turn, positively influences students' learning outcomes and attitudes toward mathematics.

The findings of this study also resonate with those of Daud *et al*. (2020) and Hagan *et al*. (2020). Daud *et al*. (2020) reported that respondents generally held a positive perception of mathematics, influenced by the supportive role of teachers. Similarly, Hagan *et al*. (2020) found that while students acknowledged the challenges associated with mathematics, they maintained a positive outlook on the subject, largely due to its practical relevance and the encouragement they received from their teachers.

Involvement

The findings of this study also indicate that students do not believe their mathematics teacher involves them in decision-making regarding the subject, raising important considerations. Student involvement in decision-making can foster a sense of ownership and agency in the learning process. When students are included in decisions about their education, they are more likely to become motivated and invested in their studies. Similarly, the perception that their ideas and suggestions are not utilized during mathematics classroom discussions suggests a missed opportunity to enhance student engagement. When students feel that their contributions are valued and integrated into the learning process, it can boost their confidence and encourage more active participation in class.

This lack of involvement aligns with the study of Ngussa and Mbuti (2017), conducted in Arusha, Tanzania, which explored secondary school students' attitudes toward mathematics. They found a moderate relationship between students' attitudes and performance when teachers used humor as a teaching

strategy, concluding that enhancing students' positive attitudes can improve their performance in mathematics. This finding underscores that active engagement in class discussions has a positive impact on students' motivation to learn mathematics.

Furthermore, student involvement can lead to a deeper understanding of mathematical concepts and a stronger connection to the learning process. This finding is consistent with the results of Davis and Wilmot (2010), who argued that when students feel they understand the concepts in mathematics, it boosts their confidence and morale, motivating them to continue learning and exploring the subject. This positive reinforcement of understanding can create a feedback loop, where increased confidence leads to greater involvement and motivation to excel in mathematics.

Co-operation

The study revealed that students perceive teamwork during group discussions as a crucial aspect of cooperation, aligning with the idea that collaborative learning can create a positive and supportive learning environment. The students' perceptions of cooperation in their mathematics class highlight the importance of teamwork and collaborative learning experiences. Promoting a classroom culture of cooperation can also have broader implications for students' future success.

This finding supports the work of Mato and De La Torre (2010) and Zimmerman *et al*. (2004), who argued that students with better academic performance tended to cooperate more with their peers in classroom activities and held more optimistic attitudes toward mathematics compared to those with pessimistic views of the subject. In a broader study involving high school

students across nine countries, Zimmerman *et al*. (2004) confirmed that fostering cooperation and collaboration positively impacted students' attitudes and performance. By encouraging a cooperative and collaborative learning environment, educators can enhance student engagement, improve learning outcomes, and increase overall satisfaction with mathematics education.

Equity

The findings of this study suggest that students perceive equal treatment from their mathematics teacher as a crucial aspect of equity. When students feel they are treated fairly and receive the same attention during teaching and learning, it fosters a sense of belonging and inclusion in the classroom. Equal treatment can enhance the learning experience and create a more conducive environment for all students.

This aligns with the work of Hall (2012) and Tang *et al*. (2010), who emphasize the importance of equity in the classroom. They argue that the perception of fairness and equal opportunities is vital for cultivating an inclusive learning environment. According to their studies, emphasizing equal treatment, encouragement, and opportunities ensures that every student feels respected, supported, and empowered to succeed. By adopting and reinforcing these equitable practices, teachers can contribute to a positive and enriching learning experience for all students.

Perceptions Towards the Learning of Mathematics

Based on the comprehensive findings, it is evident that female teacher trainees hold a positive perspective on learning mathematics. The high scores observed in subscales such as Cohesiveness, Teacher Support, Cooperation, Involvement, and Equity strongly indicate that these trainees have a favorable

and optimistic view of their mathematical learning experience. This positive outlook is consistent with the findings of studies by Asomah *et al*. (2018), Daud, Adnan, Abd Aziz, and Embong (2020), which similarly highlighted a positive perception of mathematics among students. Additionally, the research by Hagan, Amoaddai, Lawer, and Atteh (2020) also echoed this trend, noting that while students recognised the challenging nature of mathematics, they maintained an overall positive perception of the subject's learning experience.

Female Teacher Trainees' Attitudes towards the Learning of Mathematics

Effect of Mathematics

The findings of this study provide valuable insights into students' attitudes towards mathematics and its impact on their perception of the subject. The students expressed a positive attitude toward mathematics, as evidenced by their desire for more mathematics lessons each week. This eagerness for additional learning opportunities suggests that they recognize the value of studying mathematics and believe that more practice and exposure would be beneficial. This aligns with the findings of Opoku (2013), Mohamed & Waheed (2011), Hall (2012), Tang *et al*. (2010), and Salifu & Bakari (2022), who all reported a positive attitude toward mathematics in their respective studies.

Interestingly, the students scored lower on the item indicating they preferred asking their mathematics teacher for the answer to a problem rather than attempting to solve it on their own. This finding mirrors the results of Amelink (2009), Hall (2012), and Kiptum *et al*. (2013), who also observed that students tend to prefer attempting to solve mathematics problems independently before seeking assistance from their teacher.

The supporting statements provided by the students further emphasize the positive effect of mathematics on their learning. They recognize that mathematics helps them develop logical thinking and reasoning skills, which, in turn, boosts their confidence in the subject. These logical thinking abilities are not only valuable in mathematics but also have broad applications in various aspects of life.

Behaviour of Students Towards Mathematics

The findings related to students' behavior towards mathematics highlight the significant role of motivation in shaping their academic performance and overall behavior. When students are motivated, they are more likely to engage actively in their studies, overcome challenges, and demonstrate positive behavior towards learning mathematics. This aligns with the findings of Goldin, Ronsken & Torner, Masanja (2006), Owiti (2011), Tang, Chen & Zhang (2010), and the OECD (2014), which all emphasized the importance of motivation in fostering positive behavior towards mathematics.

In particular, these studies indicated that students' positive behavior towards mathematics is often influenced by the encouragement and support they receive from their teachers and peers. Positive reinforcement from the learning community helps create a nurturing environment that boosts students' confidence and enthusiasm for learning the subject. The findings of the current study also underscore the crucial role of motivation in driving students' attitudes and engagement with mathematics. When students are motivated, they are more likely to exhibit positive behaviors such as active participation, focus, and dedication to their studies.

Cognition of Students Towards Mathematics

The findings related to students' cognition towards mathematics reveal a positive and forward-thinking perspective. The students' appreciation for the cognitive benefits of mathematics, along with its practical applications, indicates their recognition of the subject's importance and relevance in their lives. This aligns with the work of Flavell (in Schraw & Dennison, 1994) and Surat, Rahman, Mahamod, & Kummin (2014), who categorized metacognitive knowledge into three components: (1) declarative knowledge (knowledge about oneself or others), (2) procedural knowledge (knowing how to do things), and (3) conditional knowledge (knowing when and why to use particular strategies).

In this study, the students' perception that learning mathematics enables them to think logically and critically reflects the cognitive benefits of studying the subject. This aligns with the assertions of Amelink (2009), Masanja (2006), Owiti (2011), and LaFleur (2011), who highlighted that understanding how mathematics applies to practical areas such as budgeting, managing expenses, and running a business emphasizes its importance in everyday life beyond the academic context.

The supporting statements provided by the students further emphasize their positive attitude towards the cognitive aspects of mathematics. They recognize that mathematics enhances their problem-solving abilities, which will have practical implications in their future endeavors, thereby reinforcing the value of the subject in both academic and real-world settings.

Attitudes Towards the Learning of Mathematics

The findings indicate that female teacher trainees have a positive attitude towards learning mathematics, and students' cognition towards mathematics

plays a crucial role in shaping this attitude. The indication of cognition in students' attitudes suggests that as students' cognitive skills and understanding of mathematics improve, their overall attitude towards the subject becomes more positive. The positive attitude of female teacher trainees towards learning mathematics and its association with cognition highlights the interplay between cognitive development and attitude formation. By recognizing the impact of cognitive skills on attitude, educators can implement effective teaching strategies to foster a positive learning environment and enhance students' cognitive abilities.

A range of research endeavours substantiates the positive attitude held by students in this study. To exemplify, in their research, Mata, Monteiro, and Peixoto (2012) conveyed that student maintained a positive disposition towards mathematics. Echoing this, Opoku (2013) highlighted those students exhibited a favourable attitude towards learning mathematics. Similarly, Mohamed and Waheed's (2011) study disclosed a predominantly positive attitude towards mathematics, albeit at a moderate level.

However, it is noteworthy that the outcomes of the present study are in contrast to those of Hwang and Son (2021). Their research identified distinct profiles of students' attitudes towards mathematics, encompassing very negative, negative, neutral, and positive categories. Strikingly, a substantial portion of students were categorised under the negative profile, indicating a lack of fondness for mathematics and perceiving it as challenging.

This divergence in findings might be attributed to the discrepancy in sample sizes. Hwang and Son's (2021) study encompassed a larger sample of 4,853 participants, whereas the current study involved 293 individuals. The

sample size variation could account for the differing results, highlighting the importance of considering sample composition in interpreting research outcomes.

Relationship Between Female Pre-service Teachers' Perception and Attitude Towards the Learning of Mathematics

The study explored the relationship between perception and attitude concerning learning mathematics. The findings unveiled a significant positive correlation between one's perception of learning mathematics and their attitude toward the subject. Specifically, it was observed that a favourable perception of learning mathematics among female teacher trainees directly impacted their attitude towards the subject. Conversely, a positive attitude towards learning mathematics also fostered a more favourable perception of the subject.

This discovery aligns with Asomah, Crankson, Asiedu and Dapaah's (2022) findings, who similarly identified a significant positive relationship between students' perceptions and attitudes towards mathematics. Likewise, in a similar vein, the research conducted by Salifu and Bakari (2022) unveiled a constructive correlation between students' perception and their interests, commonly referred to as their attitudes. The findings of their study indicated that when students hold positive or favourable perceptions regarding mathematics, their interest in the subject tends to be heightened. This suggests that a positive perception contributes to an increased level of engagement and enthusiasm towards mathematics among students. These results underscore that how female teacher trainees perceive the process of learning mathematics significantly shapes their overall attitude towards the subject.

The implications of these findings are valuable in the context of educational practices and curriculum development. By recognizing the importance of perception and attitude in shaping the learning outcomes, teaching strategies can be designed to aim at cultivating a positive perception of mathematics among female teacher trainees, ultimately contributing to improving their attitudes and academic performance.

Effect of College of Education (CoEs) Attended on Pre-service Teachers' Perceptions and Attitudes Towards Mathematics

The findings of the study indicate a noteworthy trend which shows that female pre-service teachers from mixed CoEs (Colleges of Education) demonstrate significantly higher mean perception scores in comparison to their counterparts from single-sex CoEs. Additionally, these results underscore a prevailing pattern where teacher trainees originating from mixed CoEs exhibit notably more favourable attitudes towards mathematics, as evidenced by their elevated mean attitude scores in contrast to those from single-sex CoEs. Taken together, these outcomes suggest a compelling narrative suggesting that female teacher trainees enrolled in mixed CoEs tend to cultivate markedly more positive perceptions and attitudes towards mathematics than their peers enrolled in single-sex CoEs. The findings presented suggest that there is a significant relationship between the type of institution attended by female teacher trainees and their attitudes towards mathematics. Specifically, female teacher trainees from mixed-gender Colleges of Education (CoEs) demonstrated notably higher perception and attitude scores towards mathematics compared to those from single-sex CoEs. Prior research has long explored the gender dynamics surrounding attitudes towards mathematics. Frome and Eccles (1998), as cited

in Morrissey *et al*. (2019), established a significant gender disparity in attitudes towards mathematics and the pursuit of related careers. However, Mohammed and Abdul-Razak (2018) found opposing results, suggesting that the gender differences in attitudes towards mathematics might not be as pronounced as previously believed. This recent study further delves into the impact of school type on these attitudes. It reveals those female students from mixed-gender schools tend to report more positive attitudes towards mathematics compared to those in single-sex schools. This contrasts with the commonly held belief that females in single-sex schools would have more favorable attitudes towards the subject. Additionally, the study highlights that perceptions of mathematics as a male domain are less prevalent among female students in mixed-gender schools. Moreover, the findings align with existing literature suggesting a strong correlation between attitudes towards mathematics and academic performance. Mensah and Kurancie (2013), Nicolaidou and Philippou (2003), and Joseph (2013) have all found significant associations between students' attitudes and their performance in mathematics. This suggests that fostering positive attitudes towards mathematics among female teacher trainees could potentially lead to improved performance in the subject.

Chapter Summary

This chapter focused on analysing the collected data and presenting the results and discussions of the findings. Several significant findings emerged from the study, shedding light on various aspects of students' perceptions and attitudes towards learning mathematics. Firstly, the participants demonstrated positive perceptions and attitudes among the trainees across various aspects of mathematics education. The trainees demonstrated positive perceptions,

including high pupil cohesiveness, teacher support, co-operation, involvement, and equity. They valued collaboration, teacher assistance, and equal treatment, contributing to a positive learning environment. The trainees exhibited positive attitudes towards learning mathematics, driven by their motivation, recognition of cognitive benefits, and real-life applications. They acknowledged that mathematics enhances logical thinking and problem-solving skills, making it valuable for daily activities and future endeavours.

The study found a positive correlation between perception and attitude towards learning mathematics. A good perception enhanced the attitude, and a positive attitude reinforced a favourable perception, suggesting a mutual influence between these aspects. The findings highlighted the importance of fostering a positive perception of mathematics to promote a positive attitude among teacher trainees. Overall, the study provided valuable insights into the cognitive, emotional, and behavioural dimensions of female teacher trainees' experience with mathematics.

These findings were discussed concerning the existing literature, highlighting both consistencies and inconsistencies with previous studies. The next chapter focused on presenting the conclusions drawn from the study and offering recommendations based on the findings to enhance the perceptions and attitudes of students toward learning mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study aimed to determine female pre-service teachers' attitudes and perception towards mathematics learning. This study specifically investigated:

1. The female pre-service teachers' attitudes towards the learning of mathematics.
2. The female pre service teachers' perception towards the learning of mathematics.
3. The relationship between the female pre-service teachers' perception and attitude towards the learning of mathematics.
4. What is the relationship between the CoEs attended on pre-service teachers' perceptions and attitudes towards mathematics.

A descriptive research design was used in this study. A purposive sampling technique was used to select 293 female students to participate in the study. The questionnaire was used to collect data from the research participants. The data was analysed using inferential statistics such as Pearson Moment Product Correlation Coefficient test and descriptive statistics involving means and standard deviations. Data sources from the open-ended items in the questionnaire were analysed using thematic analysis and presented as narrative descriptions with some illustrative examples. Summary of the key findings are presented below.

Summary of Major Findings

The findings of this study indicate that female pre-service teachers' hold a highly positive perception of mathematics, recognizing its relevance, enjoyment, and value in both their personal and professional lives. They

understand the cognitive benefits of mathematics, including enhanced logical thinking, problem-solving skills, and critical reasoning. The trainees also acknowledge the practical applications of mathematics in everyday activities, such as budgeting and managing expenses. This recognition of the subject's importance highlights its value beyond the academic realm.

The pre-service teachers demonstrated a strong willingness to engage with mathematics, exhibiting enthusiasm, confidence, and motivation to study the subject. A significant positive relationship was observed between their perceptions and attitudes towards learning mathematics, reinforcing the idea that a positive attitude toward the subject can influence their learning experience. This finding suggests that when trainees feel motivated and see the relevance of mathematics, they are more likely to participate actively and perform better in their studies.

Moreover, the study revealed that teacher support and encouragement played a crucial role in shaping the pre-service teachers' perception of mathematics. Engaging teaching methods and a sense of equity and inclusivity in the classroom were also key factors contributing to their positive attitudes. The trainees reported a high level of cohesiveness and cooperation in their mathematics class, indicating that a supportive learning environment fosters collaboration and mutual respect among students.

Additionally, the study found that female teacher trainees from mixed Colleges of Education (CoEs) showed higher perception and attitude scores toward mathematics compared to those from single-sex CoEs. This suggests that the mixed-gender environment in CoEs may offer a more diverse and inclusive atmosphere, potentially fostering better perceptions and attitudes towards

mathematics among female trainees. This finding highlights the importance of the learning environment in shaping students' views on mathematics and their overall academic success.

Conclusions

The study concludes that female teacher trainees exhibit positive perceptions and attitudes towards learning mathematics. The findings suggest that their recognition of the cognitive benefits of mathematics, such as enhanced logical thinking and problem-solving abilities, along with its real-life applications, plays a significant role in their enthusiasm and engagement with the subject. Furthermore, the impact of teacher support and engagement in the classroom was found to contribute greatly to their positive outlook on mathematics.

The positive correlation between perception and attitude underscores the importance of cultivating a positive perception of mathematics to improve students' overall attitude and engagement with the subject. This highlights the potential benefits of a supportive and motivating learning environment, where teacher support and relevant teaching methods can significantly influence students' perceptions.

Additionally, the study found that female pre-service teachers from mixed Colleges of Education (CoEs) scored higher in both perception and attitude towards mathematics compared to their counterparts from single-sex CoEs. This suggests that a mixed-gender educational environment may foster more positive perceptions and attitudes towards mathematics, possibly due to the diversity and inclusivity of the setting. Therefore, creating environments that

promote positive interactions and engagement with mathematics may contribute to better outcomes for female trainees.

Recommendations

1. Mathematics tutors in CoEs should prioritise pedagogical strategies that reinforces female teacher trainees' enthusiasm, confidence, and motivation to study mathematics
2. Mathematics tutors should reinforce an approach to teaching mathematics contingent on the theories of cooperative, collaborative and participatory learning. Ultimately, these positive approaches foster a supportive learning environment that empowers students to excel in mathematics and beyond.
3. GTEC should consider reorienting planners of mathematics curriculum to place emphasis on a sense of equity, inclusivity, equal treatment, cohesiveness and co-operation to create a positive and supportive mathematics learning environment.

Suggestions for Further Research

1. A replication of this study in different parts of the country in order to facilitate nationwide generalisation is suggested.
2. Further studies should consider the factors contributing to the positive attitudes and perception towards the learning of mathematics.

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APPENDICES

APPENDIX A: QUESTIONAIRE

STUDENT'S PERCEPTION TOWARDS MATHEMATICS

Dear Student,

This questionnaire contains statements about practices which could take place in your mathematics class. There are no 'right' or 'wrong' answers. Your responses will be treated as confidential and will only be used for the purposes of this research. Please give your opinion about all statements by ticking [√] in the box against your response.

Thank you for your maximum co-operation.

Section A: Biographic Data

1. Sex: Male [ ] Female [ ]

2. Age: _____ **3.** Level: …….

4**.** College: Public [ ] Private [ ] **Section**

B:

On a scale of 1 - 5 (1 = Never, 2 = Seldom (not often), 3 = Sometimes, 4 = Often, 5 = Always), how would you rate your agreement to the following statements about how you learn mathematics? (Please rate EVERY option according to the scale).

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	It is easy to form discussion groups in my mathematics class					
	I am not afraid to respond to mathematics questions asked by my teacher during mathematics lessons.					
	I am friendly to members in my mathematics class					
	I enjoy being in the mathematics class					
	I am able to study well with other colleague mathematics students in my class.					
	I help other colleagues in this class who are having difficulty with their studies in mathematics.					
	In my mathematics class, strict rules are needed to maintain discipline.					
	When I have difficulty in studying mathematics, I get help from other students in the mathematics class.					

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	My mathematics teacher takes a personal interest in my studies in mathematics.					
	My mathematics teacher listens to and accepts my comments on how he/she teaches.					
	My mathematics teacher is willing to explain things again when asked to do so by any student during mathematics lessons.					
	My mathematics teacher helps me when I have a difficulty in studying mathematics					
	I take part (participate) in class discussions during mathematics lessons.					
	My mathematics teacher maintains a friendly student-teacher relationship with me even after his/her lesson has ended.					

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	My mathematics teacher talks happily about mathematics as a subject, which encourages me and other students to study mathematics.					
	My mathematics teacher motivates me to bring out the best in me in mathematics.					
	My mathematics class teacher asks me questions during the lessons					
	I make suggestions during mathematics lessons.					
	My mathematics teacher involves me in making decisions concerning mathematics.					
	My ideas and suggestions are used during mathematics classroom discussions.					
	I explain my ideas in mathematics to other students in the mathematics class.					

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	I ask my mathematics class teacher questions when I have difficulty following a lesson					
	I get help from other students when I have difficulty in solving mathematics questions.					
	I am asked to explain how I solve mathematics problems.					
	I co-operate with other mathematics students when doing mathematics assignment.					
	I share my books and other education materials with other colleague students when doing mathematics assignment.					
	When studying mathematics in the form of group discussions with other students in my class, there is team work.					

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	In my mathematics class there is high competition among us which leads to selfishness.					
	I learn from other mathematics students in my class.					
	I work happily with other students in my mathematics class.					
	The other members of my mathematics teacher respond to any concern I have on their work.					
	Other members of my mathematics class help me in my studies so that I can perform better in my mathematics.					
	My mathematics teacher gives as much attention to my question as he/she gives to other students.					
	I get the same amount of help from my mathematics class teacher as the other students in this class					

Item	Statements about the mathematics you learn in school	Never	Seldom	Sometimes	Often	Always
	I have the same amount of say in the mathematics class as the other students.					
	My mathematics class teacher treats me the same way as he/she treats other students in class.					
	I receive the same encouragement as the other mathematics students in this class.					
	My work receives as much praise as the other mathematics students in this class.					
	I get the same opportunity to answer questions during mathematics lessons as the other students in the class.					
	My mathematics teacher trusts me to get a work in mathematics done just as he/she trusts the other mathematics students in this class.					

Section C

Kindly provide comprehensive responses [write-up] by way of answers to the following questions.

Q1. Explain how you support your colleague students during the teaching and learning of mathematics?

……

……

……

Q2. Explain how your mathematics Tutor helps and shows interest in your learning?.....

.....

Q3. Explain what motivates you to learn mathematics?.....

.....

.....

Q4. Explain how you help your colleagues to learn mathematics?.....

.....

.....

Q5. Explain the nature of treatment you receive from the mathematics teacher during the teaching of mathematics?

.....

.....

STUDENT'S ATTITUDE MATHEMATICS QUESTIONNAIRE

Section D: Mathematics Attitude Questionnaire

On a scale of 1 - 5 (1 = Strongly Disagree, 2 = Disagree, 3 =Undecided, 4 = Agree, 5 = Strongly Agree), how would you rate your agreement to the following statements about how you learn mathematics? (Please rate EVERY option according to the scale).

	Statements about the mathematics you learn in school	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1	I am capable of learning mathematics on my own (by myself) without help from my classmates					
2	I have the capacity to understand lessons taught in mathematics					
3	I can perform well in mathematics without help from my classmates					
4	I have confidence in my ability to learn mathematics					
5	I can overcome challenges in the learning of mathematics					
6	There should be more mathematics lessons each week.					
7	I would rather agree with the other mathematics students in this class as to the solution to a problem than investigate it myself.					

8	Mathematics is one of the most interesting school subjects.					
9	It is better to ask my mathematics class teacher the answer to a mathematics problem than to find out by trying a mathematics problem.					
10	I really enjoy mathematics lesson periods.					
11	The topics covered in mathematics lesson are not interesting.					
12.	I really expect more mathematics lessons.					
13	I would enjoy school more if there were no mathematics lessons.					
14	I am interested in the learning of mathematics					
15	I feel motivated to study mathematics					
16	The learning of mathematics is difficult					
17	I prefer to have more mathematics lessons in the school					
18	The learning of mathematics enables you to think logically					
19	Mathematics serves as the foundation for technological advancement					

20	The teaching and learning of mathematics enable you to pursue to higher education					
21	Mathematics is very useful in our everyday activities at home					

Section E

Kindly provide comprehensive responses [write-up] by way of answers to the following questions.

Q6. Explain what makes you confident in the learning of mathematics?

……

……

……

Q7. Explain what makes the learning of mathematics interesting to you?

……

……

……

Q8. Explain the usefulness of mathematics in your daily activities?

……

……

Q9. Explain the importance of mathematics in the in the future life (activities)?

……

……

The Table Depicts Items Measuring Students Perception of mathematics under the five subscales

Subscale	No. of Items from the questionnaire	Response questions
Pupil Cohesiveness	1-8	Q1
Teacher Support	9-16	Q2
Involvement	17-24	Q3
Co-operation	25-32	Q4
Equity	33-40	Q5

Table Depicts Items Measuring Students Attitudes Towards mathematics three the five subscales

Dimension	No. of Items from the questionnaire	Response questions
The effect of Mathematics	1-12	Q6
The behavior of students towards mathematics	12-16	Q7
The cognition of students towards mathematics	17-21	Q8, Q9

APPENDIX B: ETHICAL CLEARANCE

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26TH OCTOBER, 2023

Mr Samuel Crankson
Department of Mathematics and ICT
University of Cape Coast

Dear Mr Crankson,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2023/52)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research **Female Teacher Trainees' Attitudes and Perceptions Towards Mathematics: The Case of Public Colleges of Education in the Western and Central Regions of Ghana.** This approval is valid from **26th October, 2023** to **25th October, 2024**. You may apply for an extension of ethical approval if the study lasts for more than 12 months.

Please note that any modification to the project must first receive renewal clearance from the UCCIRB before its implementation. You are required to submit a periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithful

Kofi F. Amuquandoh
Ag. Administrator