UNIVERSITY OF EDUCATION, WINNEBA

EXAMINING PRE-SERVICE TEACHERS' ATTITUDES TOWARDS MATHEMATICS LEARNING IN MT. MARY COLLEGE OF EDUCATION SOMANYA, GHANA

DANIEL OWUSU

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MAY, 2023

DECLARATION

CANDIDATE'S DECLARATION

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

SIGNATURE:……..

DATE:……..

SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR: GLORIA ARMAH (Ph.D.)

SIGNATURE:……

DATE:……...…….

DEDICATION

This dissertation is dedicated to my HEAVENLY FATHER whose amazing grace, favour and mercy have brought me this far as well as my dad, the late Tetteh-Tsu Teye Roman who was not privileged to have any formal education but toiled the soil to ensure that the formal education he did not get, I had it.

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LIST OF ABBREVIATIONS

GES	: Ghana Education Service
INSET	: In service training for teachers.
JHS	: Junior High School
NaCCA	: National Council for Curriculum and Assessment
MAQ	: Mathematics Attitude Questionnaire
WAEC	: West African Examination Council
WASSSCE	**:** West Africa Senior Secondary School Certificate Examination

ABSTRACT

The study was conducted to examine the attitudes of pre-service teachers towards mathematics learning, what contributed to the attitude of the pre-service teachers and the relationships between pre-service teachers' attitudes and their performance in mathematics at Mt. Mary College of Education in Ghana. The study was based on Ajzen's (1993), ABC Attitude Model also called the Tripartite Model. The convergent parallel mixed method design was adopted in this study, applying both qualitative and quantitative research methodologies. Out of the four hundred and sixty-five (465) pre-service teachers sampled, only three hundred and twenty-five (325) of the pre-service teachers willingly participated in the study. The main instrument used to collect data in this study was the Mathematics Attitude Questionnaire (MAQ) in the form of a Likert scale, open-ended questions, semi-structured interviews and tests designed by the researcher. Findings from this study revealed that; the pre-service teachers had positive attitudes towards mathematics learning in the ABC model. The following factors contributed to the attitudes of pre-service teacher's attitudes towards mathematics: Usefulness of Mathematics, Mathematics as a compulsory subject, Encouragement and support received from others, Difficulty and Fear, Having a good teacher and Self-Confidence. A strong correlation existed between pre-service teachers' attitudes towards mathematics learning and their academic performance. This study implies that the school management should advantageously use the pre-service teacher's positive attitude towards mathematics to continue creating a strong inclination and culture of mathematics in the college where the pre-service teachers can score more favourably in mathematics and any other mathematics-related courses.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter focuses on the background to the study; the statement of the problem; the purpose of the study; the objectives of the study; the research questions; the significance of the study; the delimitations of the study; the limitations of the study; operational definitions of terms and an organizational plan of the study.

1.1 Background of the Study

A number of factors may influence the teaching of mathematics but the teacher plays an important role in the teaching process. In this 21st century, the researcher being a teacher trainer in mathematics education believes effective teaching goes beyond just content but also includes blending content, pedagogy, technology and also influencing students positively. Beliefs about what teachers need to know have completely changed based on the development of teacher preparation programs.

Mathematics is seen as the fundamentals of scientific and technological knowledge for political, socio-economic, scientific and technological development by many countries globally (Nekang, 2016).

Globally, pre-service teacher education is concerned with the development of specific instructional competencies. Pre-service teacher education is also focused on the promotion of teacher attitudes that facilitate effective instructional practice. It, therefore, does not only consider teachers' pedagogical content knowledge but it has been accepted that teachers' attitudes towards their subject area are an important factor for the teacher qualification (McLeod, 1992). It is in line with this that the government of Ghana through the Ministry of Education and the National Teaching

Council directed that teachers must be trained to develop a positive teacher identity and acts as good role model for students. The teacher must see his or her role as a potential agent of change in the school, community and the country at large (NTS 2017, 1f & 1g).

The National Council for Curriculum and Assessment (NaCCA), Mathematics Curriculum for both lower and upper primary schools and Junior High Schools (NaCCA, 2019) is "aimed at developing individuals to become mathematically literate, good problem solvers, have the ability to think creatively and have both the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens." "Learners are expected to acquire positive attitudes, values and psychosocial skills that will enable them to participate in debates and take a stand on issues affecting them and others" (NaCCA,2019). Thus the mathematics curriculum of Ghana focuses on the development of positive attitudes and values.

Pre-service teachers' attitudes towards mathematics are very important because they would determine the course of action, they would take in their teaching journey. Teacher attitudes are often translated into specific classroom and instructional practices which in turn affect student behaviour and learning outcomes (Cook, 2002). The experiences, values and beliefs of pre-service teachers influence the formation of their attitudes and these, in turn, influence their classroom practices or activities and beliefs.

Pre-service primary teachers are special people who shape future generations, as they will be the first face of mathematics a young child meets or have an encounter with when he/she starts school (Hill & Bilgin 2018). To Hill and Bilgin (2018), numerical literacy is as important as literacy itself due to the simplicity of its data collection and

analysis. It is very necessary to educate the future generation and their teachers to be as effective as possible in their abilities to learn/teach mathematics (Hill & Bilgin 2018). Hill & Bilgin (2018), research on pre-service teachers' mathematical anxiety and their attitudes towards mathematics show that pre-service teacher typically has high levels of mathematics anxiety and that their attitude to mathematics has a great influence on their learning during their studies at the university and then teaching mathematics to their young students.

Pre-service primary teachers are believed to have a high level of mathematics anxiety, and a great number of them show a negative attitude towards mathematics (Burton, 2012). It is believed that when teachers are poorly trained and poorly motivated, the foundation on which effective learning takes place among students is weakened (World Education Report, 1998). There is, therefore, the need for pre-service teachers, to be equipped with the requisite knowledge, skills, experiences, and positive attitudes in the teaching and learning of mathematics.

Mt. Mary College of Education is situated northeast of Somanya, on a hill overlooking the Somanya and Odumase townships. The institution was founded by American Catholic SVD Missionaries in 1947. Mt. Mary College of Education is the first teacher-training college with a specialization in the French language to be set up in the country Ghana. Currently, the College has students offering the 4-year Bachelor of Education programs in Primary or Junior High School (JHS) program specializing in languages (French, English and Ghanaian language), History, Social Studies and Religious and Moral Education. As they are studying to be JHS or Primary School teachers, they would be expected to teach mathematics as a subject or apply it. Students admitted into this college usually come straight from senior high

schools and they are therefore usually very young (averaging eighteen or nineteen years old). Many of these students hardly have any background in elective mathematics, except their high school core mathematics since most of them did General Art-related courses in Senior High School.

Mathematics is a compulsory subject at the basic education and secondary education level, as well as in almost all colleges of education in Ghana. At Mt. Mary College of Education, now affiliated with the University of Ghana, a pre-service teacher offering the 'Four years Bachelor of Education Program', either Primary or Junior High School, is mandated to do the courses 'Introduction to Learning, Teaching and Applying Number and Algebra' in year one, semester one, and 'Learning, Teaching and Applying Geometry and Handling Data' in year one, semester two.

The Ministry of Education in recent times made several efforts to reform teacher education to enhance the quality of teaching and learning of mathematics. One of the major breakthroughs to improve the teaching and learning of mathematics in the colleges of education is the upgrading of these colleges from diploma-awarding institutions to degree-awarding institutions and the selection of some selected colleges of education to pursue a specialized programme in science and mathematics.

1.2 Statement of the Problem

It is expected of teachers to demonstrate a repertoire of teaching skills that are believed to facilitate pupils' learning and as well display attitudes that foster learning and genuine human relationships (Ryan & Cooper, 1998). Ryan and Cooper (1998) observed that teachers' attitudes towards mathematics in one way or another affect their pedagogical practices and pupils' attitudes towards Mathematics. It is therefore

expected that teachers help learners to acquire positive attitudes and values which will intend affect their achievements in mathematics.

There are consistently low achievement levels in mathematics among SHS students (WAEC, 2018). Many SHS students struggle with mathematics and perform very poorly in their final examinations in most Jurisdictions in recent times (Fletcher, 2018). A mathematics performance data from 2015-2018 of SHS students revealed that more than half of students who sat within the period could not obtain a grade C6 or better in mathematics (WAEC, 2018), which is needed to qualify them for university or college of education admissions. It is important to emphasize that over 50% of the students who sat for the examination between 2015-2018 were not eligible to gain admission to any university or college of education in Ghana. The pass rate was 32.4% in 2015, 33.1% in 2016, 41.7% in 2017 and 38.2 in 2018.

Table 1.1: Percentage of Candidates Obtaining A1-C6 in Mathematics (core) in the WASSCE

Year	Percentages pass from A1-C6
2015	32.4
2016	33.1
2017	41.7
2018	38.2
2019	64.2
2020	65.7
2021	54.1

Source: WAEC, 2018 and 2021

Students' performance in mathematics at the WASSCE level saw much improvement in 2019 and 2020, with the most significant improvement in 2020 with a percentage of 65.7% getting A1-C6. However, mathematics recorded a decline in

the performance of candidates in grades A1 to C6 in 2021 as compared to 2020 (WAEC, 2021). There is therefore the need to still improve it further.

The students' poor mathematics performance in national assessments has become a disquiet for students, parents, and other stakeholders in education in Ghana (Fletcher, 2018). Considering the fact that a bulk of SHS graduates cannot pursue further studies, it is obvious that this problem is critical, and requires investigation to understand which variables seem to negatively impact students' mathematics achievement and performance. Researchers (Abreh, Owusu, & Amedahe, 2018; Enu, Osei, & Nkum, 2015; Fletcher, 2018) have conducted studies on the factors influencing mathematics performance at the SHS level and observed that those variables such as students' attitudes towards mathematics, interest in the subject, inadequate teaching and learning materials, insufficient mathematical practice by students, home factors, and peer factors play in students' mathematics performance.

The researcher being a mathematics educator and examiner observed that level 100 pre-service teachers of Mt. Mary College of Education over the years have challenges with mathematics learning to the extent that if not because it is mandatory to do the courses 'Introduction to Learning, Teaching and Applying Number and Algebra' in year one, semester one, and 'Learning, Teaching and Applying Geometry and Handling Data' in year one, semester two, most of the pre-service teachers in Mt. Mary College of Education wouldn't have willing taking any mathematics course.

There is a relationship between students' performance and their attitude to Mathematics (Mohd, Mahmood & Ismail, 2011; Marchis, 2013). Students with a positive attitude towards Mathematics have better problem-solving skills and would like to solve more non-routine problems (Marchis, 2013). Those students use most of

their time solving a problem, and they give up later in case of an unsuccessful problem-solving activity.

Students with positive attitudes enjoy mathematics and engage with mathematics, and they believe that he/she is good at mathematics and that mathematics is useful. On the other hand, students with negative attitudes do vice versa (Kartal, 2020).

Researchers (White, Way, Perry, & Southwell, 2005-2006; Burton, 2012; Flegg, Mohammed, & Trimmer, 2013) have studied pre-service teachers' attitudes to learning mathematics and mathematics teaching and have shown that many contributing factors to a pre-service teacher's attitude to mathematics are the student's background, their beliefs and mathematics achievement, the role of mathematics anxiety and even gender.

Cook (2002), observed that pre-service teachers' attitudes are very important because they would determine the course of action, they would take in their teaching journey. Teacher attitudes are most likely translated into specific classroom and instructional practices which in turn affect student behaviour and learning outcomes (Cook, 2002). Preservice teachers' attitude needs to be investigated before they become in-service teachers since teachers' attitude can help or hurt student motivation, and shape their learning experience, achievements and well-being.

The experiences and beliefs of pre-service teachers influence the formation of their attitudes and these, in turn, influence their classroom practices and beliefs. It is very important pre-service teachers are assisted to understand their own beliefs, attitudes and practices since their attitudes and beliefs may have a greater influence on the future of the students they will be teaching. In Ghana, more still needed to be known

about the attitudes of pre-service mathematics teachers and how their attitudes are formed.

1.3 Purpose of the Study

The purpose of this study is to investigate:

1. Mt. Mary College of Education pre-service teachers attitudes towards mathematics learning.
2. the factors that led to Mt. Mary College of Education pre-service teachers attitudes towards mathematics learning.
3. The relationship between Mt. Mary College of Education pre-service teachers' attitudes towards mathematics learning and their performance in mathematics.

1.4 Objectives of the Study

The objectives of the study were to;

1. Investigate the attitude of Mt. Mary College of Education pre-service teachers towards mathematics learning.
2. Investigate the factors that led of the attitude of pre-service teachers of Mt. Mary College of Education towards mathematics learning.
3. Investigate the relationship between Mt. Mary College of Education preservice teachers' attitude and their performance in mathematics.

1.5 Research Questions

The following research questions would guide this study:

1. What is the attitude of pre-service teachers towards mathematics learning?
2. What factors led to the attitudes of the pre-service teachers?
3. What is the relationship between pre-service teachers' attitudes towards mathematics and their performance in mathematics?

1.6 Significance of the Study

It is essential to examine the beliefs and attitudes of pre-service teachers at the teacher pre-service preparation program level in order to provide best practices and interventions to modify and change potential negative beliefs and attitudes toward mathematics, including beliefs and attitudes in learning and teaching mathematics.

Findings from this study might therefore improve pre-service preparation programs by providing information about interventions that enhance primary and junior high school pre-service teachers' positive attitudes toward mathematics while ensuring they learn the wide range of strategies and approaches, they need to become successful teachers of mathematics. Findings will again help us know how pre-service teachers' attitude towards mathematics was formed and within a carefully planned space given, an opportunity will be given to address these perceptions of their prior mathematics experiences. This would translate into improved performance in mathematics.

Findings moreover have implications for policies that address the roles of primary and junior high education teachers regarding teaching and learning mathematics at the basic levels. This would form the basis for the Ghana education service to organize in-service training (INSET) for teachers of mathematics at the pre-tertiary level to develop a strong positive attitude towards mathematics.

Finally, this study will contribute to the existing literature on pre-service teachers' attitudes towards mathematics learning and teaching in Ghana and globally as large.

1.7 Delimitations of the Study

The study was limited to Mt. Mary Colleges of Education in the Eastern region of the Republic of Ghana. Mt. Mary College was selected and used among the many colleges in the Eastern region and Ghana as a whole because of its proximity and convenience to the researcher. The study was further delimited to only level 100 pre-service teachers. All the level 100 pre-service teachers were used for the study. Ideally, the study should have been conducted among only pre-service teachers offering the primary school programme. This is because the pre-service teachers offering the primary school programme here are not subject teachers but have few mathematics major courses and are expected to teach mathematics as a subject when they become in-service teachers. This is not the case with pre-service teachers offering the J.H.S. programme. They have no mathematics major course except the level 100 mathematics mandatory courses. They are therefore not expected to teach mathematics as a subject when they become in-service teachers rather apply it. Both pre-service teachers offering the primary school and the junior high school programme were used because it was difficult getting the sample population using only those offering the primary education programme.

1.8 Limitations of the Study

Limitations are believed to be conditions beyond the control of the researcher that place restrictions on the conclusion(s) of the study and its application to other situations (Best & Kahn, 1989). A limiting factor was the methodology used for selecting the college of education for the study. The findings of this study can only be generalized within the studied college, but could not be generalized for all colleges of education in Ghana. This is because purposive sampling and convenience sampling techniques were used to select the college.

Apart from this, empirical verification by way of observation was necessary for pre-service teachers. This is because a descriptive statement is regarded as true if and only if it is found to correspond with observed reality (Creswell, 2014). The observation was necessary to find out if what were observed depicted earlier data collected using interview and questionnaires.

Lastly, the transformation of a negative statement into the same variable group may have an effect on the result which may be not easily known. Therefore, there were likely to be gaps in the data collection, analysis and interpretation.

1.9 Organization of the Study

This is a five-chapter research study. Chapter One dealt with the introduction to the study. It comprises background relating to the research, statement of the problem for the study, the purpose with respect to the research, questions guiding the research, significance of the study and finally delimitation as well as limitations of the research. Chapter Two was confined to the review of related literature. It also takes care of the conceptual, theoretical, and empirical approaches given the attitudes of students towards mathematics learning, mathematics attitude formation and academic achievement.

The third chapter captures the methodology of the research. It is made up of the research design, population and sample, instrument for collecting data and finally the analysis of the collected data. It also deals with the description and administration of the research. Chapter Four is about the results and discussion to the research findings, and sub detailed into an overview, responding to the questions posed and discussion of research findings. The fifth chapter, which happens to be the final chapter, is dedicated to the summary, conclusions, and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter first discussed the conceptual and theoretical framework followed by a discussion on related literature on the following key thematic areas: what is attitude? the affective component of attitude (self-confidence, anxiety and enjoyment of mathematics), behaviour (intrinsic motivation) component of attitude, cognition (perceived usefulness) component of attitude, mathematics attitude formation and the relationship between mathematical attitude and mathematical achievements.

2.1 Conceptual Framework

The study adopts Ajzen's (1993), ABC Attitude Model also called a Tripartite Model. The Ajzen (1993), ABC Attitude Model serves as a useful theoretical framework for developing mathematics attitude measures. Ajzen (1993) conceptualizes an attitude as an amalgam of three different measurable components: affect (A) component, behaviour (B) component and cognition (C) component. The affect component is the emotional component consisting of feelings and emotions that are associated with an attitude object (in our mathematics). Behaviour is the action component consisting of predispositions to act in a particular way towards the attitude object or variable. Thus, the way the attitude we have influenced how we act or behave. The cognition component involves a person's belief or knowledge about an attitude object. For instance, attitude consists of a positive emotion that is, feeling happy in a mathematics classroom (affect), intent to learn more mathematics (behaviour) and belief that mathematics is easy to learn (cognition).

The major underlying assumption about the link between attitudes and behaviour is that of consistency (McLeod, 2018). Thus, we often or usually expect the behaviour of a person to be consistent with the attitudes that they hold known as the principle of consistency. The principle of consistency reflects the idea that people are rational and attempt to behave rationally at all times and that a person's behaviour should be consistent with their attitudes (McLeod, 2018). Cognitive and affective components of behaviour do not always match with behaviour (LaPiere, 1934). Attitudes in one way or another other service functions for the individual (Katz, 1960). Katz (1960) observed that Knowledge Attitudes provide meaning (knowledge) for life. The knowledge function provides a meaning to our needs according to our world which is consistent and relatively stable. This allows us to predict what is likely to happen, and so gives us a sense of control. Attitudes also help us organize and structure our experiences (Katz, 1960). Knowing a person's attitude helps us predict their behaviour.

The ABC model of the attitude of Ajzen (1993), adoption enables researchers to investigate how people feel, think and interact with the attitude object (McLeod, 2018).

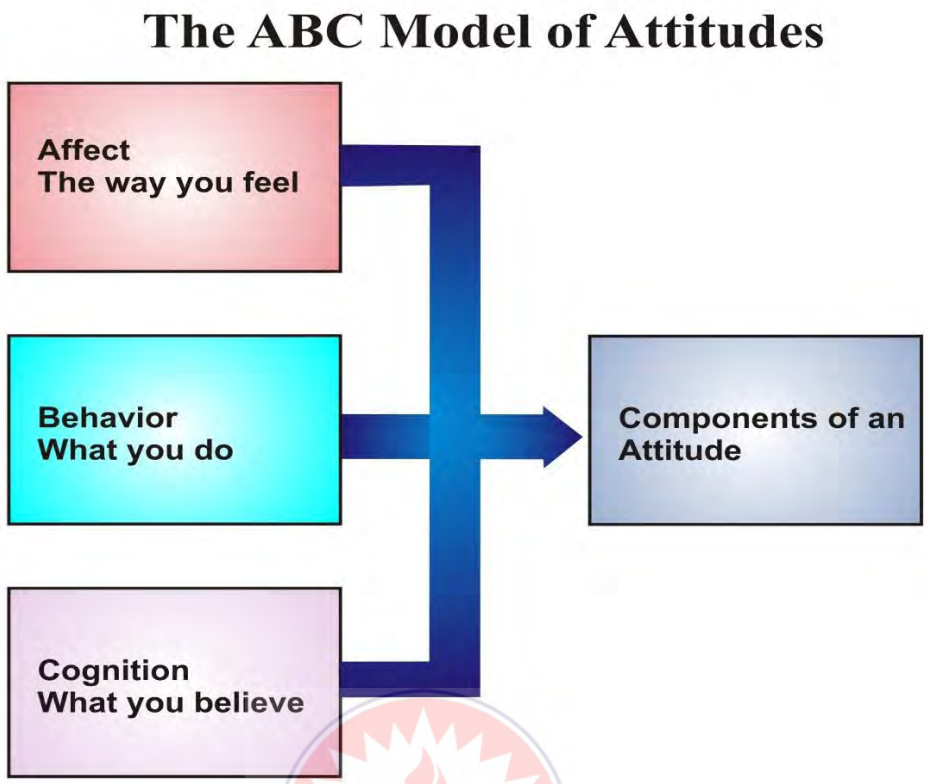

Figure 2.1: The ABC model of attitude

Source: The ABC model of attitude images.

2.3 The Concept of Attitude

According to McLeod (2018), an attitude is "a relatively enduring organization of beliefs, feelings, and behavioural tendencies towards socially significant objects, groups, events or symbols" or a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour". To McLeod (2018) attitudes can be described in terms of three structure components; affective component, behavioural (or conative) component and cognition component.

McLeod (2018) observed that the strength with which an attitude is held is mostly a good predictor of behaviour. Thus, the stronger the attitude the more likely it affects behaviour. Attitude strength includes Importance or personal relevance or self-interest,

social identification and value. If an attitude has a high self-interest in a person it is going to be extremely important to the person. As a consequence, attitude will have a very strong influence on a person's behaviour (McLeod, 2018). By contrast, an attitude will not be important to a person if it does not relate in any way to their life.

McLeod (2018) again observed that the knowledge aspect of attitude strength covers how much a person knows about the attitude object. Moreover, attitudes based on direct experience are more strongly held and influence behaviour more than attitudes formed indirectly.

Attitudes can serve functions for the individual (Katz, 1960). Katz (1960) outlined that knowledge attitudes provide meaning (knowledge) for life. This allows us to predict what is likely to happen, and so gives us a sense of control. Attitudes also help us organize and structure our experiences. Thus, knowing a person's attitude helps us predict their behaviour (McLeod, 2018). The attitudes we express help us to communicate who we are to others and make us assert our identity (McLeod, 2018). Hence, our attitudes are part of our identity, and help us to be aware through the expression of our feelings, beliefs and values. McLeod (2018) again observed that "positive attitudes towards ourselves, for example, have a protective function (i.e. an ego-defensive role) in helping us preserve our self-image. The basic idea behind the functional approach is that attitudes help a person to mediate between their own inner needs (expression,defence) and the outside world (adaptive and knowledge)".

Attitudes are likes and dislikes. Cook (2002) sees attitudes as a mental predisposition to act that is expressed by evaluating a particular entity with some degree of favour or disfavour. That is the way individuals evaluate people with whom they are familiar in everyday life. Attitudes are generally positive or negative, but they can also be

uncertain at times. According to Simmers (2011),an attitude refers to a learned tendency of a person to respond positively or negatively towards an object, situation, concept, or person. It is also regarded as a belief held by individuals that reflects their opinions and feelings and can be sometimes manifested in behaviour (Simmers, 2011). There is a relationship between attitudes, behaviour, and feelings 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 themselves (Simmers ,2011) . Ajzen (1993) observed that attitude is a hypothetical construct that cannot be observed directly but can be inferred from measurable reactions to the attitude object.

Attitudes are mostly been regarded as having been learnt. They predispose an individual or a group to an action that has some degree of consistency and can be evaluated as either negative or positive (Fishbein & Ajzen, 1980). From the point of view of Fishbein and Ajzen (1980), attitudes are linked to beliefs and for each belief, an individual would have a corresponding attitude. Attitudes are been linked to action and can be categorized according to their focus.

According to Syyeda (2016), attitude is multidimensional in nature. It takes into account three components that are represented in what is called the ABC model of attitudes: A for the affective component, B for the behavioural component, and C for the cognitive component. The affect component is made up of emotions, beliefs, and vision of the subject. The affective component is the emotional or feeling segment of an attitude. It is related to the statement which affects another person. It deals with feelings or emotions that are brought to the surface about something, such as fear or hate (Syyeda, 2016). The affective component is made up of self-confidence, anxiety

and enjoyment Emotions are the feelings of enjoyment or pleasure in learning the subject of mathematics (Syyeda, 2016). Thus, seeing something as boring, difficult and dull.

Syyeda (2016), again states that beliefs are associated with and are normally linked to students' confidence in their abilities to learn the subject. The behavioural component is also made of intrinsic motivation. Intrinsic motivation is related to both interest and the desire to learn mathematics

Cognition represents the students' perceived usefulness of the subject. Conversely, behaviour is connected to students' motivation to learn which is reflected in students' actions, commitment, and performance in class (Syyeda, 2016).

2.4 The Affect Component of Attitude

The affective component of attitudes refers to feelings or emotions associated with an attitude object**.** The affective component of attitude is the feeling or emotions of the individual associated with how mathematics is learned (Ingram, 2015). According to Ingram (2015) one important way in which affect shapes overall attitudes is through the feelings and emotions that are elicited in response to an attitude object. Thus, the affective component is the source of driving the engagement of students towards mathematics learning. Furthermore, the affective component is also dominated by the belief formed from the cognitive component of attitude, which creates a mindset that becomes permanent over time and affects the feelings of the students towards learning mathematics (Ingram, 2015; Zan & Di Martino, 2007).

Students' mathematics affect component has been a sustained topic of mathematics educational research for many years and for the years to come (Hannula, 2014).

Although many students perceived mathematics as boring, difficult and impractical, students however regard the subject as a very important discipline (Ignacio, Nieto, & Barona, 2006). Research suggests that mathematical achievement is attributable not only to cognitive factors but also to affective variables, such as attitudes, beliefs, and motivation (Lim & Chapman, 2013). Studies on the affective domain in mathematics continue to be given much more attention since improvements in attitudes tend to support student performance (Lim & Chapman, 2013). The affective component is made up of self-confidence, anxiety and enjoyment.

2.4.1 Self-Confidence in Mathematics:

According to Adelson and McCoach (2011), self-confidence in mathematics is defined as a student's perceptions of self as a mathematics learner and includes beliefs about one's own ability to learn and do well in mathematics. Self-confidence is also seen as the judgment of one's capabilities to successfully perform a particular given task. Hannula, Maijala, and Pehkonen (2004), show in a study that self-confidence 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 and that they can be successful in learning mathematics, thus overcoming the fear of failing. Self-confidence is an essential criterion of students in high academic achievement. It is also the factor of mathematical calculations without which the students cannot be able to perform mathematical errorless operations (Van der Bergh, 2013). Self-confidence towards the studied subject is very important in order for students to succeed in their field of study. There is some relationship between self-confidence and the students' achievement (Hannula, Maijala & Pehkonen ,2004). Thus, self-confidence is essentially believed to improve students' achievement in learning mathematics. These

students are ready to take on mathematical challenges which in turn increase their academic achievement; otherwise, students with low self-confidence do not believe in themselves and therefore tend to avoid taking mathematics challenges and vice versa (Adelson & McCoach, 2011). Thus, leading to minimizing the chances of expanding their mathematical capabilities and success. Self-confidence in mathematics by students is highly correlated with student achievement to the extent that the higher the student's self-confidence in mathematics learning the higher the student mathematical achievements (Bouchey & Harter, 2005). Self-confidence is one of the influential factors which is unrecognized regarding students' mathematics achievement. students' self-confidence in learning mathematic influenced the mathematics learning achievement. Thus, self-confidence is essentially believed to improve students' achievement in learning mathematics (Peker, 2009). The learning of mathematics is influenced by a pupil's mathematics-related beliefs, especially self-confidence. self - confidence is conceded as part of pre-service teachers' knowledge because pre-service teachers' confidence and beliefs links straight forward with other aspects of knowledge (Simmers, 2011).

2.4.2 Anxiety in Mathematics

According to Van der Bergh (2013) Mathematics anxiety is debilitating factor which hinder the performance of the students in their mathematical operations. Anxiety in mathematics is a feeling of tension or fear that interferes with the manipulations of mathematical problems. Students with negative attitudes toward mathematics have performance problems simply because of anxiety (Van der Bergh, 2013). Mathematics anxiety is defined as a feeling of tension and apprehension that interferes with maths performance ability, the manipulation of numbers and the solving of

mathematical problems in a wide variety of ordinary life and academic situations (Vinson ,2001)

Peker (2009) sees mathematics anxiety as a global problem which calls for a better curriculum implementation, competent teachers, improved teaching strategies, appropriate teaching and learning materials, and prudent use of technology in the mathematics classroom expecially during mathematical instructions.

Mathematics anxiety component is there either in the cognitive domain or affective domain or psychomotor domain of affected students. Its negative effects on academic performance, emotional stability and physiological build of those students therein can't be ignored but for us to clinically examine and provide, if possible, solutions (Peker, 2009). Peker (2009) noted the following as reasons to why pre-service teachers' mathematics teaching or learning anxiety may increase :

- if the mathematics being taught is too difficult
- mathematics knowledge of the pre-service teacher is inadequate
- the level of interest towards the teaching profession may be lacking
- the inability to teach to the appropriate level of the learners/grade
- learning style preferences may affect the pre-service teachers' mathematics teaching anxiety.

Jackson (2012) bemoan attitude as a link between mathematical anxiety and attitudes towards mathematics and observed that there is a relationship between anxiety and students' achievements. The study focused on primary school teachers, exploring the possibility of reducing mathematical fears and improving attitudes toward mathematics.

Awanta (2000) studied the relationship between anxiety and learning mathematics and noted its complexity. He notes that some level of anxiety may be helpful in learning mathematics, especially when used as a form of arousal of alertness. He however suggests that too much anxiety, particularly when combined with a perceived lack of ability can hinder learning. It may be a major standing block to learning since it influences the effectiveness of students' understanding of mathematical concepts (Gresham, 2009; Vinson, 2001).

Mathematics teachers' anxiety is such that, teachers who possess higher levels of anxiety might unintentionally transfer their negative feelings, avoidance and fear of mathematics to their students since mathematics anxiety is related to how one teaches mathematics (Vinson, 2001). Vinson (2001) again argues that basic school teachers with higher margins of mathematics anxiety might encourage the early development of mathematics anxiety in their students. The outcome and implication of mathematics anxiety of teachers is the development of negative attitudes toward mathematics and very low mathematical achievement levels for the students (Gresham, 2009).

Guy, Cornick, and Beckford (2015) observed that mathematics anxiety can be detrimental to an individual to the extent that it can interrupt and even make everyday activities of an individual difficult, for example balancing a check book, developing a household budget or simply calculating a restaurant bill. In the academic domain, mathematics anxiety affects an individual in any school related activities, in classrooms and standardized test taking, resulting global avoidance of mathematics learning (Guy, Cornick, & Beckford, 2015).

Anxiety at relatively low to moderate levels can be very constructive. Beyond a certain point or level, however, anxiety becomes counterproductive in terms of

performance, particularly in the case of higher mental activities and conceptual processes (Saha, 2007).

2.4.3 Enjoyment of Mathematics

The enjoyment of mathematics is the extent to which the students or pupils enjoy doing and learning mathematics (Kupari & Nissinen, 2013). Students' enjoyment while learning mathematics normally influence their behaviour or cognitive aspect of attitude (Syyeda, 2016). Syyeda (2016), observed that students usually learn mathematics when they find it enjoyable and interesting. The enjoyment affects both the degree and continuity of engagement in learning mathematics and the depth of understanding of the subject. This means that if the students enjoy doing mathematics more they are likely to engage in problem-solving which will enhance their learning and performance. Enjoyment, students' learning and performance are related, it is, therefore, worth evaluating the students' status of mathematics enjoyment in order to keep track of students' learning and performance (Gresham, 2009).

A longitudinal study by Attard (2013) has reported that students often view mathematics as a set of isolated procedures, failing to see real-life applications of their learning outside of the classroom and mathematical enjoyment is considered particularly significant for addressing student disengagement. Attard (2013) again found that the nature of the mathematics classrooms and the individualistic nature of mathematics, whereby students work independently, actually discourages both social interaction and learning, which could reduce engagement and understanding and therefore affects students' performance. Kupari and Nissinen (2013) noted that improving student enjoyment of mathematics is a key strategy to address subject disengagement. Innovative teaching methods that provide positive mathematical

learning experiences could help to enhance students' enjoyment, experiences and outcomes in mathematics (Kupari & Nissinen, 2013).

Bouchey and Harter (2005), observed that enjoyment of mathematics by students is very important as enjoyment leads to the willpower to do more mathematics and also leads to better mathematical achievements. Pre-service teacher's enjoyment of mathematics is positively associated with a number of valued outcomes, such as a willingness to spend more time learning mathematics (Bouchey & Harter ,2005).

2.5 Behaviour (Intrinsic Motivation) Component of Attitude

Behaviour or intrinsic motivation is related to both interest and the desire to learn or study mathematics. Behaviour is an action, activity, or process which can be observed and measured. Often, these actions, activities, and processes are initiated in response to stimuli which are either internal or external (Guy, Cornick, & Beckford, 2015). It is believed that 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 mathematics (Yunus & Ali, 2009). Intrinsic motivation or behaviour has the tendency to affect the degree of student engagement, career choice, and performance. Therefore, studying motivational variables as related to attitude and achievement is crucial.

Mensah et al. (2013) noted that the behavioral component is how our attitude influences how we act or behave. The behaviour component of an attitude consists of a person's tendencies to behave in a particular way towards a mathematical object. It refers to that part of attitude which reflects the intention of a person in the short run or long run. The behavioural aspect of attitude is the tendency to respond in a certain way towards learning mathematics (Akinsola & Olowojaiye, 2008; Maio & Haddock,

2009; Mensah et al., 2013). Behavioural attitude is also influenced by affective attitude. Students feeling confident in doing mathematics is linked with being successful in mathematics, which is regarded as positive behaviour. Students who are not confident in mathematics may not experience success, and unsuccessful behaviour is regarded as negative feelings (Zan & Di Martino, 2007). Hence the behavioural component of attitude impacts the cognitive component of attitude as well. When students see the importance of mathematics in real life, they feel engaged, confident and connected to their learning (Attard, 2012). Behavioural attitudes indicate a person's judgment of performing the behaviour as good or bad or that the person was in favour of or against performing the behaviour. Hence, the more favorable a person's attitude is toward a behaviour, the more likely the person would intend to perform that behaviour. Clearly, a dialectical relationship appears true for attitude and behaviour (Mensah et al., 2013).

The three components of attitude, confidence, importance of mathematics and engagement of mathematics are interrelated (Mensah et al., 2013). Ajzen and Fishbein (1980) reported that beliefs influence behaviour in spite of studies by Argyris and Schon (1974) and that of Beswick (2005) that reported inconsistencies in beliefs influencing behaviour. Argyris and Schon (1974) argued that the inconsistency was a result of people having a number of different collections of beliefs. The inconsistencies might also be the result of behaviour influencing beliefs.

Beswick (2005) affirmed that beliefs and actions develop together and influence each other in many ways because they are didactically related. Beswick (2005) further noted that different contexts may elicit different beliefs, and that consistency cannot

be expected when beliefs and behaviour are measured such that the contexts are not closely matched.

2.6 Cognition (Perceived Usefulness/Importance/Value) Component of Attitude

Cognition or perceived usefulness refers to students' perception of the importance of mathematics in their present everyday life and in the future (Adelson & McCoach, 2011). Cognition or perceived usefulness of mathematics is believed to have an influence on students' attitudes towards the subject. If a student or group of students noted the importance of mathematics in their lives, they will become motivated to study, practice, and learn the subject (Syyeda, 2016). Syyeda (2016) again reveals that despite the fact that the majority of students had negative emotions towards mathematics they demonstrated positive cognition towards mathematics. This means students recognize and appreciate the value of mathematics in their lives and future careers. A study by Guy, et al. (2015) found that mathematics usefulness is a positive predictor of success. Thus, it is important to study the relationship between mathematics value, attitudes, and performance context as well.

Mensah, Okyere, and Kuranchie (2013) observed that the cognitive component involves a person's belief and knowledge about an attitudinal mathematical object. Thus, the cognitive component of attitudes refers to the beliefs, thoughts, and attributes that we would associate with a mathematical object. Thus, the opinion or belief segment of an attitude. It also refers to that part of attitude which is related to the general knowledge of a person. The cognitive component of attitude is what the individual thinks or believes about mathematics (Mensah, Okyere, & Kuranchie, 2013). Teachers' beliefs about the utility of Mathematics are often found to correlate with either a more positive or negative attitude towards the subject (Syyeda, 2016).

Mensah, Okyere, and Kuranchie (2013) are of the view that a teacher who sees no usefulness of mathematics in the real world and believes that mathematics should be learnt as a set of rules and algorithms will require his students to memorise procedures and rules without meaning. This is a negative outlook that will make his students develop a negative attitude towards the subject.

Kloosterman and Clougan (1994) observed that students' beliefs about the utility of mathematics influence their attitude towards mathematics and mathematical problem-solving. In a study with primary school pupils by Kloosterman and Clougan (1994), it was observed that many times pupils can't give concrete examples, of why mathematics is useful in their future life, they just motivate the utility of it by the fact that they need mathematics for the major external and internal exams in their lives. Mathematics occupies a crucial and unique role in the human societies and represents a strategic key in the development of the whole mankind. The ability to compute, related to the power of technology and to the ability of social organization, and the geometrical understanding of space time, that is the physical world and its natural patterns, show the role of Mathematics in the development of a Society (Kloosterman & Clougan ,1994).

Blazar and Kraf (2017) noted that in modern times, adoption of mathematical methods in the social, medical and physical sciences has expanded rapidly, confirming mathematics as an indispensable part of all school curricula. In order to live a social life, mathematical knowledge is needed, because of the give and take process, business and industry depends upon the knowledge of mathematics (Blazar & Kraf ,2017).

2.7 Mathematics Attitude Formation

Yara (2009) learnt that attitudes are formed as a result of some kind of learning experiences students go through. Thus to say that it has a part to play in the teaching and learning situation of mathematics. The learner draws from his teachers' disposition to form his own attitude, which may likely affect his learning outcomes (Yara, 2009). Yara (2009) noted that teachers with a positive attitude towards mathematics are inclined to stimulate favorable attitudes in their pupils and students. "Students' positive attitude towards mathematics is enhanced by the following teacher-related factors: teachers' enthusiasm, teachers' resourcefulness and helpful behaviour and teachers' thorough knowledge of the subject matter and their making mathematics quite interesting" (Yara, 2009).

Yara (2009) again noted that among the factors that affect the stability of attitude are learning environment, teacher quality, and meaningful teaching methods. McLeod (1992) is of the view that beliefs are the most stable and that mathematical attitudes are relatively stable once formed. Yang (2013) shows in a study that students' attitude is affected by many factors. Among the many factors are the school, peer students, home environment and society. Yılmaz, Altun, and Olkun (2010) also identify the following factors that include; connecting mathematics with real-life situations or contextual mathematics learning and teaching, using instructional materials, teachers' personalities, teachers' pedagogical content knowledge, bad instructional practices, lack of commitment by students' and teachers' classroom management as factors that influence students attitude formation in mathematics. Important factors identified that formed student's attitudes towards mathematics learning 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, peer and parental influence.

According to Simmers (2011), the factors that formed mathematics attitudes for some students include, creating insecurities in students' mathematics abilities and teacher failure to provide explanations for the mathematical concepts being taught. Yilmaz et al. (2010) observed that factors responsible for students liking of mathematics or attitude toward mathematics formation are good teaching and course enjoyment. From the point of view of Yilmaz et al. (2010), factors such as boring teachers, students' failure to solve mathematics problems, failure to understand the topic well, friends talking during lectures, receiving a bad grade for an examination are related to the students' disliking of mathematics or attitude for mathematics and mathematics attitude formation.

Haladyna et al. (1983) found that attitude toward mathematics is mainly influenced by teacher quality and the social-psychological dimension. The management-organization dimension shows no effect on attitude but may have had some influence on student motivation (Haladyna et al. 1983). Brassell, Petry, and Brooks (1980) noted that the student's attitudes toward the teacher may be important in the formation of mathematics attitudes since students' attitudes towards the teacher may determine their interest in the subject and the class in general. De Fraine et al. (2012) observed that there is no direct association between learning environment and student attitudes towards mathematics, however, the results of De Fraine et al. (2012) suggest that the learning environment is associated with the student's enjoyment of mathematics. Students enjoy mathematics to a higher extent when the teacher motivates them to exert learning, activates self-regulated learning, provides feedback and coaches, and

structures and steers the learning activity (De Fraine et al., 2012). Thus the learning environment, teacher quality, and meaningful teaching methods have been considered as factors that influence attitude formation.

Past educational experiences have been identified by Meyer (1980) as a major factor on the formation of pre-service teachers' attitudes towards mathematics learning. Meyer (1980) gave an attitude questionnaire consisting of two open-end questions to pre-service teachers to investigate the factors the students believe contributed to the formation of their attitude towards mathematics and observed that, among the major factor that influence the formation of pre-service teachers' attitudes towards mathematics were the teachers they had had at their previous schools.

Mazana et al. (2019) are of the opinion that students acquire or formed mathematics 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" (Mazana et al., 2019). Also among the many factors which influence the students' attitudes formation towards the learning of mathematics includes student's aptitude attribute, instructional and social psychological environmental factors. "Other factors 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" (Mazana et al., 2019).

Attitudes are developed as a result of one's experiences which influences a person's view of situations, objects, and people and how to respond to them either positively or negatively or favourably or unfavourably (Mensah et al, 2013).

The social learning theories by Bandura (1977) postulate that individuals acquire attitudes through observing, imitating and modelling the behaviours of others. Hence attitudes are therefore formed through direct experience with models, objects or issues or ideas we interact with. Thus attitudes are a result of personal experience; that one is expecting a favourable outcome, popular or successful. A student can develop a positive attitude towards mathematics because he or she learns to associate positive experiences or events with it. Also, positive reinforcement creates room for the formation of a positive attitude for Mathematics (Mensah et al., 2013).

Eagly and Chaiken (1993), observed that attitudes have three foundations or origins: affect or emotion, behaviour, and cognitions. Attitudes may also develop out of psychological needs (motivational foundations), social interactions (social foundations), and genetics (biological foundations).

From the point of view of Eagly and Chaiken (1993), the affect or emotion part of attitude is associated with whether we like or dislike something or find an idea pleasant or unpleasant. Thus our attitudes are formed through our emotions rather than through logic. This normally happens through; sensory reactions, values, operant/instrumental conditioning, classical conditioning, semantic generalization, evaluative conditioning and mere exposure (Eagly & Chaiken, 1993).

The behavioural foundations of attitudes are formed from our actions. "That there are times when just going through the motions can cause us to form an attitude consistent

with those actions. People may come to hate, support or like something because their actions have led them to engage in these behaviours, which then led to the formation of an attitude" (Eagly & Chaiken, 1993).

Eagly and Chaiken (1993) state further that there are four lines of evidence that account for how attitudes are formed out of our actions:

- First, self-perception theory suggests that we look at our behaviour and figure out our attitude based on what we have done or are doing.
- Second, cognitive dissonance theory suggests that we strive for consistency between our attitudes and our actions and when the two do not match, we may form a new attitude to coincide with our past actions.
- "Third, research evidence using the facial feedback hypothesis finds that holding our facial muscles in the pose of an emotion will cause us to experience that emotion, which may then colour our opinions." People normally developed positive or negative attitudes toward neutral objects after moving their facial muscles into smiles or frowns.
- Fourthly, role-playing, such as improvising persuasive arguments, giving personal testimony, taking on another person's perspective, or even play-acting, are all additional ways that people may come to form attitudes based on their behaviors.

The cognitive foundation of attitudes, called beliefs, comes from direct experience with the world or through thinking about the world. This includes any kind of active information processing, like deliberating, wondering, imagining, and reflecting, as well as through activities such as reading, writing, listening, and talking (Eagly & Chaiken, 1993).

Uusimaki and Nason (2004) indicated that most of the pre-service teachers' mathematics learning anxiety could be linked to situational factors. The majority of the participants in the study of Uusimaki and Nason (2004) revealed that their mathematics anxiety could be attributed to their primary school mathematics learning experiences. They were able to remember the exact year in their primary school experience in which they learnt to dislike mathematics. The perceived reason accredited was that of the teacher rather than the mathematical content or social factors.

The study by Uusimaki and Nason (2004) identified three other situational factors related to the mathematics anxiety experienced by pre-service teachers. "The first situational factor related to mathematics anxiety was experienced when they had to communicate their knowledge of mathematics either in a test situation or verbal explanation". The second cause of anxiety cited by Uusimaki and Nason (2004) was the teaching of mathematics by the pre-service teachers in practice teaching in the classroom.

Mathematics attitude of anxiety formation range from home environment factors such as family pressure for higher achievement; to intellectual factors such as learning styles; or dispositional factors which are internal and related to personalities such as low self-esteem or situational factors such as classroom climate which are external immediate factors surrounding the stimulus (Yüksel-Sahin, 2008).

It is recognized that middle school years are the time period where students' behaviours, emotions and attitudes towards mathematics are formed (Bishop & Kalogeropopoulos, 2015). Many students recognize the use of traditional teacher-

centred approaches in mathematics as disengaging and do affect their mathematical attitudes (Attard, 2013).

2.8 Relationship between Attitudes and Academic Achievements

Nkum et al. (2015) studied the relationship between attitude and mathematics performance and factors influencing students' Mathematics performance in some selected colleges of education in Ghana. In the study, sex played a key role in determining the relationship between attitude and performance. A Likert scale questionnaire and a mathematical test was used 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.

Similarly, Churcher, Mensah, Okyere, and Kuranchie (2013) also in Ghana assessed the performance of high school students' attitudes toward mathematics. In total, there were 140 final-year students from three (3) selected schools. Respondents were sampled using a purposive sampling method. Their study observed that there is a correlation between attitude and performance. Teacher performance and inadequate textbooks were identified as the main cause of poor student performance and attitude towards mathematics. It was also found that parental and extracurricular activities affect student performance and attitudes. Their study also shows that when assessing student performance and attitudes, 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 need to be taken into consideration.

Arthur, Asiedu-Addo and Assuah (2017) assessed students' perspectives and their impact on the interest of Ghanaian students in mathematics using 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 found that 58.1 percent of respondents agreed that the negative perception of mathematics in elementary school strongly affects students' interest (attitude) 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 students' interest (attitude) in mathematics. Arthur et al. (2017) have therefore concluded that educators have to take notice of the impact of phenomenal interest (attitude) of students in mathematics, which could be detrimental to their interests since there is a link between interest (attitude) and mathematical achievements which can adequately motivate students, as well as help, reduce bad perceptions to optimize interest (attitude).

In South Africa, Bayaga and Wadesango (2014) analyzed student attitudes towards mathematical performance based on factor structure and observed a direct relationship between students' attitudes and mathematical performance. Their study determines 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. Their 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. Their results show that seven of the eight factors in the study represent about one-fifth of the variation in mathematical success. Bayaga and his colleague concluded that students' understanding and attitude towards the evolution of

mathematical and classroom teaching techniques easily improve the factors that affect the performance of students and are therefore directly proportional.

In Tanzania, Mazana, Montero and Casmir (2019) investigated students' attitudes towards Learning Mathematics and observed that students' learning of mathematics and performance in mathematics is affected by a number of factors, including students' attitude towards the subject, teachers' instructional practices, and school environment. Their study was conducted to investigate students' attitudes towards learning mathematics in Tanzania.

Mazana et al. (2019) also sought to ascertain reasons for the liking or disliking of mathematics and the relationship between attitude and performance. Mazana and his colleagues employed the ABC Model and Walberg's Theory of Productivity to investigate students' attitudes towards mathematics and associated factors. The quantitative and qualitative data were collected from 419 primary school students, 318 secondary school students, and 132 College students from 17 schools and 6 colleges in mainland Tanzania using a survey. When the data collected were analysed, the results show that initially, students exhibit a positive attitude towards mathematics, but their attitude becomes less positive as the students move forward to higher levels of education. Their results again show a significant positive weak correlation between students' attitudes and performance. The factors that influenced the students' liking or disliking of mathematics were; the student's aptitude attribute, instructional and social psychological environmental factors.

In Pakistan Ayub, Khurshid and Akram (2017) studied the relationship between the attitudes of Prospective Teachers and their Academic Achievements in Teacher Educational Programs. Their study was conducted to find out the relationship between

the attitudes of the prospective teachers towards the teaching profession and their academic achievement and explore the impact of prospective teachers' positive attitudes towards the teaching profession on their academic achievement. In their study questionnaires were given to 180 prospective teachers including boys and girls, to ascertain the attitudes of the prospective teachers, enrolled either in ADE or B.Ed. (Hons.) programs. The academic achievement scores of the respondents were obtained from their examination results. The major findings of the study of Ayub et al (2017) were that there is a strong correlation between mathematical attitude and mathematical academic achievements. The study of Ayub et al (2017) further observed that prospective teachers were of the view that the teaching profession is a highly admired, noble and reverent job and it required high skills and competencies in the area of mentorship. This finding clearly indicated that prospective teachers realize that teaching, should be the job and profession of those who possess the necessary knowledge, skills and values (attitudes) related to the profession.

Burton (2012) observed that there is a significant relationship between students' attitudes and academic achievements. He investigates the relationship between the attitude and academic achievement of students in mathematics. The descriptive-correlational research design was employed in the study. The sample size of the study was 560 students enrolled in a first-year mathematics course. The Survey of Attitude Towards Mathematics instrument was used in this study with the 6 attitude components namely affective, cognitive competence, value, interest, difficulty, and effort. Pearson's correlation was used to test the significant relationships between the attitude components and the academic performance of the students in the course. His findings revealed that the 5 attitude components such as affective, cognitive competence, value, interest and effort have a significant positive relationship with the

academic achievement of the students in mathematics. However, the difficulty component found no significant correlation with the academic achievement of the students.

Marchis (2013) studied the relationship between students' attitudes toward mathematics and mathematics achievement and discovered a positive relationship between students' attitudes toward mathematics and mathematics achievement. According to Marchis (2013), the following students are more likely to have high mathematics achievement:

- those who like to study mathematics and pursue mathematics-related activities,
- those who believe that learning mathematics will result in a positive outcome (e.g., success in school and job opportunities), and
- those who trust in their mathematical abilities.

Hill and Bilgin (2018), investigate the relationship between grade seven students' attitude towards Mathematics and their achievement in Mathematics using the adopted version of the Attitude toward Mathematics Inventory (ATMI) survey questionnaire developed by Tapia and Marsh (2004). The study by Hill and Bilgin (2018) revealed that grade VII students have a high level of attitude towards Mathematics with no significant difference between the attitude of male and female students towards Mathematics. They further revealed that there was a strongly positive and significant correlation between students who have high achievement in Mathematics and their attitude towards Mathematics.

2.9 Chapter summary

The literature shows that mathematics attitude is an important and common problem in teaching and learning of mathematics from the basic to the college levels. Several scholars all agree that mathematics attitude refers to a learned tendency of a person to respond positively or negatively towards an object, situation, concept, or person and attitudes can be described in terms of three structure components; affect (A) component, behavior (B) component and cognition (C) component.

Attitudes are developed as a result of one's experiences which influences a person's view of situations, objects, and people and how to respond to them either positively or negatively. Attitudes are formed through direct experience with models, objects or issues or ideas we interact with. Attitudes also develop out of psychological needs.

Literature indicated that there is a positive correlation between attitude and performance. Teachers performance was identified as the main cause of poor student performance and attitude towards mathematics.

The ABC model of the attitude of Ajzen (1993), adopted enables the researchers to investigate how people feel, think and interact with the attitude object. This literature also shows that the Ajzen (1993), ABC Attitude Model served as a useful theoretical framework for developing mathematics attitude measures.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter presents the methodological structure of the study. It looks at the research design, population, sample, sampling procedures, instrument, validity and reliability, data collection procedure and data analysis procedure

3.1 Research Design

According to McMillan and Schumacher (2014), a research design describes the procedures for conducting the study; including when, from whom, and under what conditions would the data be obtained. Thus, the research design indicates the general plan: how the research is set up, what happens to the subjects and what methods of data collection are used. The main purpose of a research design is to specify a plan for generating empirical evidence that will be used to answer the research questions. The intent of a research design is to use a plan that will result in drawing the most valid and credible conclusions from the answers to the research questions (McMillan & Schumacher, 2014). Mixed methods research design according to Creswell (2014) is an approach to researching a study, thereby making use of both quantitative and qualitative approaches on the premises of collection, analysis, and integration of the data or information. Mixed methods research design implicates, merged or incorporated qualitative and quantitative research data in a single study (Creswell, 2014).

The research design used in this study is the convergent parallel mixed method design. A convergent parallel mixed method design according to Creswell (2014) is a form of mixed methods design in which the researcher converges or merges quantitative and

qualitative data in order to provide a comprehensive analysis of the research problem. The researcher in this design, typically collects both quantitative and qualitative data at roughly the same time and then integrates the information in the interpretation of the overall results. Contradictions or incongruent findings are explained or further probed in this design (Creswell, 2014). A mixed methods research design is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative research methods in a single study.

The researcher used mixed-method design because in the mixed-method design, the result can be shown (quantitative) and explain why it was obtained (qualitative). Again, the researcher believes both qualitative and quantitative approach integrated into the single study establishes a better understanding of the problem than either research approach alone. The basic assumption of the mixed methods research is utilizing multiple data sources to ensure a holistic understanding of the research problem rather than depending on a single research design, thus depending on qualitative or quantitative data only (Creswell, 2014). The mixed design methods complement each other's weaknesses and strengths (Denscombe, 2010). The qualitative data were derived from the open-ended questions whereas the quantitative data comes from the closed ended data sources. Both quantitative and qualitative data were collected, analyzed separately for the purpose of establishing the facts. This is because the attitude was measured primarily by the attitude scales that show whether the attitudes are positive or negative. However, finding out about the attitude formation calls for qualitative methods (Yılmaz, et al., 2010).

3.2 Population

According to McMillan (1996), a set of elements or cases, that are individual objects or events that meet certain criteria and whose results can be generalized is a population. Similarly, Ary, Jacobs and Razavieh (2002) concluded that the population is the entire group of people to which the results of a study apply, the population is therefore the group on which the researcher wishes to draw conclusions. The population of this study comprised of all pre-service teachers of Mt. Mary College of Education. The total population is one thousand and seventy (1,070) made up of four hundred and seventy-four (474) males and five hundred and ninety-six (596) females. Three hundred and seventy (370) of the students offering the Primary Education Program and seven hundred (700) of the students offering the Junior High School Programs.

3.3 Sample and Sampling Procedures

A sample is a smaller set of data that a researcher chooses or selects from a larger population using a pre-defined selection method. Researching the whole population is often impossible, costly, and time-consuming. Hence, examining the sample provides insights the researcher can apply to the entire population. Thus sample usually represents a manageable size of the population (De Lange, 2007).

The sample was all level 100 students of Mt. Mary College of Education made up of 465 students (282 females and 183 male), 97 of the students offering the Primary Education program and 368 of the students offering the Junior High School Programs. Out of the 465 students sampled for the study only 325 voluntarily and willingly took part in the study. The 325 students are made up of 282 females and 143 males, 97 of

the students are offering the Primary Education program and 228 of the students offering the Junior High School Programs.

Sampling is the process of selecting a statistically representative sample of individuals from the population of interest. Sampling is an important tool for research studies because the population of interest usually consists of too many individuals for any research project to include as participants. A good sample is a statistical representation of the population of interest and is large enough to answer the research question.

Sampling is a process or technique of choosing a sub-group from a population to participate in the study; it is the process of selecting a number of individuals for a study in such a way that the individuals selected represent the large group from which they were selected (Creswell, 2014).

All 465 pre-service teachers (282 females and 183 males), were purposively chosen to answer the questionnaires and the test items. Out of the 465 pre-service teachers purposively sampled for the study, only 325 voluntarily and willingly took part in the study. All the 325 pre-service teachers, made up of 282 females and 143 males answered the questionnaires and the test items. A simple random sampling technique was adhered to in the selection of three students (one male and two females) in each of the classes A to F for interview.

The rationale for choosing this category of students is, that the researcher being a mathematics educator and examiner has observed that level 100 pre-service teachers of Mt. Mary College of Education over the years have challenges with mathematics learning to the extent that if not because it is mandatory to take a mathematics course

in year one semester, they wouldn't have taking any mathematics course. The researcher also observed that the attitudes of the level 100 pre-service teachers are carried on from their Senior High Schools since almost all of them come directly from Senior High Schools where researchers (Abreh, Owusu, & Amedahe, 2018; Enu, Osei, & Nkum, 2015; Fletcher, 2018) observed there is a relationship between their attitudes towards mathematics learning and their performance in mathematics.

Again, if the attitudes of level 100 pre-service teachers are known and how their attitude towards mathematics formed, within a carefully planned space given, an opportunity would be given to address these perceptions of their prior mathematics experiences whiles studying before they will become in-service teachers by ensuring they learn the wide range of strategies and approaches they need to become successful teachers of mathematics.

Lastly, Mt. Mary College of Education pre-service teachers form part of our future basic school teachers, they will soon graduate and will be ushered into the teaching profession where they will be expected to teach mathematics to other young ones or apply mathematics in their work. It is therefore not out of place to inquire about their attitude towards mathematics.

3.4 Instruments

A Research Instrument is a tool used to collect, measure, and analyze data related to your research interests. It includes interviews, questionnaires, tests, surveys and checklists The Research Instrument is usually determined by the researcher and is tied to the study methodology (De Lange, 2007).

According to De Lange (2007), a good research instrument is one that has been validated and has proven reliability. It should be one that can collect data in a way that is appropriate to the research question under study. The research instrument should be able to assist in answering the research aims, objectives and research questions, as well as prove or disprove the hypothesis of the study. It should not have any bias in the way that data is collected and it should be clear as to how the research instrument should be used appropriately (De Lange, 2007).

The Mathematics Attitude Questionnaire (MAQ), open-ended questions, test items and semi-structured interview designed by the researcher were used.

3.4.1 Questionnaire

A questionnaire according to Oppenheim (1992) is a vital research instrument or tool used for data collection and its main function is measurement. Bulmer (2004) opines that a questionnaire is a very vital tool within social science research that basically collects information on participant's views of matters relating to their social distinctiveness, present and past, standards of behaviour or attitudes as well as beliefs and reasons for action with respect to the topic under investigation.

According to Vanek (2012), the Likert scale is the most useful option when you want to get an overall measurement of a particular topic, opinion, or experience on attitudes. The Likert scale thus enables participants to indicate the degree of their beliefs and feelings about a given statement or object. Apart from the fact that the Likert-type questionnaire is popular; the researcher has an interest in it because it is convenient to construct, administer and score, and the Likert scales look interesting to participants and people enjoy completing them.

The MAQ consists of 26 close-ended questions in a form of a 5-point Likert scale. Five attitude aspects were considered: self-confidence in mathematics, perceived usefulness of mathematics, enjoyment of mathematics, mathematics anxiety, and intrinsic motivation. All statements composing attitude aspects were scored on a 5-point Likert scale ranging from 5 = strongly agree to 1 = strongly disagree.

Due to the inability of the Likert scale items to explain reasons for the formation of attitudes (Hourigan et al., 2016), open-ended questions also were used. These questions gathered qualitative data regarding opinions about how the attitudes were formed.

Section A of the questionnaire sought participants' background information. Section B consisted of 26 items on the attitude toward mathematics among participants. Section C consisted of 2 items on opinionated responses on attitude formation.

3.4.2 Interview Guides

Interview generally denotes a dialogue between two or more people with the sole aim of achieving a specified goal. It is believed that interviews permit interviewers to observe and gain insights from non-verbal cues (Anderson, 1998). Ampadu (2012) noted that interviews are a relevant tool in the assessment process in respect to the attitudes of individuals and morals since they are difficult to be observed or put up in an official questionnaire. Interview as a primary data collection were useful to the researcher in the sense that detailed information about the research questions was obtained. Moreover, the researcher had control over the process and was able to adopt all necessary and appealing strategies to lay hands on what he is after.

Interviews are categorized into three forms namely; the structured, the semi-structured and lastly the unstructured type. For the purposes of this study, the semi

structured interview with all open-ended questions was selected for the study. The reason being that the interviewer in semi-structured interview is always at the helm of affairs controlling the process leading to the soliciting of information from the respondent, and the interviewer with the liberty of applying new strategies as and when it becomes necessary in the process (Bernard, 1988). The researcher again chose the semi-structured interview method because it allows the interviewee the freedom to express his or her viewpoints in a manner that comforts him or her.

The interview guide was made up eight open-ended questions enquiring of the attitudes of the respondents with regards to importance of mathematics, interest in mathematics, how they enjoy mathematics and how comfortable they are when it comes to mathematics learning

The interviews were conducted in groups. In this kind of environment, students are likely to open up and be truthful in responding to questions (Shaw, Brady & Davey, 2011). The interview was guided by interview guide to ensure consistency. The interview method offers the possibility for clarifications and helps in getting hold of information that would have been difficult to obtain (Randolph, 2008).

All 18 students (12 females and 6 males) were interviewed in groups with each group consisting of five students and one of the groups consisting of three students. Each of the groups was interviewed between 15 and 25 minutes

The group interviews were conducted taking into consideration that students identify themselves easily in the presence of their colleagues or peers. The interview was however challenging because it was time consuming or requires a longer time.

Another difficulty was in scheduling of time with respondents and at the same time getting the respondents to meet and respect the scheduled time.

3.4.3 Achievement Test

The test has been used for many purposes, such as providing student grades, national accountability, system monitoring, student placement or monitoring, determining interventions, improving teaching and learning, or providing individual feedback to students and their parents/guardians (Newton 2007). Class test/quiz gathers information and provides feedback to support individual student learning (De Lange, 2007) and improvements in teaching practice.

Mathematics achievements were measured by self-reported scores based on the mid-semester quiz for the semester. The mid-semester quiz was made up of close-ended (multiple choice) questions where the students were to choose the correct answer and open-ended (subjective) questions where students were to provide or solve on their own.

The multiple choice or objective test questions were used because they can test a wide sample of the curriculum quickly and can be marked easily. The Open-ended (subjective) questions were also used because they typically take less time to develop, and they offer students the ability to be creative or critical in constructing their answers. In all ten multiple-choice and two subjective test questions were given.

It scored 20 marks in all and converted to 100 marks (100 percent). The scores were converted into a 4-point scale ranging from 1=fail (0 to 39 marks), 2=weak pass (40 to 49 marks), 3= pass (50 to 79 marks) and 4=excellent (80 to 100 marks). This was executed because the researcher wanted to find out about the performances of the

students and to establish whether such performances could be linked to the attitudes of students towards mathematics, or whether three is relationship between the students' performance and their attitudes in mathematics learning.

3.5 Validity and Reliability of Instruments

Validity and reliability are very important in research findings. Validity is the degree to which research instruments accurately represent that which it was intended to research or the degree to which an instrument measures what it is supposed to measure. In simple terms, validity determines whether an instrument measures what it is anticipated to measure. Ary, Jacob and Razavieh (2002) stated that validity is very important in the development and evaluation of research instruments. To ensure validity, the drafted questionnaire and the interview guides were given to colleague post graduate students at the Mathematics Education Department of University of Education, Winneba for their comments and suggestions. Finally, it was given to my supervisors for corrections and suggestions.

To ensure the reliability of the instrument used for the study, a pilot study was conducted at the SDA College of Education, Koforidua. The researcher selected SDA College of Education, Koforidua, because SDA College of Education offers Early Grade and the Primary School Programs.

Cronbach's Alpha reliability scores for the five attitude aspects were also calculated. The values ranged between 0.56 and 0.87. The values agree with Abe and Gbenro (2014), who suggested that the reliability coefficient of instruments should lie between 0.5 and 0.8 or high. The reliability scores for the attitude aspects were presented in Table 3.1.

Table 3.1: Cronbach's Alpha of the Attitude Aspects of Items

Attitude aspect		Cronbach's Alpha
Affect	Self-confidence	0.56
	Mathematics anxiety	0.87
	Enjoyment of Mathematics	0.83
Behaviour	Intrinsic Motivation	0.86
Cognition	Perceived Usefulness	0.71

Validity was also checked by comparing the responses from the questionnaire with the objectives stated for the study.

Clarity, understanding and ambiguity was discussed with the students and the feedback helped the researcher to develop the final questionnaire with inputs from the expert (supervisor).

3.6 Ethical Consideration

The authorities of Mt. Mary College of Education, Somanya where the participants (students) were sed for the study were served with an introductory letter from the mathematics department of the University of Education Winneba for approval. After obtaining permission from the appropriate authorities, the researchers with the respective head of department of the school met with the appropriate research participants. Participants were informed about the purpose and nature of the research verbally. Voluntary participation and complete anonymity were guaranteed to all participants. In all guide lines for graduate studies in UEW on research was adhere to.

3.7 Data Collection Procedure

The data collection procedure determines the outcome of the study results. It was, imperative to adopt a standard and workable method of collecting the relevant data to ensure that the results of the study would be acceptable. A preliminary survey or pilot studies was carried out to modulate the questionnaire, identify available and credible sources of data, and ascertain any challenges likely to hinder the smooth conduct of the study. To obtain maximum cooperation from participants and to have access to credible sources of data, the researcher sought permission from the Principal of Mt. Mary College of Education with a letter from the Department of Mathematics Education, of the University of Education, Winneba.

This was to enable the researcher to gain access to the participant for the study. The researcher finally together with the head of mathematics department and all tutors of the mathematics department at Mt. Mary College of Education met with the participants. The purpose of the study and the rationale for them to answer the items independently was explained to the pre-service teachers involved before the instruments were administered. The researcher together with the head of the department and all tutors in the mathematics department administered the instruments to all the participants on the same day at the same time and responses were collected. Each participant was given a code by the researcher which helped the researcher to identify each participant, to mapped the achievement score of each participant from the mid semester quiz with the response of the questionnaire. Interview dates and time was scheduled with pre-service teachers who have been selected through simple random sampling. The participants for the interview were put into four groups with each group consisting of five students, three females and two males. The interview section for each group lasted for between 20 minutes to 45 minutes.

3.8 Data Analysis

The answered questionnaire was scrutinized to ensure they have been completed correctly. A triangulation mixed method design was adopted in analyzing the data. The Triangulation mixed method design according to Creswell (2014) generally uses separate quantitative and qualitative methods as a means to offset the weaknesses inherent within one method with the strengths of the other (or conversely, the strength of one adds to the strength of the other) for onward analysis and interpretation. The Triangulation Design is a one-phase design in which researchers implement the quantitative and qualitative methods during the same time frame and with equal weight (Creswell,2014). Creswell (2014) again noted that the triangulation mixed method design involves the concurrent, but separate, collection and analysis of quantitative and qualitative data so that the researcher may best understand the research problem. Quantitative and qualitative data were analyzed separately.

Triangulating data, methods, and investigators, helps the researcher to avoid the bias that comes with using a single perspective in one's research. The researcher gets a well-rounded look into the research topic when he uses triangulation. Using triangulations, the researcher combines different methods, data sources, and theories that enhance the credibility and validity of the research. The researcher will be able to trust that his data reflect real life more closely when gathers them using multiple perspectives and techniques.

The triangulation mixed method design was adopted because it is an efficient design, in which both types of data are collected during one phase of the research at roughly the same time. Each type of data was collected and analyzed separately and independently, using the techniques traditionally associated with each data type.

3.8.1 Quantitative Analysis Procedure

Data obtained from closed-ended items in the questionnaire were coded and entered in the Statistical Package for Social Sciences (SPSS) version 16.0. All statements composing attitude aspects were scored on a 5-point Likert scale ranging from 5= strongly agree to 1 = strongly disagree. Negative items, thus item numbers 1,12,14,15,16,17,18 and 19 in the mathematics attitude scale were scored in the reverse order. Mathematics achievements measured by self-reported scores based on the mid-semester quiz for the semester were scored on a 4-point scale ranging from 1=fail, 2=weak pass, 3= pass and 4=excellent.

Mean scores were calculated for each statement of attitude aspect to get variables which were used in subsequent analysis. The first research question of the study was required to establish the students' attitude towards mathematics. Towards this end, descriptive statistics such as mean was used where mean values of all attitude aspects were averaged to get the overall attitude. Bivariate correlation analysis was carried out to establish the relationship existing between mathematics achievement and attitude component variables.

Relevant information was presented in the form of charts and tables to make the findings clearer. In quantitative method, simple frequency tables and percentages were calculated and inferences were drawn by comparing these figures.

The researcher believes that adopting both descriptive and inferential statistics indicates a powerful avenue for description and prediction in data analysis. It also brings to bear the complete picture of the data collected from the population. Descriptive statistics were much a choice by the researcher because there was the

need to describe the patterns that emerged from the data and were interested in the performance of the students about their attitudes.

3.8.2 Qualitative Data Analysis

A descriptive narrative method was used to analyze the responses to the open-ended items. Students' responses to questions: How did your attitude (like or dislike) towards mathematics form? (item number 27). Can you recall specific incidences which might have contributed to the formation of your attitude (like/dislike) for mathematics? (item number 28) were coded and arranged based on the emerging themes.

Thematic analysis was used to analyze the data from the open-ended items (textual) and interviews (aural). Braun and Clarke (2006) state that thematic analysis is in the form of identification, analyzing and reporting of patterns in the data collected during interviews. This form of analysis was employed because it is very useful in summarizing crucial features of a huge data set in that it compels the researcher to take a well-structured approach to manage data as well as helping to produce a clear and organized final report. The analysis was done manually through a number of stages. The first stage involved familiarization with the data whereby the data were transcribed in such a way that textual data were recorded as close to verbatim as possible from the students' hand written responses. Then the transcriptions were read in a repeated manner while writing notes of the initial issues. In the second stage, the data were coded and verbal expressions relevant to each code were identified.

The third stage involved sorting of different codes into the emerging themes and pulling together all relevant data extracts within the identified themes which were organized by using a table. In the next stage, the themes were reviewed to ascertain

the relationships with the data set. The themes were then grouped into different subjects based on the research questions. Finally, verbal extracts were used to support the identified factors pertaining to students' attitude formation that affected students' learning of mathematics.

CHAPTER FOUR

RESULTS/FINDINGS AND DISCUSSIONS

4.0 Overview

This chapter presents the results of the study. Results from data analysis of items in the instruments used are presented. Prior to this, some demographics of the participants are presented. Also included in this section are discussions pertaining to the findings. In this chapter, the results are presented under the following themes in response to the research questions posed:

1. Demographic characteristics of respondents.
2. Research question one – What is the attitude of the pre-service teachers towards mathematics learning?
3. Research question two - What contributed to the formation of the attitude of pre-service teachers?
4. Research question three – What is the relationship between the pre-service teachers' attitudes towards mathematics and their performance in mathematics.

4.1 Demographic Characteristics of Respondents

Of the 325 respondents, 133, representing 40.9 % were males whilst 192, representing 59.1 % were females. The demographic information about the gender of participants in the study showed that the females students outnumbered the male students. Table 4.1 shows the gender of respondents.

Table 4.1: Gender of respondents

Gender	Frequency	Percent
Male	133	40.9
Female	192	59.1
Total	**325**	**100.0**

Out of the 325 respondents, 85 (22.6 %) of them offered the Primary Education Program and 240 (73.8 %) of them offered the Junior High School (JHS) Program. Table 4.2 shows the program of study of the respondents.

Table 4.2: Program of Study of Respondents

Program	Frequency	Percent
Primary	85	26.2
JHS	240	73.8
Total	325	100.0

4.2 Research Question One: What is the Attitude of Pre-Service Teachers Towards Mathematics Learning?

Research question one sought to find out the attitude of pre-service teachers towards mathematics learning. To answer this question descriptive statistics such as means, standard deviation and percentages were used. To say that a student has a positive attitude towards mathematics, he or she has to at least score a mean value above 3.0, the midpoint of the scale. The mean values are above 3.0 indicating that, the students possessed positive attitudes towards mathematics. The mean, as well as the standard deviation of the pre-service teachers' responses to the questionnaire items, are indicated in Table 4.3.

Table 4.3: Mean Distribution and Standard Deviation of Pre-Service Teachers' Responses to Questionnaire Items on Attitudes of Students Towards Mathematics on The Likert Scale.

Variable	N	Mean(M)	Standard Deviation (SD)
Mathematics attitude	325	3.68	0.780

From Table 4.3, the average mean for all the mean items of the students' responses to items on mathematics attitude is 3.68, (*SD=0.78)*. This indicates that pre-service teachers generally have a high attitude towards mathematics. For further details, the attitudes of students towards mathematics in the questionnaire for each item on the Likert scale were calculated and the results are shown in Appendix C.

To make the findings clearer, the attitudes of students towards mathematics in the questionnaire were grouped into attitude categories or components. The mean and standard deviations of the attitude components are presented in Table 4.4.

Table 4.4: Means and Standard Deviations of Respondents' to Attitude towards Mathematics in Categories

Attitude components	Item number	Mean	Standard deviation (SD)
Value/Importance	1,2,3,4,5,6	4.34	0.78
Anxiety	12,13,14,15,16,17,18	2.67	1.98
Confidence	7,8,9,10,11	3.72	1.03
Enjoyment	23,24,25,36	3.98	1.01
Interest	19,20,21,22	3.97	1.02
Overall		**3.68**	**1.16**

From Table 4.4, importance or value of mathematics had the highest mean among the various attitude components with a mean of 4.34. Thus, most of the participants see mathematics as very important or valuable in their daily lives. As depicted in Table 4.4, the mean score for the interest component is 3.97 which is above 3.0, indicating that the respondents have a high or positive interest in mathematics.

The majority of the respondents also indicated that they enjoy mathematics very well with a mean of 3.98 which is also above 3.0 indicating that the respondents enjoy mathematics. Mathematics anxiety according to Table 4.4 is below 3.0. This indicates that anxiety in mathematics for the pre-service teachers is low with a mean of 2.6.

Apart from the mean, frequencies and percentages of responses of the pre-service teachers to each mathematics attitude item on the Likert scale of the questionnaires were also examined. The results are summarized in Appendix D

For further details, the attitudes of students towards mathematics in the questionnaire were reduced to three; agree, undecided and disagree the frequencies and percentages were computed. This grouping was done by merging responses to items under “strongly disagree” and “disagree “to constitute disagree whilst items under “strongly agree “ and “agree” were merged to constitute agree. The groupings are in line with the view of Joseph (2013), who observed that attitudes are either positive or negative but they can also be uncertain at times. This grouping is also similar to the study and analysis conducted by Syyeda (2016). Syyeda (2016) examined college students’ attitudes towards mathematics learning by finding the frequencies and percentages of three profiles of attitudes toward learning mathematics namely negative, neutral and positive. The responses in frequencies and percentages of pre-service teachers'

attitudes towards mathematics for each of the Likert scale items in the questionnaire were presented in Table 4.5.

Table 4.5: Frequencies and Percentages of Responses to each Mathematics Attitude item on the Likert scale by the Pre-service Teachers

Item number	Disagree	Undecided	Agree	Total
1	12 (3.7%)	11 (3.4%)	302 (93%)	325 (100%)
2	13 (4.0%)	11 (3.4)	301 (92.6%)	325 (100%)
3	15 (4.6%)	5 (1.5%)	305 (93.2%)	325 (100%)
4	9 (5.2%)	8 (2.5%)	308 (93.3%)	325 (100%)
5	19 (5.9%)	12 (3.7%)	294 (90.4%)	325 (100%)
6	12 (3.7%)	14 (4.3%)	299 (92.0%)	325 (100%)
7	53 (16.3%)	26 (8.0%)	246 (75.7%)	325 (100%)
8	54 (16.7%)	16 (4.9%)	255 (78.5%)	325 (100%)
9	51 (15.7%)	28 (8.6%)	246 (75.7%)	325 (100%)
10	53 (16.3%)	28 (8.6%)	244 (75.1%)	325 (100%)
11	77 (23.7%)	11 (3.4%)	237 (72.9%)	325 (100%)
12	57 (17.5%)	33 (10.2%)	235 (72.3%)	325 (100%)
13	96 (29.6%)	27 (8.3%)	202 (62.2%)	325 (100%)
14	92 (28.0%)	14 (4.3%)	219 (67.4%)	325 (100%)
15	79 (24.3%)	17 (502%)	226 (69.5%)	325 (100%)
16	77 (23.7%)	11 (3.4%)	237 (72.9%)	325 (100%)
17	78 (24.0%)	9 (2.8%)	237 (72.9%)	325 (100%)
18	69 (21.3%)	11 (3.4%)	241 (74.8%)	325 (100%)
19	48 (14.7%)	18 (5.5%)	259 (79.7%)	325 (100%)
20	33 (10.2%)	18 (5.5%)	273 (84.0%)	325 (100%)
21	32 (9.9%)	11 (3.4%)	281 (86.4%)	325 (100%)
22	35 (10.8%)	7 (2.2%)	282 (86.8%)	325 (100%)
23	38 (11.7%)	9 (2.8%)	278 (85.5%)	325 (100%)
24	40 (12.3%)	15 (4.6%)	270 (83.1%)	325 (100%)
25	34 (10.8%)	11 (3.4%)	279 (54.8%)	325 (100%)
26	38 (11.7%)	16 (4.9%)	271 (83.4%)	325 (100%)
Average	47 (14.4%)	15 (4.7%)	263 (80.8%)	325 (100%)

From Table 4.5, it was observed that on average only 14.4 percent of the participants disagreed with the items on the Likert scale of which most of the items are positively worded. Again, on average, only 4.7 percent of the respondents were not

certain/undecided about the items on the Likert scale. It is evident from the responses of the pre-service teachers that, they had positive attitudes towards mathematics. A high majority with an average of 80.8 percent of the respondents agreed with items on the Likert scale which were mostly positively worded

To make the findings clearer, the percentages of the attitudes of students towards mathematics learning in the questionnaire were grouped into categories/components and the results were summarized in Table 4.6

Table 4.6: Percentage of Responses to Mathematics Attitude components by Respondents

Attitude components	Item number	Disagreed %	Undecided %	Agreed %	Total %
Value/importance	1,2,3,4,5,6	4.51	3.13	92.36	100
Anxiety	12,13,14,15,16,17,18	63.77	5.37	30.86	100
Confidence	7,8,9,10,11	18.57	6.87	74.56	100
Enjoyment	23,24,25,26	11.63	3.93	84.44	100
Interest	19,20,21,22	11.40	4.15	84.45	100

The majority of the respondents agreed that mathematics is useful or important. Thus, a whopping 92.4 percent of respondents as against 4.51 percent disagreeing to the usefulness or importance of mathematics. This is suggestive that the respondents truly understand and appreciate the relevance of mathematics in their lives.

It was also observed that the majority of the students considered mathematics as an interesting subject or have an interest in studying mathematics as 84.5 percent of them responded in that direction and only 11.4 percent of the respondent see mathematics as otherwise and 4.15 percent of the respondents are undecided on see mathematics as interesting or do not have interest in mathematics.

As regards students' mathematics anxiety, 63.8 percent affirmed to the statement that they do not have mathematics anxiety whilst 30.9 percent held opposite view and 5.4 percent of the respondents do not know whether they have mathematics anxiety or not. As to whether respondents enjoy studying mathematics, a majority of 84.4 percent indicated that they enjoy studying the subject mathematics whilst the remaining 11.6 percent indicated otherwise and only 4.0 percent of the respondent were undecided.

The scores above 50 percent represent high self-confidence, and below 50 percent represent low self-confidence. Table 4.4 shows that the value for self-confidence is 74.5 for agreed, indicating that pre-service teachers in the sample were very confident when it comes to learning mathematics with only 18.6 percent not having self-confidence and 6.9 percent undecided in self-confidence when it comes to mathematics learning.

4.2.1 Results of Interview for Research Question One

The interview guide sought to further enquire from participants about their attitudes towards mathematics learning. The students were interviewed to elicit their attitudes towards mathematics learning to complement the Likert scale questionnaire responses. When the interviewees were asked whether mathematics is important or not, (importance of mathematics).

> Out of the 18 students interviewed on the importance or the relevance of mathematics, most of them linked it to its application in their daily lives. Five of the respondents responded by giving responses the same as, "*Mathematics is relevant because you can learn mathematics in other subjects".* Ten of the interviewees also answered by indicating "*It is relevant because every job that you will do require mathematics". Three of the i*nterviewees also underscored the relevance of mathematics by asserting, "*Mathematics is relevant because it helps us in all the other subjects we study".*

From the responses of the interviewees, it was observed that all the interviewees recognized the relevance of mathematics in their lives.

When the respondents were asked, "How often do you learn mathematics and why?" (interest in learning mathematics).

> Out of the 18 students interviewed, 12 of the interviewee gave a response, that implies, "*mathematics is a subject that I learn almost every day. Whether I have it on my learning timetable or not I make sure I solve at least a question every day".* 2 out of the 18 interviewees posited, "*because mathematics is a very interesting subject I learn mathematics 3 times in a week". 4 of the* interviewee responded by saying, "*because mathematics is compulsory I learn it on my own every morning "*

The response given by the respondents clearly indicates that, they have an interest in studying mathematics. When the interviewees were asked do you always feel comfortable studying mathematics and why? *(anxiety in mathematics)*

> Out of the 18 students interviewed, "do you always feel comfortable studying mathematics and why?" Ten (10) of the interviewees said "*I sometimes feel uncomfortable when am not able to solve a question correctly".* Similarly, 4 of the interviewees responded by saying, "*Most of the time I feel very happy if am able to get it correct, if I don't get it correct, I get worried.* Three (3) of the interviewees answered the question by saying "*weather the answer is correct or not I am not worried. If it is wrong my teacher motivates me by encouraging me that I should try again because am not far from the correct answer".* One (1) of the interviewees just said "*Oh how can you feel comfortable when your answer is wrong".*

It is evident from the responses that students feel some discomfort (anxiety) towards mathematics especially if concede that the mathematics question is difficult. When the interviewee were asked "are you able to solve mathematics problems correctly within a given time?" (self-confidence in mathematics).

> Out of the 18interviewees, 12 of the interviewees gave a response, that implies, " *mathematics is a subject that sometimes you will finish within the given time and get it correct but not always "*. Two (2) out of the 18 interviewees posited, "*I don't think you can always finish a mathematics problem correctly before they say stop work". Four (4) of the* interviewees responded by saying, " *even if you can do it you won't always finish".*

It can be observed from the responses of the respondents that the majority of them have some self-confidence when it comes to solving mathematics within a given time whiles some of the respondents lack self-confidence when it comes to solving a question correctly. This is a positive development since it shows some level of self-confidence towards Mathematics.

When asked do you get a great deal of satisfaction out of solving a mathematics problem? (enjoyment of mathematics)

> Out of the 18 interviewed 7 of the interviewees said sometimes mathematics is difficult but it's enjoyable even if you can't do it. It is full of fun if the teacher is good. Some of the respondents, (12) of the interviewees give an answer which implies "solving a mathematics question is full of fun.

The answer to research question one which sought to investigate the attitude of pre-service teachers towards mathematics learning can be concluded from the analysis of the questionnaire items and the interview items that pre-service teachers have a positive attitude towards mathematics learning.

4.2.2 Discussions of Results for Research Question One

The findings from the study indicate that pre-service teachers generally have a positive attitude towards mathematics. Positive attitudes are important to providing a conducive environment for learning as the students learn better if they enjoy what they are learning. This result corroborates with the findings of Mazana et al. (2018), who conducted a study to investigate students' attitudes towards learning mathematics in Tanzania and observed that pre-service teachers possessed positive attitudes towards mathematics learning. The mean attitudes of the attitude components

towards mathematics learning were generally very high (Mazana et al. 2018). The findings further agrees with Hannula (2014) who observed in a study that pre-service teacher have a positive attitude towards mathematics learning because it influences their mathematics academic achievement.

The findings of the study were also in accordance with those of Syyeda (2016), who examined college students' attitudes towards mathematics learning and found three profiles of attitudes toward learning mathematics. The three profiles of attitude towards mathematics learning according to Syyeda (2016) are negative, neutral, and positive. The study by Syyeda (2016) concluded that the attitude of the college students is very positive.

The results of this study contradict with the findings of other researchers like Burton (2012) and Michaluk et al. (2018). Burton (2012) in a study of pre-service teachers' attitude towards mathematics learning observed that pre-service teachers have negative attitude towards mathematics learning and have more especially high level of mathematics anxiety. Michaluk et al. (2018) also noted that pre-service teachers of all levels of education often have negative attitudes towards mathematics and fears about the teaching of mathematics. All the levels of mathematics teachers, both in-service and pre-service teachers' have negative attitudes towards mathematics and that the pre-service teachers have negative attitude towards mathematics learning as well (Michaluk et al. 2018).

4.3 Research Question Two: What Factors led to the Formation of the Attitude of Pre-Service Teachers ?

The respondents were asked an open-ended opinionated question in the mathematics attitude questionnaire. "How did your like or dislike towards mathematics form?".

Followed by can you recall a specific incidence(s) which might have contributed to the formation of your attitude (like/dislike) for mathematics

Their responses resulted in several themes that are discussed below. Among the identified themes were: usefulness of mathematics, mathematics being a compulsory subject, encouragement and support received from others, having a good teacher, self-confidence, difficulty and fear.

Usefulness of mathematics: Some of the respondents said their likeness for mathematics is because mathematics is very useful in their daily lives. They can apply mathematics in real life situations like buying and selling, finding time and distance. They said that most of the things they did in everyday life were about mathematics. When people go to church, home, school, shopping, and even when they travel, they apply mathematics. The quote from one respondent states "… *I started liking mathematics when I realized in the primary school that, mathematics is applied in our daily lives, when we are in the church, the school, the shop and in different aspects of business issues mathematics is applied, I think that is how my likeness formed*…". Mathematics being an aid in solving mathematics-related problems encountered in other subjects and fields also emerged; some respondents said that problems related to mathematics in other subjects could be done when a person had mathematical knowledge or can apply mathematical knowledge. This are illustrations by some respondent's "….*I like mathematics because I can apply this knowledge in different areas like closing a school register on Fridays and working on students exams scores. It happened when I was teaching after SHS*" . " *I started liking mathematics when I started helping my mom at the super market*". "*Oh, I like mathematics because in this modern world, if you want to do anything it involves mathematics. I use mathematics*

knowledge to share water and light bill for my house owner from Primary school". "*It all started when I started helping my father at the blocks factory to find things like cost and profit, to calculate the total number of blocks to give to a customer and..*"

***M*athematics being a compulsory subject**: Some respondents said that they developed the likeness for mathematics because the subject was compulsory. Mathematics is a compulsory subject in the basic schools and senior high schools in Ghana. Students are mandated to pass mathematics as a subject in Ghana as a requirement. The following are some quotes from some respondents to support the finding "… *because mathematics is among the mandatory subjects that are studied at the JHS and SHS, I had no choice than to like it and pass it and even here, that is how I am forced to develop the likeness for mathematics".* "*Every morning in the primary school we did mental and recited the multiplication tables, it has helped me to have likeness for the subject*" . "*If not that mathematics is compulsory, I wouldn't have studied it ..., I hate it being compulsory*". "*I have no choice than to pass also the mathematics course before I can proceed to level 200, I am forced to like mathematics".* This suggests that students developed likeness or dislike for mathematics because it is a compulsory subject.

Encouragement and support received from others: Some respondents said that they developed the likeness for mathematics due to the encouragement and support they received from parents, teachers, and fellow students. examples of such quotes: *"…I remember my teachers and parents encouraged me to practice myself when I was in SHS. They corrected me when I missed it, that is how I came to like mathematics*" . "*When it comes to the likeness of mathematics, my elder brother who was at the university did the magic in me when I was at SHS*". "*My teacher always*

told me I was good and was giving me a lot of questions to try, I think that encouraged me to like mathematics" "*When in JHS, my teachers and parents encouraged me to practice mathematics myself. They corrected me when I missed it, that is what I remember*". "*… when I was faced with difficulties in mathematics… I asked my teachers and fellow students, they explained well*." "*My best friend in SHS was good in mathematics, he helped me a lot, I now like mathematics because of him, I wish we were in the same tertiary institution.*"

This response from the above respondents showed that teachers, parents, and peers are crucial in building student's attitudes towards mathematics.

Having a good teacher: Having a teacher who teaches for understanding, makes lessons enjoyable and is of crucial importance for students' engagement in mathematics. This is supported by quotes from the following respondents "… *my teacher taught well in JHS … when I study mathematics, I enjoy it because I had a good teacher in the primary school and I like that , that is how come I developed the likeness for mathematics*" , another respondent narrated "*The teacher who taught me during WASSCE remedial always taught for me to understand, I liked his style of teaching and that made me love mathematics*". "*… My teacher taught me well. When I study mathematics, I enjoy because I had a good teacher, that is how I developed likeness for mathematics*".

Having a teacher who does not teach for students understanding, also makes lessons less enjoyable. It is very importance for students to be engagement in mathematics. This is supported by quotes from the following respondents "..*My problem is that our Mathematics teacher in JHS was too fast. I did not understand and did not enjoy Mathematics, that is how come I don't like mathematics.*" " *I wanted a teacher who*

was patient and does not get angry with me, but it did not happen so, I don't enjoy learning Mathematics,.....anytime I told him I don't understand, he ended up shouting and asking how come I don't understand such an easy thing. He constantly told me i don't use my brains, I hate mathematics". "*I sometimes wonder why our mathematics teacher was given mathematics to teach. She insisted that we memorize mathematics formula because it is the only way to learn mathematics. When I ask her any question, she became very angry and accused me of laziness. She told us that the curriculum doesn't allow a teacher to spoon feed learners. She usually said answers were in the textbooks and not in her" that teacher developed in me the hatred for mathematics*".

This results illustrates the importance of the teachers' personal and professional characteristics in developing students' liking or dislike for mathematics. Thus, teachers' characteristics help students develop a positive or negative attitude towards the subject mathematics. This again connotes that irrespective of the mathematical capability of students if teachers display negative attitude towards mathematics students may not develop positive attitude towards mathematics learning and vice versa

Self-Confidence: Some of the respondents were of the view that they lacked confidence in themselves as mathematics learners and that has affected their likeness for mathematics. Some of the respondents believed they are not good at mathematics and others also believed they are good in mathematics. Some respondents narrated, *"... Because I was not good at mathematics from primary... I don't like mathematics". "What I remember was that anytime I was doing mathematics, I wasn't so sure so I stopped". "I have been good in mathematics from class one without any reason, no specific incidents made me so". "I am able to solve plenty of questions in*

mathematics, that is all I will say". These illustrations from respondents indicates the importance of self-confidence in students' attitude towards mathematics formation.

Difficulty and Fear: Some of the respondents were of the opinion that mathematics is difficult and believed that they were not good at mathematics and not able to pass no matter how hard they tried. "*Mathematics is a difficult subject for everyone. We struggle to learn Mathematics and our teacher also struggles when teaching us. It is not her making because Mathematics is just a difficult subject*." "*… Mathematics has been difficult since class one… despite much of my efforts, I couldn't pass, that is how come I don't like it …*". "*….I feel mathematics is always difficult because I always got it wrong from primary school, that is how I developed the hatred for mathematics…*" ."*I am afraid of mathematics tests. Mathematics is my greatest enemy. I do write mathematics tests but I don't pass. I am not the only one who fail Mathematics test several times".*

For some Students' mathematics is difficult due to the lack of understanding of some topics. As a result, they score poor marks in class exercises, class test and examinations, hence disliking mathematics. This is supported by responses given by some respondents: "*Sometimes I feel mathematics is difficult because I might be provided with math problems… while I have not understood… I end up scoring marks contrary to my expectations, that is why I developed dislike for mathematics*". "*I always fear mathematics exams and don't like mathematics exams, I just don't like mathematics and….*". " *….I feared mathematics when I failed the WASSCE examination*". *I always want to be in a mathematics class but hate mathematics exams, I don't like mathematics from class one*" .

"*… In primary school the teacher was so angry to the extent that it caused me from attending the class, that is how I developed a hatred for mathematics*". "*In JHS the mathematics teacher during mental always caned so I stop attending his class, so since JHS I don't like mathematics…*". "*When you failed the mathematics class test the teacher would beat me, so I hate mathematics".*

Difficulty and fear of mathematics do affect students' likeness or unlikeness of mathematics as a subject. The use of punishment when a student failed in a test or an exam makes students lose interest in the subject. These responses from respondent's point to the fact that teachers' behaviour sometimes puts fear in the students affecting them negatively in their attitude towards mathematics learning. These practices discourage students as they instill fear and by so doing the mathematics instructions become less enjoyable. Hence, students develop a dislike towards the subject of mathematics.

4.3.1 Discussion of Results for Research Question Two

It was revealed by the respondents that the usefulness of mathematics, mathematics being a compulsory subject, encouragement and support received from others, having a good teacher, self-confidence, difficulty and fear are very important factors in students' development of positive or negative attitude towards mathematics. The findings agree with the results of Simmers (2011 opined that when a student thought of a teacher as good or if they liked him or her, this could affect their intrinsic and extrinsic motivation to learn the subject in a positive way and attend class punctually and regularly, thus affecting their mathematics attitude formation.

Most of the respondents from the study had their attitudes formed in one way or the other related to their teachers at primary, junior high or senior high school. Students'

expectations from their teachers is that, they wanted the teachers to deliver their lessons and points clearly as they are the ones who would make lessons enjoyable or otherwise. The learning of Mathematics depends on the way it is presented to the learner, the way the learner actively interacts with the learning experiences to him and the environment within which the learning takes place. The positive attitude of mathematic teachers towards the subject, the positive the pre-service teachers attitude towards the learning of mathematics. The attitude of the mathematics teacher resonates in the attitude of the pre-service teachers towards mathematics learning. Teachers' attitude towards mathematics, therefore, matters as it has a powerful influence on student attitude formation. These affirmed the studies by the findings of Akey (2006), Maat and Zakaria (2010) which indicated that how students perceive teacher characteristics largely shape their attitudes towards mathematics.

The respondents also linked their attitude formed towards mathematics with their teachers' ineffectiveness in relation to appropriate or inappropriate teaching methods which instilled in them fear and difficulty for mathematics. Thus, mathematics teachers used methods that learners did follow or not follow easily. These finding also agree with Simmers (2011), who reveals that pace of instruction, teachers' perception towards students' capabilities and failure to provide support to students with special learning problems in mathematics greatly affected students' learning in a negative way. Simmers (2011), further says "that research in the structuring and delivery of mathematics instruction suggests that at each grade or level students must cover relatively few topics, but in great depth which was also discovered in the study that teachers who teaches too fast or too slow make students to develop likeness or dislike for mathematics. Thus, teachers do not have to rush to cover many things at a time, leaving students with so many difficulties unattended to. These findings was also

supported by Papanastasiou (2000) who observed that teaching method explored by the teacher, his personality and style, greatly accounted for the students positive attitude development towards mathematics and that without interest and personal effort in learning mathematics by students they can hardly perform well in mathematics. Papanastasiou (2000) observed further that the teacher factors influencing students' attitudes formation includes; the teachers content knowledge and personality, teaching methods, teachers' attitudes and beliefs towards the subject mathematics.

It was revealed in the study that some respondents said that they developed the likeness for mathematics because the subject was compulsory in basic schools and senior high schools in Ghana. That they are mandated to pass mathematics as a subject in Ghana as a requirement.

This finding collaborates with the findings of Kloosterman and Clougan (1994), that many at times pupils can't give concrete examples, why mathematics is useful in their future life, they just motivate the utility of it by the fact that they need mathematics for the major external and internal exams in their lives.

It was also noted from the study that students wanted to link mathematics to the various occupations which affected their attitude towards mathematics formation which agrees with the findings of Syyeda (2016) which states that if students recognize the importance of mathematics in their lives, they will become motivated to study, practice, and learn the subject and thus affect their attitude formation and development. Students do not see the need to study mathematics if they cannot directly or indirectly apply mathematics in their daily activities (Syyeda, 2016). This finding again agree with the findings of Callahan (1971) and Selkirk (1975) that

students form unproductive attitudes towards mathematics when they perform poorly or consider mathematics as not important and relating to life activities. Thus, once students realized the importance or usefulness of mathematics in the real world, they would be moved to develop positive attitudes towards the subject. Again the study this is in line with Van Oers (1996) study that have revealed that the growth of constructive mathematical interest and attitudes is connected to the direct student's involvement in activities that entail quality mathematics

The study also revealed that, encouragement or discouragement from peers, parents etc. affected students' learning and their attitude formation towards mathematics which agrees with Ingram (2015) that peer influence is among the important factors that significantly affect students' perception and personal development towards mathematics learning.

Findings from the study also agrees with Blazar and Kraft (2017) that support of students from teachers and friends are very important to student's mathematics learning, and that emotional support is associated with an increase in students' self-efficacy in mathematics and their happiness in class. The reason is that students spent much time with peers in schools or environments than other people. In school, students met and interacted with different individuals in a variety of ways. In so doing, they communicated and learned from peers who at times could be a bad or good influence on them when it comes to mathematics learning and mathematics attitude formation.

4.4 Research Question Three: What is the relationship between Pre-service Teachers' Attitudes and Their Performance in Mathematics?

The study sought to find out the relationship between the attitudes of pre-service teachers and their academic performance or achievements. Pearson Moment Correlation was used to test for the degree of relationship that exists between attitude and performance in mathematics. On the strength of the correlation, a strong positive correlation (0.72) exists between the attitude towards mathematics learning and the performance in mathematics. A correlation figure of 0 shows no correlation, 0.1 – 0.4 shows a mild correlation and 0.5-0.9 shows a strong correlation. From Table 7, there is a strong positive relationship existing between attitudes towards mathematics and performance in mathematics, and it is statistically significant (r =.72*, p (.007) < .01). This means that an increase in attitudes will lead to better academic performance. In this case, the more students develop positive attitudes towards the study of mathematics, the more they are likely to achieve greater success in mathematics. In that regard, if one does not develop a positive attitude towards the study of mathematics, he or she will be unable to achieve success in the subject. This means that an attitude towards the study of mathematics will automatically lead to greater achievement in mathematics. It can therefore be said that attitude towards mathematics learning is one of the greatest predictors of achievement in mathematics

Table 4.7: Correlation between Attitude towards Mathematics and Achievement of Mathematics

	r	P
Attitude towards mathematics	.72*	
Mathematics quiz scores		.007

P<0.01

A bivariate correlation was also carried out to determine the relationship between students' mathematics performance and attitude components. The results show that a positive relationship exists between students' attitudes components and their academic performance in mathematics and it is statistically significant since the p-value < 0.01. This means that students who have positive attitudes in the attitude components were more likely to have positive performance in mathematics. The result is presented in Appendix E.

For further details, the bivariate correlation carried out to find the relationship between students' mathematics performance and attitude aspects/components were summarized and presented in Table 4.8.

Table 4.8: Correlation Between Respondents Grade/Score and Attitude Components

	Grade	**Importance**	**Confidence**	**Interest**	**Enjoyment**	**Anxiety**
Grade						
importance	0.347					
Confidence	0.403**	0.524**				
Interest	.273**	.341**	.422**			
Enjoyment	.372**	.466**	.688*	.471**		
Anxiety	.330**	.361**	.555**	.366**	.497**	
Attitude	0.545**	0.642**	0.812**	0.690**	0.777**	0.423**

P<0.01

A correlation figure of 0 shows no correlation, 0.1 – 0.4 shows a mild correlation and 0.5-0.9 shows a strong correlation. The results in Table 4.8 indicated that all attitude aspects were highly positively correlated with the repondents grades. The highest correlation occurred at confidence (r = 0.81). Enjoyment (r = 0.78) was the second highest, followed by interest (r = 0.70). The anxiety about mathematics had the least correlation value (r = 0.42). The results from Table 4.8 indicate a significant positive correlation between attitude components and mathematics grades. The results indicate

that there is a relationship between the factors/variables: value/importance, anxiety, self-confidence, enjoyment and interest and the pre-service teachers grades. These variables contributed significantly to the pre-service teachers' attitudes towards mathematics learning and as these variables increased students' attitudes became more positive and their performance in mathematics also increased.

It can be concluded that there is a positive relationship between students' attitudes towards mathematics and their mathematics performance ($p < 0.01$). The correlation scores between students' mathematics grade and attitude components/aspects were generally positive and significant in the attitude components (ABC model).

4.4.1 Discussions of Results for Research Question Three

Attitudes affected the effort and behaviour of students towards mathematics in various ways. Attitude determines students' ability, willingness to learn, choice of action and response to challenges. It determines the level of engagement, interest, and personal effort without which one can hardly perform. Attitude also determines the confidence level of students in mathematics learning.

The findings from the study indicate a significant positive correlation between pre-service teachers' attitude towards mathematics learning and pre-service teachers' mathematics achievements. A strong positive correlation among attitude aspects and the respondents' mathematics achievement, which is consistent with Mata et al. (2012) who had established that mathematical achievement of students and their optimistic attitudes towards mathematics are directly proportional. The positive correlation between students' attitude and students' performance/achievements in mathematics demonstrate that attitude plays a central role in student learning

Again, findings from the study agree with researchers such as Van der Bergh (2013); Zakaria and Nordin (2008) who posit that factors like enjoyment, usefulness, value or importance, anxiety and interest are crucial in shaping students' attitudes and consequently their performance in mathematics learning. That attitude in educational research is very important since the development of a positive attitude is desirable because of its association with higher performance and a negative attitude is associated with lower performance when it comes to mathematics learning (Van der Bergh, 2013).

Findings is further in line with that of Mahanta and Islam (2012), who observed that the attitude of students and achievements are positively correlated and students with high attitude scores tend to obtain good scores in mathematics examinations whereas their counterparts with low attitude scores obtain bad marks or scores in mathematics examinations. This finds also corroborates with that of Eshun (2004) who posited that positive inclinations in mathematics are crucial because they can influence the willingness of students to learn as well as the gain, they can obtain from mathematics instruction now and even in the years to come. Thus, students with optimistic inclinations in mathematics did very well in mathematics examinations and all mathematics enderbours (Eshun, 2004)

Kupari and Nissinen (2013) also noted that student achievement is influenced by their perception of interest, enjoyment, value and anxiety of the subject. They further noted that student group who liked mathematics, had high levels of expectancy for their success in mathematics, were aware of the value of mathematics, and believed that studying mathematics was more important than studying other subjects. Therefore, their willingness to study mathematics contributed to high achievement scores in

mathematics as a subject (Kupari & Nissinen 2013). Thus, there is a direct relation between attitude in mathematics and achievement in mathematics which is confirmed by this study. The findings of this study again corroborate those of Mazana, Montero and Casmir (2019) studies that reported that there is a positive relationship between students' attitudes toward mathematics and mathematics performance and that pre-service teachers performance were influenced by attitude components like interest, value/importance, anxiety, self-confidence and enjoyments.

The findings of the study are also in accordance with those of Syyeda (2016), who examined the relationship between student attitudes and performance in mathematics' that revealed a significant relationship between student attitudes and performance in Mathematics learning. Syyeda (2016), noted that the cognitive, affective and behavioural attitudes components of students influence their performance in Mathematics.

The study further corroborates with that of Mata, et al. (2012), who had established that mathematical achievement of students and their optimistic attitudes towards mathematics are directly proportional. Furthermore, the result of this study is consistent with a Chilean study by Ramírez (2005), which examined attitudes towards mathematics and school performance in Chilean Grade 8 and concluded that beliefs and attitudes were important predictors of performance. A study by Mato and De La Torre (2010) on high school students' attitude towards mathematics learning and academic achievements revealed better academic performance with students who had more optimistic attitudes towards mathematics than their counterparts with pessimistic attitudes towards the subject mathematics and these same findings were corroborated by Zimmerman et al (2004) which is same for this study

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This study investigated pre-service teachers' attitudes towards mathematics learning in Somanya, Ghana. The study used the convergent parallel mixed method design making use of both qualitative and quantitative data. The qualitative data was used to verify the results obtained from the quantitative data.

Many pre-service teachers from elementary to their present level have experienced learning difficulties and illustrated poor mathematics performances due to poor attitudes (Ingram, 2015; Mensah et al., 2013). This situation calls for an investigation into pre-service teachers' mathematics learning attitude in Ghana, how these attitudes of pre-service teachers are formed or what contributed to the attitude of the pre-service teachers and to find out if there is a relationship between pre-service teachers' attitude towards mathematics learning and their academic achievement in mathematics.

The following research questions guided the study;

1. What is the attitude of pre-service teachers towards mathematics learning?
2. What factors led to the attitude of the pre-service teachers?
3. What is the relationship between pre-service teachers' attitudes towards mathematics and their performance in mathematics?

Descriptive statistics were used to establish the levels of mathematics learning attitude of the pre-service teachers. Thematic analysis was used to determine what contributed to the pre-service teachers' attitudes. To establish the relationship between pre-service teachers' attitudes towards mathematics learning and their achievement in

mathematics Correlation analysis was used. Bivariate correlation analysis was finally carried out to establish the relationship existing between mathematics achievement and attitude components/aspects.

The target population of this study was all pre-service teachers of Mt. Mary College of Education, Somanya-Ghana. The accessible population was all first-year pre-service teachers of Mt. Mary College of Education. The subjects for the study include 465 students (282 females and 183 males), 97 of them offering the Primary Education Program and 368 of them offering the Junior High School Programs. Out of the 465 students sampled for the study only 325 voluntarily and willingly took part in the study. The 325 students are made up of 282 females and 143 males, 97 of the students are offering the Primary Education program and 228 of the students offering the Junior High School Programs.

The instruments used in this study were the Mathematics Attitude Questionnaire (MAQ) in the form of Likert scale, open-ended questions, test and interview guides designed by the researcher,

5.1 Summary of Study

5.1.1 The attitude of pre-service teachers towards mathematics learning

The findings of the study indicated that the pre-service teachers have positive attitudes towards mathematics learning. The means of the pre-service teacher's attitude towards mathematics learning in Categories are importance/value (Cognition) of mathematics 4.34, self-confidence in mathematics 3.72 and mathematics anxiety 2.67 (affect), enjoyment of mathematics 3.98, and interest in mathematics 3.97 (behavior). This indicates that the pre-service teachers possess a positive attitude towards

mathematics learning in the affect (A), behavior (B) and cognition (C) components of mathematics.

Also, the percentage of responses to mathematics attitude components by the pre-service teachers indicates that most pre-service teachers agreed that mathematics is useful or important. Thus, a whopping 92.4 percent of the pre-service teachers agreed with the value or importance of mathematics. The majority of the pre-service teachers consider mathematics as an interesting subject or have an interest in studying mathematics as 84.5 percent of them responded in that direction. On mathematics anxiety, 63.8 percent of the pre-service teachers affirmed the statement that they do not have mathematics anxiety. As to whether pre-service teachers enjoy studying mathematics, 84.4 percent indicated that they enjoy studying the subject mathematics. For self-confidence, 74.5 percent of the pre-service teachers indicated that they were very confident when it comes to learning mathematics. Thus the attitude of pre-service teachers in the affect, behavior and cognition (ABC model) is very positive

5.1.2 What factors led to the attitude of the pre-service teachers?

The findings of this study reveal that among the factors that contributed to the attitudes of the pre-service teachers towards mathematics learning were;

- Usefulness of Mathematics
- Mathematics is a compulsory subject,
- Encouragement and support received from others,
- Having a good teacher,
- Self-Confidence,
- Difficulty and Fear

From the study majority of the pre-service teachers considered mathematics as a useful and fascinating subject hence forming affirmative attitudes towards it, though a few of them considered it as otherwise. The pre-service teachers said their likeness for mathematics is formed because mathematics is very useful in their daily lives.

Again the pre-service teachers said that they developed a likeness for mathematics because the subject was compulsory. They said since mathematics is a compulsory subject in the basic schools and senior high schools in Ghana, they are mandated to pass it as a subject in Ghana as a requirement for entry into a tertiary institution.

When it comes to encouragement and support received from others the pre-service teachers said that they developed the likeness for mathematics due to the encouragement and support they received from parents, teachers, and fellow students.

Having a good teacher, the pre-service teachers said having a teacher who teaches for understanding, makes lessons enjoyable and is of crucial importance for students' engagement in mathematics. Thus, they develop likeness or unlikeness as a result of their teachers.

On self-confidence, the pre-service teachers were of the view that they lacked confidence in themselves as mathematics learners and that has affected their likes and dislike for mathematics learning.

When it comes to difficulty and fear, the pre-service teachers were of the view that mathematics being difficult or not difficult has contributed to their attitude towards mathematics learning.

5.1.3 The relationship between pre-service teachers' attitudes towards mathematics and their achievement in mathematics?

The analysis of the result from the study revealed a strong relationship between pre-service teachers attitudes towards mathematics and academic achievement. The correlation between pre-service teachers' mathematical achievements' (grade/score) and attitude components are confidence (r = 0.81), Enjoyment (r = 0.78), interest (r = 0.70), anxiety (r = 0.42) and importance/value (r=0.51). Thus, positive correlations have been found between pre-service teachers' affect (self-confidence and anxiety), behaviour (enjoyment and intrinsic motivation) and the cognition (value/importance), thus the ABC model of attitudes components and the pre-service teacher's achievements in mathematics.

5.2 Conclusion

The main purpose of the study was to determine the attitudes of pre-service teachers towards mathematics learning in Ghanaian at Mt. Mary Colleges of Education. At the end of the study, it was found that pre-service teachers have a very positive attitude towards the learning of mathematics. The attitudes of the pre-service teachers are positive in the affect (self-confidence, anxiety and enjoyment), behaviour (intrinsic motivation) and cognition (value or importance). Thus the attitudes of the pre-service teachers towards mathematics learning are positive in the ABC model of attitudes. The study also found out that these factors: usefulness of mathematics, *m*athematics is a compulsory subject, encouragement and support received from others, difficulty and fear, having a good teacher and self-confidence contributed to the attitudes of the pre-service teachers. The study also established a strong positive correlation between attitude in mathematics and performance in mathematics. A strong positive correlation exist between attitude in mathematics in the ABC model and performance

in mathematics. This means that students who have positive attitudes towards mathematics are more likely to achieve greater success in mathematics and vice versa.

5.3 Educational Implications of the Study for Mathematics Learning and Teaching

The results of this study revealed that the pre-service teachers have positive attitudes towards mathematics learning. Therefore the school management should advantageously use the learners' positive attitude towards mathematics to continue creating a strong inclination and culture of mathematics in the college where the pre-service teachers can score more favourably in mathematics and any other courses.

The college management and mathematics tutors should explore other avenues to change the negative behaviour of pre-service teachers towards mathematics and improve the students' interest towards mathematics courses. The pre-service teachers generally should be motivated through persuasion, use of reinforcements, provision of learning resources and improvement on tutors' support which cuts across the school environments

Pre-service teacher's mathematics learning attitude depends on mathematics teachers teaching pedagogical skills, teachers should appropriately adopt instructional techniques that include learners' diversities to learning, minimize fear, and enhance active interest, and enjoyment in what is being taught and learnt. Thus, creating an ideal mathematics learning environment begins with the teacher understanding students as learners. It is not only important for a teacher to have content knowledge, but also to develop awareness of how individual students learn mathematics.

5.4 Recommendations

From the summary of the findings of this study, it is recommended that:

1. The mathematics teachers should articulate well the usefulness and applicability of mathematics in general so that the students will continue to create positive minds towards the subject and subsequently continue to strive to improve in the subject.
2. The school management in collaboration with the mathematics unit should always examine the attitudes of preservice teachers at the beginning of their college study to provide best practices and interventions to modify and change potential negative attitudes toward mathematics learning.
3. Mathematics teachers, parents and peers must recognize the immense role they play in enhancing or inhibiting the attitude of students towards the study of mathematics and the attitude formations of students and hence engage in activities that will stir the interest of students in studying mathematics and mathematics attitude formation.

This can be achieved through the following:

- Mathematics teachers and parents must be aware of their own attitudes towards mathematics. Negative attitudes towards mathematics easily trickle down from parents, mathematics teachers and peers. Eliminating the 'I can't do mathematics' phrase from their vocabulary and show students that everyone is capable of doing and enjoying mathematics.
- Mathematics teachers, parents and peers must help students to see that mistakes are positive learning opportunities, not something to be embarrassed about. Students often worry about not doing something the right way, which prevents them from trying. Encourage students to explore problems and

reassure them that it's okay to get stuck - perseverance, resilience and determination are all key skills that will help students' problem-solve.

- Mathematics teachers must show how numeracy and problem-solving skills are built into every subject, to help students practise these skills and demonstrate the uses of mathematics outside of a mathematics lesson. Mathematics teachers can help students integrate mathematics into art lessons; use ratio to mix paints, create some symmetrical artwork and show the enlargement of 3D shapes using perspective.
- Mathematics teachers must remember that all students respond to different methods and representations of concepts. What works for one student might not work for the student next to them. Mathematics teachers must ensure they have a variety of methods at their fingertips to help all students access the skill that they are working on.
- Mathematics teachers must make the connection between mathematics and real life**.** Show that mathematics isn't just something confined to the classroom. Mathematics is all around us so must point out the connections with real everyday examples.

5.5 Suggestions for Further Studies

The educational implications of the findings of this study call for further research in the area of pre-service teachers' mathematics learning attitude

1. An extensive similar study be done in all colleges of education in Ghana, so as to have a comprehensive report on pre-service teachers' mathematics learning attitudes and attitudes on mathematics performance of all pre-service teachers in Ghana

2. The study also left out in-service teachers who are key stakeholders in developing students' attitudes in the classroom. The researcher, therefore, thinks further studies must take them on board to incorporate their views for a comprehensive report.

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APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION
P. O. Box 25, Winneba, Ghana
math@uew.edu.gh
+233 (020) 2041076

June 29, 2021

TO WHOM IT MAY CONCERN

Dear Sir /Madam,

LETTER OF INTRODUCTION: DANIEL OWUSU (202122553)

I write to introduce to you the bearer of this letter, Daniel Owusu, a postgraduate student in the University of Education, Winneba. He is reading for Master of Philosophy degree in Mathematics Education (M.Phil) and as part of the requirements of the programme, he is undertaking a research titled – ***pre-service teachers attitude towards Mathematics.***

He needs to gather information to be analysed for the said research and he has chosen to do so in your institution. I would be grateful if he is given the needed assistance to carry out this exercise.

Thank you.

Yours faithfully,

Dr. Joseph I. Nyala
Graduate Coordinator

DEPARTMENT OF MATHEMATICS EDUCATION
UNIVERSITY OF EDUCATION
WINNEBA

APPENDIX B

PRE-SERVICE TEACHERS' ATTITUDE TOWARDS MATHEMATICS

Dear Participant,

I am inviting you to participate in a study on the attitudes of pre-service teachers towards mathematics learning which consists of statements on the following categories: self-confidence in mathematics, anxiety in mathematics, enjoyment of mathematics, Intrinsic Motivation /Interest (Behavior) of mathematics and Perceived Usefulness/value (Cognition) of mathematics. There are no correct or incorrect responses. Read each statement carefully. The information you give will be treated with confidentiality and will be used for research purposes only. You are therefore not required to write your name. Please answer the questions as honestly as possible. Please answer all the questions.

Thank you.

SECTION A; Background Information

Instructions: Make a tick (√) in the appropriate box below

Program of Study: Primary Program ☐ J H S Program ☐

Gender : Male ☐ Female ☐

Age : 19years and below ☐ 20-25years ☐ 26-30years ☐ above 30years ☐

SECTION B: Mathematics Attitude Scale

DIRECTION

This Mathematics Attitude Scale consists of 26 statements about how you feel or think about the teaching and learning of mathematics. Make a tick (√) in the space against the response you consider as the most appropriate response to the extent to

which you agree or disagree to the statement. (SA= Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree).

	SA	A	U	D	SD
Importance/value of mathematics					
1. Taking math is a waste of time.					
2. I will use mathematics in many ways as a teacher					
3. Mathematics is one of the most important subjects for people to study					
4. Mathematics helps develop the mind and teaches a person to think					
5. I believe studying math helps me with problem solving in other areas.					
6. Mathematics is important in everyday life					
Self-Confidence in mathematics					
7. I can solve math problem within a given time					
8. I am able to answer math questions in class					
9 .I am sure of myself when I do math.					
10. I can get good grades in math					
11. Mathematics does not scare me at all.					
Anxiety of mathematics					
12. Mathematics makes me feel nervous					
13. I have usually been at ease during math courses					
14. When I had trouble with a concept I usually gave up and stopped trying					
15. I get nervous when math teacher is in class					
16. I always get frustrated when trying to do mathematics					
17. I feel insecure about asking math questions in class					
18. No matter how hard I tried am not able to solve maths problem					
Interest in mathematics					
19. Mathematics is dull and boring					
20. I like to solve new problems in mathematics					

21. I am interested and willing to acquire further knowledge of mathematics					
22. Mathematics is a very interesting subject					
Enjoyment of mathematics					
23. I enjoy learning math with my friends					
24. I am happier in a math class than in any other class					
25. I get a great deal of satisfaction out of solving a mathematics problem					
26.I have usually enjoyed studying mathematics in school					

SECTION C: Opinionated response on attitude formation

These questions provide a place for you to express your feelings and opinions. They are to elicit your opinionated responses without restrictions.

27. How did your attitude (like or dislike) towards mathematics formed ?

……..
……..
……..
……..
……..
……..

28. Can you recall specific incidences which might have contributed to the formation of your attitude (like/dislike) for mathematics?

……..
……..
……..
……..
……..
……..

STUDENTS' INTERVIEW GUIDE

Name of student: …… Age …….

Program of Study:……

Interview star time:….....Interview Duration:……

1. Do you like mathematics and why?

2. How often do you learn mathematics and why?

3. How often do you answer questions during mathematics lessons?

4. Do you feel comfortable studying mathematics and why?

5. Are you able to solve math problem within a given time

6. Do you get a great deal of satisfaction out of solving a mathematics problem ?

7. Do you enjoy learning math with your friends?

8. Is mathematics an interesting subject ?, why ?

APPENDIX C

Mean Distribution and Standard deviation of Pre-Service teachers Response To Each Questionnaire items on Attitudes of Students Towards Mathematics on The Likert Scale.

Item	N	Minimum	Maximum	Mean	Std. Deviation
1. Taking math is a waste of time	325	1.00	5.00	4.3446	.78056
2. I will use mathematics in many ways as a teacher	325	1.00	5.00	4.3200	.78709
3.Mathematics is one of the most important subjects for people to study	325	1.00	5.00	4.3354	.80209
4.Mathematics helps develop the mind and teaches a person to think	325	1.00	5.00	4.3754	.72479
5.I believe studying math helps me with problem solving in other areas.	325	1.00	5.00	4.1969	.85598
6.Mathematics is important in everyday life	325	1.00	5.00	4.2800	.80031
7.I can solve math problem within a given time	325	1.00	5.00	3.7231	1.02300
8.I am able to answer math questions in class	325	1.00	5.00	3.7446	.96193
9.I am sure of myself when I do math	325	1.00	5.00	3.7231	.98300
10.I can get good grades in math	325	1.00	5.00	3.7354	1.04711
11.Mathematics does not scare me at all	325	1.00	5.00	3.6831	1.07491
12.Mathematics do not makes me feel nervous	325	1.00	5.00	3.4400	1.20708
13.I have usually been at ease during math courses	325	1.00	5.00	3.4154	1.18494
14.When I had trouble with a concept I gave up and stop trying	325	1.00	5.00	3.5046	1.25860
15.I get nervous when math teacher is in class	325	1.00	5.00	3.9138	3.17474

16.I do not get frustrated when trying to do mathematics	325	1.00	5.00	3.6646	1.21264
17.I feel secure about asking math questions in class	325	1.00	5.00	3.7385	2.54634
18. I am able to solve maths problem with a given time	325	1.00	5.00	3.8800	2.56178
	325	1.00	5.00	3.9077	1.09323
19.I like to solve new problems in mathematics	325	1.00	5.00	4.1200	2.41032
20. I am interested and willing to acquire further knowledge of mathematics	325	1.00	5.00	4.2615	2.98803
21.Mathematics is a very interesting subject	325	1.00	5.00	4.2492	2.46382
22.I enjoy learning math with my friends	325	1.00	5.00	4.0831	1.01037
23.I am happier in a math class than in any other class	325	1.00	5.00	3.9754	1.00585
24.I get a great deal of satisfaction out of solving a mathematics problem	325	1.00	5.00	4.0585	.95886
25.I have usually enjoyed studying mathematics in school	325	1.00	5.00	3.9846	1.02277
26. Mathematics is enjoyed both in class and at home	325	1.00	5.00	3.9846	1.02277

APPENDIX D

Frequencies and percentages of response to each mathematics attitude item on the Likert scale by pre-service teachers

Item number	Stongly Disagree	Disagree	undecided	Agree	Strongly Agree	Total
1	5 (1.5%)	7 (2.2%)	11 (3.4%)	150 (46.2%)	152 (46.8%)	325 (100%)
2	5 (1.5%)	8 (2.5%)	11 (3.4%)	155 (47.7%)	146 (44.9%)	325 (100%)
3	6 (1.8%)	9 (2.8%)	5 (1.5%)	155 (47.7%)	150 (46.2%)	325 (100%)
4	4 (1.2%)	5 (1.5%)	8 (2.5%)	156 (48.0%)	152 (46.8%)	325 (100%)
5	8 (2.5%)	11 (3.4%)	12 (3.7%)	172 (52.9%)	122 (37.5%)	325 (100%)
6	7 (2.2%)	5 (1.5%)	14 (4.3%)	163 (50.2%)	136 (41.8%)	325 (100%)
7	14 (4.3%)	39 (12.0%)	26 (8.0%)	190 (58.5%)	56 (17.2%)	325 (100%)
8	8 (2.5%)	46 (14.2%)	16 (4.9%)	206 (63.4%)	49 (15.1%)	325 (100%)
9	11 (3.4%)	40 (12.3%)	28 (8.6%)	195 (60.0%)	51 (15.7%)	325 (100%)
10	15 (4.6%%)	38 (11.7%)	28 (8.6%)	181 (55.7%)	63 (19.4%)	325 (100%)
11	23 (7.1%)	54 (16.6)	11 (3.4)	158 (48.6%)	79 (24.3%)	325 (100%)
12	17 (5.2%)	40 (12.3%)	33 (10.2%)	174 (53.5%)	61 (18.8%)	325 (100%)
13	21 (6.5%)	75 (23.1%)	27 (8.3%)	152 (46.8%)	50 (15.4%)	325 (100%)
14	29 (8.9%)	63 (19.4%)	14 (4.3%)	153 (47.1%)	66 (20.3%)	325 (100%)
15	22 (6.8%)	57 (17.5%)	17 (5.2%)	145 (44.6%)	81 (24.9%)	325 (100%)
16	23 (7.1%)	54 (16.6%)	11 (3.4%)	158 (48.6%)	79 (24.3%)	325 (100%)
17	27 (8.3%)	51 (15.7%)	9 (2.8%)	170 (52.3%)	67 (20.6%)	325 (100%)
18	22 (6.8%)	47 (14.5%)	11 (3.4%)	156 (48.6%)	85 (26.2%)	325 (100%)
19	16 (4.9%)	32 (9.8%)	18 (5.5%)	159 (48.9%)	100 (30.8%)	325 (100%)
20	9 (2.8%)	24 (7.4%)	18 (5.5%)	181 (55.7%)	92 (28.3%)	325 (100%)

21	11 (3.4%)	21 (6.5%)	11 (3.4%)	161 (49.5%)	120 (36.9%)	325 (100%)
22	7 (2.2%)	28 (8.6%)	7 (2.2%)	158 (48.6%)	124 (38.2%)	325 (100%)
23	10 (3.1%)	28 (8.6%)	9 (2.8%)	156 (48.0%)	122 (37.5%)	325 (100%)
24	11 (3.4%)	29 (8.9%)	15 (4.6%)	172 (52.9%)	98 (30.2%)	325 (100%)
25	8 (2.5%)	27 (8.3%)	11 (3.4%)	171 (52.6%)	108 (33.2%)	325 (100%)
26	14 (4.3%)	24 (7.4%)	16 (4.9%)	170 (52.3%)	101 (31.1%)	325 (100%)
Average	14 (4.3 %)	33 (10.2 %)	15 4.6 %	166 (51.1 %)	97 (29.8 %)	325 (100 %)

APPENDIX E

CORRELATION BETWEEN RESPONDENTS GRADE/SCORE AND ATTITUDE COMPONENTS

		Marks/score	importance	confidence	interest	enjoyment	anxiety	attitude
Marks/score	Pearson Correlation	1	.347**	.403**	.273**	.372**	.330**	.445**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	325	325	325	325	325	325	325
importance	Pearson Correlation	.347**	1	.524**	.341**	.466**	.361**	.642**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	325	325	325	325	325	325	325
confidence	Pearson Correlation	.403**	.524**	1	.422**	.688**	.555**	.812**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	325	325	325	325	325	325	325
interest	Pearson Correlation	.273**	.341**	.422**	1	.471**	.366**	.690**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	325	325	325	325	325	325	325
enjoyment	Pearson Correlation	.372**	.466**	.688**	.471**	1	.497**	.777**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	325	325	325	325	325	325	325
anxiety	Pearson Correlation	.330**	.361**	.555**	.366**	.497**	1	.423**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	325	325	325	325	325	325	325
attitude	Pearson Correlation	.545**	.642**	.812**	.690**	.777**	.423**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	325	325	325	325	325	325	325

P < 0.01

APPENDIX F

University of Ghana
College of Educational Studies

Mt. Mary College of Education

Dept. of Science, Mathematics and ICT

Teaching, Learning and Applying Number and Algebra

Name:…… **Index Number:……**

Answer all the questions on the question paper

1. The additive and multiplicative inverse of $\frac{-2}{3}$ $respective\ are$ … …

A. $\frac{-2}{3}, \frac{-3}{2}$ $B. \frac{2}{3}, \frac{-3}{2}$ $C. \frac{-2}{3}, \frac{-2}{3}$ $D.$ $\frac{-3}{2}, \frac{-2}{3}$

2. Two sets whose intersection is an empty set are

A. disjoint sets B. equivalent sets C. finite sets D. empty sets

3. Express 72 as a product of prime factors

A. $2^3 \times 3^2$ $B.\ 2^2 \times 3^3$ $C. 2^2 \times 3^2$ $D. 2 \times 3$

4. Find the Least Common Multiple (LCM) of 2, 3 and 5.

A. 6 B. 12 C. 24 D. 30

5. Write two hundred and two million, two thousand, two hundred and two in figures.

A. 202,002,202 B. 202,020,202 C. 202,022,202 D. 202,200,202

6. If P = {factors of 36} and Q = {multiples of 4 less than 40}, find the number of subsets in P∩Q. A. 10 B. 8 C. 6 D. 4

7 . Divide 64.5 by 0.015, leaving the answer in standard form.

A. 4.3×10^4 $B. 4.3 \times 10^3$ $C. 4.3 \times 10^2$ $D. 4.3 \times 10^{-3}$

8. Which of the following statements about sets is **true**?

A. Every set is a subset of the null set. B. The universal set is the subset of the null set

C. The intersection of two sets is always a null set D. The universal set is the union of all **its subsets**

9. Which of the following is true?

A) {0, 2, 6, 9, 12} is a subset of even numbers B) {-1, 0, 2, 3, 5} is a subset of odd numbers.

C) {-2, -1, 1, 3, 9} is a subset of integers. D) {2, 3, 5, 7, 27} is a subset of prime numbers

10. Which property of operation is illustrated by the statement a(b+c) = a×b + a×c

A) Distributive property of addition and multiplication

B) Distributive property of addition over multiplication

C) Distributive property of multiplication over addition

Section B

1. Simplify $2\frac{1}{2} \div (1\frac{2}{3} + \frac{5}{6})$

2. The set H ={$\ldots -6, -4, -2, 0, 2, 4, \ldots$}, $K = \{x: 0 \leq x \leq 9\}$ *and* $M = \{x: -4 < x \leq 0\}$ are subsets of Z,the set of integers.

(a). Find $H' \cap K$

(b) Represent the sets K and M on a venn diagram