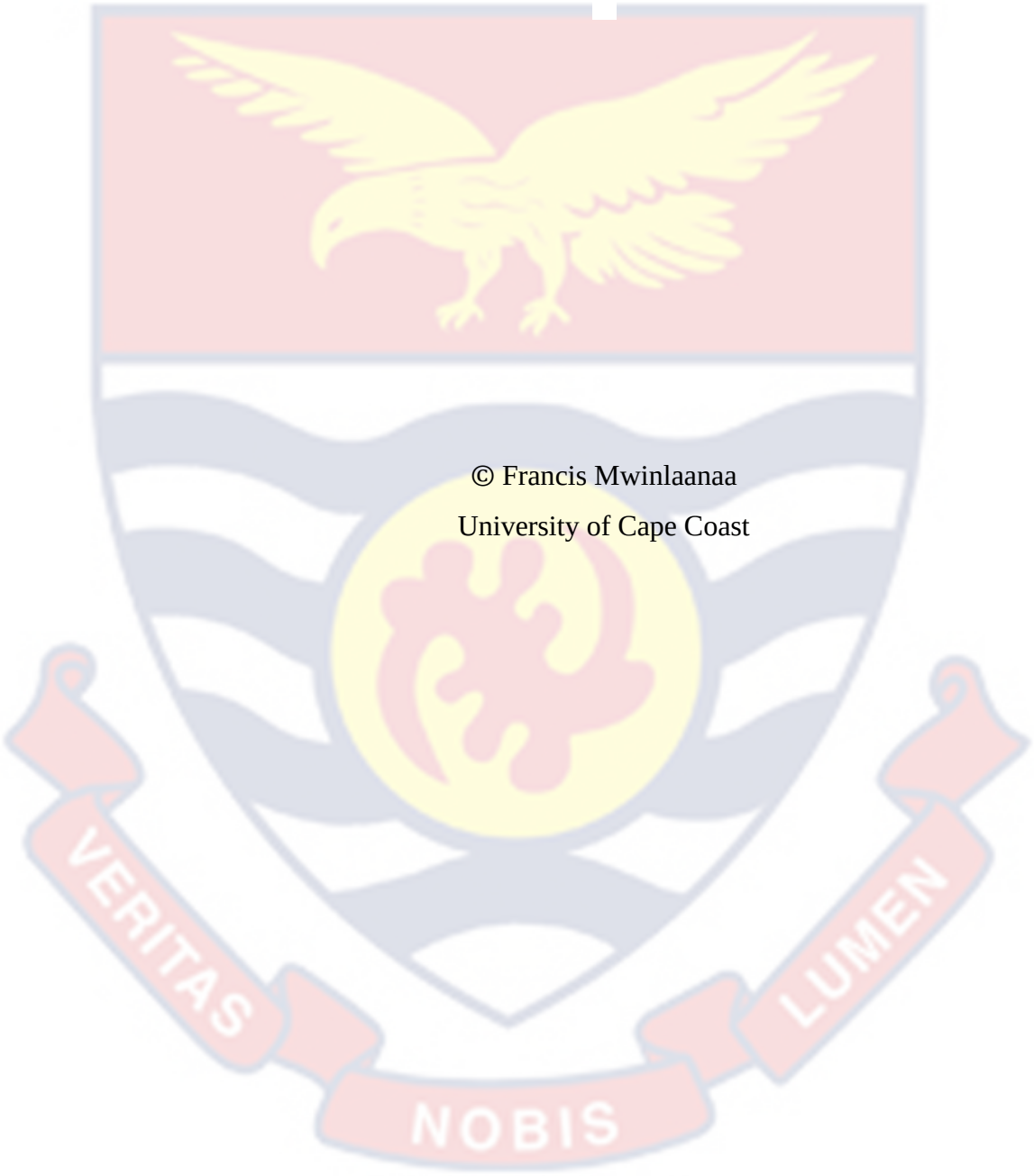
UNIVERSITY OF CAPE COAST

RELATIONSHIP BETWEEN FIRST-YEAR PRE-SERVICE TEACHERS' MATHEMATICS AFFECTS AND MATHEMATICS ACHIEVEMENT

FRANCIS MWINLAANAA

2023



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RELATIONSHIP BETWEEN FIRST-YEAR PRE-SERVICE TEACHERS' MATHEMATICS AFFECTS AND MATHEMATICS ACHIEVEMENT

BY

FRANCIS MWINLAANAA

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

NOVEMBER, 2023

DECLARATION

Candidate's Declaration

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

Candidate's Signature……. Date…….....

Name: Francis Mwinlaanaa

Supervisor's Declaration

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

Supervisor's Signature……. Date…….

Name: Prof. Douglas Darko Agyei

ABSTRACT

The relative abysmal performance in mathematics at the colleges of education is of great concern and affective variables have been identified as some of the contributory factors to the poor mathematics achievement. This study's objective was to find out the relations between mathematics affects (self-concept, self-efficacy, achievement motivation) and mathematics achievement of first-year pre-service teachers (PSTs) and also to measure the self-concept, self-efficacy, and achievement motivation in relation to gender and programme of study. The study employed the correlation study design. A sample of 764 pre-service teachers was drawn from five colleges of education using the following sampling technique; convenient and stratified sampling. Statements from the Mathematics Self-Description Questionnaire (Adegoke, 2015), the Middle School Mathematics Self-Efficacy Scale (Usher & Pajares, 2009), the Fennema-Sherman Mathematics Anxiety Scale-Revised (Lim & Chapman, 2013), and the GAGOS Scale (McInerney, 1997) were incorporated into the questionnaire. Independent sample t-test, ANOVA, Pearson's product moment correlation co-efficient, and multiple regression were the statistical techniques used. The study showed a moderately positive relationship between pre-service teachers' mathematics achievement and their affects (self-concept, self-efficacy, and achievement motivation). All affects are related to mathematics achievement, and are all able to predict mathematics achievement. The findings also showed a significant gender difference favouring male affects. It was therefore recommended for tutors to take into consideration how these variables impact pre-service teachers' success in mathematics. Tutors should be given refresher training and encourage to use teaching strategies gear towards developing pre-service teachers' affects.

KEY WORDS

Mathematics Tutors

Self-concept

Pre-service Teachers

Self-efficacy

Achievement motivation

Mathematics achievement

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Special thanks go to my supervisor Prof. Douglas Darko Agyei, for his insightful guidance, patience, support and encouragement throughout my period of study on this work. Thank you, Dr. Benning Isaac, for your helpful suggestions and encouragement. I will also thank all the tutors of the various colleges of education who took time off their busy schedule to assist me in collecting data for this thesis. To my family, I say God richly bless us all with sufficient grace.

DEDICATION

To my family

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CHAPTER ONE

INTRODUCTION

Overview

A firm grounding in mathematical affects and how they are used in teaching and learning is desirable. This study completely agrees with other studies in that it is important to understand affective factors in order to fully appreciate the work that goes into teaching and learning (Awoniyi, 2017; Sikhwari, 2007) and training to become a professional teacher. This study seeks to examine the relationship between first-year pre-service teachers' (PSTs') mathematics self-concept, self-efficacy, achievement motivation, and their mathematics accomplishment.

Background to the Study

Over the last four decades, teacher education in Ghana has undergone a lot of transformation. The Colleges of Education (formerly, Teacher Training Colleges) were not also left out in terms of their status, admission procedures, pragrammes and courses offered, and the type of certificates awarded. The Ghanaian government, with support of the international development component of the Transforming Teacher Education and Learning (T-TEL) project, as part of the process of transforming of colleges of education (COE) in Ghana into tertiary institutions, intended to redefine colleges as critical venues for the education of prospective teachers (MoE, 2018). The intention is to produce teachers who are fully skilled, committed, competent, and perfectly committed to teach the foundational level content to enhance instruction (National Council for Tertiary Education [NCTE], 2018). As such, the 4 – year Bachelor of Education (B. Ed.) Initial Teacher Education (ITE)

curriculum was introduced under the guidance of the NCTE (now Ghana Tertiary Education Commission [GTEC]) and the National Teaching Council (NTC). The 4–year B.Ed. course for pre-service teachers' progresses from beginning teaching (1st year general foundation courses for all specialisations); developing teaching (2nd year); embedding teaching (3rd year); and extending teaching (4th year). Specializations and specialized programs are pursued in the second, third, and fourth years. Field instructions are integrated into the Supported Teaching in School (STS) to provide the student teacher with the opportunity for continuous practice and development as a teacher throughout the duration of their study in order to meet the requirements set by the NTS and GTEC. Teachers form an important link in the success of any curriculum as it is teachers who sieve the curriculum through to the learners (Graham & Fennell, 2001), and as such, their training requires critical consideration. Among the general foundation subjects, first year pre-service teachers are expected to study is algebra, and same group observes mathematics lessons during their STS. Due to specialisation and specialized programmes pursued in the second, third, and fourth years there are some pre-service teachers who do not offer any mathematics related course at those levels or years.

Historically, mathematics has been the foundation to success in many fields globally and in Ghana to be specific. Mathematics has changed our way of life and is important to Ghana's current and future development (MoE, 2019). It is expected that Ghana will become a mathematics friendly country with a clear culture of STEM education within the next 10 to 20 years (MoE, 2018). This vision looks gloomy since mathematics and, for that matter algebra are considered difficult to learn and Ghanaian students' performance

in mathematics has been abysmal over the years (Wehmeyer, Agran & Hughes, 2000; Tetteh, Wilmot & Ashong, 2018). Among the many branches of mathematics in the world and Ghana, mainly included are number theory, geometry, topology, mathematical analysis, probability and statistic, calculus, number and algebra, and trigonometry. An important area of pure mathematics called algebra focuses on studying symbols and the guidelines for understanding them. Algebra is among the significant and extremely interesting topics in the curriculum in Ghana (Fumador & Agyei, 2018), and its usefulness cannot be underestimated. The world as a whole cannot function effectively without the use of mathematics, especially algebra as its foundation course. As described by Skouras (2014), algebra is the gate to the realization of complex number connections, and a path that assists learners in grasping easily concrete and abstract concepts in learning mathematics. According to Fumador and Agyei (2018), algebra is also a core part of elective mathematics, which is usually a compulsory course for students who major in science, technical, arts, or business programmes. It is important that the authors of the Standards-Based Curriculum in Ghana chose algebra to be among the four strands for pre-kindergarten through Basic 12 (MoE, 2018, 2020). This will enable every child, whether male or female, to take a course in algebra to start developing their interest. Many students are prevented from taking further courses in high school mathematics because of the filtering role that algebra serves, limiting their readiness for college. Studying mathematics in general as well as algebra has many importance aspects.

It is important to note that algebra (now called Introduction to Learning and Applying Number and Algebra) is a vital course in Ghanaian

colleges of education, and as such, it has served as a foundation course for the 4-year B.Ed. programme. A solid foundation in algebra can help develop the confidence level of student teachers (MoE, 2018). Yet many pre-service teachers in Ghana are observed to have challenges with mathematics because of their lack of success in algebra (Iddrisu, Abukari & Boakye, 2017).

The high rates of failure over the years in colleges of education examinations (Institute of Education, University of Cape Coast, 2015, 2016, 2017 and 2018) on algebra conducted by UCC confirm the poor performance. There was a repeat of the same old story in the most recently released colleges of education results in the Algebra I paper, which declared that candidates had grades between D and D^{+}, representing 29.03%, while 27.76% failed. Therefore, with such abysmal performance, one can understand the attempt to find variables that could meaningful and repeatedly affect performance in algebra.

Julius, Abdullah and Suhairom (2018) claimed that the unique problem faced by students in solving problems in mathematics is as a result of foundational understandings of abstract reasoning, the acquisition of language, and the different structural nature of mathematics. Salman, Yahaya and Adewara (2011) and Naseer (2016) categorise problems responsible for students' poor performance in algebra as students' negative attitude towards solving problems in algebra, poor grasp of symbols and alphabets, manipulating equations and algebraic expressions, and also the course's abstract nature. Adequacy of educational infrastructure, poor attitudes by both teachers and students, and understaffing are among some of the reasons responsible for the poor performance. Beside these factors, there is a need to

research into students' affective variables in teaching and learning and try to measure them in relation to their study programmes and gender. One focus area of increasing interest in mathematics education research is affects (Zan, Brown, Evans & Hannula, 2006).

Affective variables denote feelings or emotions about one's attitude towards an object, person, event or place. Perceptions, wants, thoughts, and beliefs may serve as triggers for these emotions and moods (Sikhwari, 2007). Numerous studies have demonstrated that affective variables are crucial to students' success in mathematics. This is especially crucial when the schoolchildren are prospective elementary school teachers because, in the absence of it, they are more likely to graduate from college, become teachers, and raise still another generation of kids who are cognitively weak and have low self-esteem, which could eventually cause them to avoid mathematics or perform poorly in the area of study (Ampofo, 2019). However, a few years ago, researchers, curriculum developers, parents, and mathematics tutors have been very much concerned about the critical role that affective elements play in mathematics learning. A large number of research have been conducted on this subject, and the majority of them agree that affective factors like self-concept, self-efficacy, and achievement motivation cannot be ignored in mathematics achievement success or failure (Soureshjani & Naseri, 2011; Obiero, 2018; Sikhwari, 2007). Academic success is also influenced by affective aspects like motivation, attitude, and self-concept, as said by Sikhwari (2007). Also, the significance of teacher' self-efficacy thoughts and mathematics knowledge for teaching was highlighted during the conference programme of NCTM in 2012.

Considering the rising need for qualified mathematics teachers in public basic schools, the study aims to provide insights into teachers' mathematics achievement, especially in the area of algebra. Since the students' early career decisions begin to emerge in Initial Teacher Education (ITE), before active professional involvement, first-year pre-service teachers will be investigated to explore whether their mathematics achievement is related to any of these three affective variables; self-concept, self-efficacy, and achievement motivation. This will provide evidence on whether the three affective variables are possibly responsible for student's abysmal achievement in mathematics.

Statement of the Problem

Ghana's students have not always performed well across the educational ladder, that is, at the primary, junior high school, senior high schools and tertiary institutions (Enu, Agyman, & Nkum, 2015). Despite the relative importance of mathematics, a number of assessment reports have indicated that students' performance in mathematics across all the grades has declined. According to a poll done in the Maldives between 2012 and 2013, arithmetic was the subject where students performed the worst overall (UNICEF & NIE, 2014). The WAEC Chief Examiner's Report (WAEC, 2014), in general mathematics indicates that learners showed weakness in using algebra to solve probabilities. It was also observed in the Elective Mathematics Chief Examiner's report of 2018 that topics such as binomial expansion, polynomials, and circle theorem that mostly depend on algebra were among the areas students had challenges (WAEC, 2018). Corroborating this, the Chief Examiner's report for the Colleges of Education Examinations

(IoE, 2015, 2016, 2017, and 2018) on Algebra by the Institute of Education-UCC, indicates students' abysmal performance in mathematics over the years. The 2016/2017 reports released by the Institute of Education-UCC to colleges of education showed that students who took the Algebra I paper obtained grades between D and D^{+} representing 19.03%, while 37.76% failed. In the 2018/2019 academic year, out of 11,875 first-year pre-service teachers who sat for the colleges of education examinations in Algebra in Ghana, only 6,081 passed, representing 51.2%. Following the direction of events, the future of colleges of education looks gloomy. There is therefore a need to find pragmatic steps to problems affecting pre-service teachers' performance in algebra (Introduction to Learning and Applying Number and Algebra) a branch of pure mathematics. The 4-year B.Ed. course uses the title Introduction to Learning and Applying Number and Algebra, though the course content is the same as Algebra I. Researchers, tutors, and other stakeholders have since been asking for the possible cause of such abysmal performance, even though there was the hope that the NTECF have come to address challenges of poor performance.

The relative decline of students' achievement in mathematics has been of interest to stakeholders of education. It is becoming increasingly important that one cannot be successful in mathematics without the required foundational knowledge. Researchers have inquired into the variables that affect students' proficiency in algebra, an integral component of mathematics (Anamuah-Mensah, Mereku, & Ghartey-Ampiah, 2008; Wiredu, 2015; Wilmot & Otchey, 2012). Some of these studies have identified factors/attributes such as, poorly-resourced school, poor nature of curriculum

in relation to students' daily lives; instructional quality, teaching methods, factors at home (e.g. Socio-economic status, parents influence, education, etc.), students and teachers attitude towards mathematics, attendance to school, and a lack of motivation.

As per Sikhwari (2007), the majority of studies on the factors that determine academic achievement have focused on cognitive aspects while ignoring affective factors. Limited studies conducted in advanced nations considered affective factors but in isolation (Awoniyi, 2017, p.10). There is therefore a void that needs to be filed.

However, there are varied views on whether affective or non-cognitive concepts like self-concept, self-efficacy, and motivating people also play very important roles in academic achievement, especially in mathematics. The researcher's personal experience garnered through offering academic advice and Student Reflective Journal (SRJ) discussions with pre-service teachers in his college seems to suggest that some pre-service teachers' unsatisfactory performance is affect-related. In view of this, this research will be carried out to ascertain whether the poor performance is connected to first-year learners' self-concept, self-efficacy and their achievement motivation across the other colleges. If this relationship exists and the problem is solved, then it will encourage pre-service teachers to learn mathematics on the next stage including content in number and algebra.

A review of literature reveals some studies in self-concept field of research (Parker, Marsh, Ciarrochi, Marshall and Abduljabbar, 2017; Umar & Imam, 2019); self-efficacy (Bong & Skaalvik, 2003), and achievement motivation (Mustofa, 2006; Obiero, 2018; Wang & Lin, 2008) on students.

Most of these studies were conducted in non-mathematics related courses with gender difference playing diverse roles. Previous studies in Ghana provide evidence, though limited, on non-mathematics related courses on self-concept (Alawiyi & Alawiyi, 2010) and achievement motivation (Affum-Osei, Adom, Barnie, & Forkuoh, 2014; Acquah, 2017). The studies by Laryea, Saani, and Dawso-Brew (2014); and Afrifa-Yamoah, Cofie, Bashiru, Saeed, Azumah, and Adu, (2016) are some of the studies carried out in Ghana linked to mathematics. A careful review of literature indicated that limited evidence existed for a single study that involved all the three constructs.

Also, researchers have frequently employed sex as a variable in education (Ergen, Yelken & Kanadi, 2019). Maheswari and Aruna (2016) and Liu and Zhu (2009) all inferred that there was significant difference between gender of the respondents with regard to achievement motivation. Awan *et* al. (2011) research work revealed that not only were girls favoured but mathematics self-concept was also significant, whereas the male and female students' academic self-concept did not show a statistically significant difference in Dramanu and Balarabe (2013) study. Other research revealed that male learners performed significantly better in mathematics and had stronger mathematics self-efficacy achievement than their female colleagues (Naz, Shah & Rehman, 2016; Peters, 2013), while Ampofo (2019) found no significant difference. All the above studies suggested disparities between sex/gender difference and the three affective factors.

Other studies have also conducted research into the factors affecting students' performance from the perspectives of programmes and courses of study (Ajmal & Rafique, 2018; Matuvo, 2012). In this case, data was collected

on pre-service teachers to account for factors perceived to affect their mathematics performance. It is relevant to note, nonetheless, that no literature on research done to examine the programme of study differences on the three affects and mathematical achievement in Ghana could be located. The present study was carefully designed to further explore the disparities in views between programme of study and the affective variables on first-years' mathematics achievement in colleges of education.

The research work was motivated by the fact that available data within the scope of the author showed there are few known studies in Ghana by other researchers when it comes to examining relationship between and among first-years' mathematics self-concept, self-efficacy, achievement motivation and their mathematics accomplishment. This study therefore considered how these concepts relate to or influence each other and with other dimensions like differences in gender and programme of study.

Furthermore, none of these studies were conducted at our educational colleges in Ghana. This study was undertaken to probe the possible link that exists between first-year students' self-concept, self-efficacy, achievement motivation, and success in mathematics at colleges of education. This is done to fill the gap in the literature that currently exists on the subject.

Purpose of the Study

The primary goal of the study was to examine the association that exist between the constructs (self-concept, self-efficacy, achievement motivation) and mathematics performance of first year Bachelor of Education student teachers at the public teacher training colleges in Ghana. The study was also to explore and understand how mathematics affects (self-concept, self-efficacy

and achievement motivation) differ in across gender and programme of study levels.

Research Questions

The following research questions served as the study's guide:

1. How would you describe pre-service teachers on the following mathematics affects (self-concept, self-efficacy and achievement motivation)?
2. What is pre-service teachers' academic achievement in mathematics in the first year of their training?
3. To what extent do pre-service teachers' mathematics affects (self-concept, self-efficacy and achievement motivation) differ in terms of gender and programme of study?
4. To what extent do mathematics affects (self-concept, self-efficacy, and achievement motivation) of pre-service teachers influence their mathematics achievement?

Research Hypothesis

The study was guided by the research hypothesis stated below:

H_0**:** There is no significant difference between pre-service teachers in terms of low and high mathematics affects (self-concept, self-efficacy, and achievement motivation), gender and programme of study on their mathematics achievement.

Significance of the Study

Numerous research works have been conducted separately on the association among self-concept and mathematics achievement; self-efficacy and mathematics accomplishment and that of achievement motivation and

mathematics achievement outside Ghana but there is scarce information about the inter-relationship among first-years' self-concept, self-efficacy, achievement motivation and mathematics achievement in Ghana especially in the colleges of education. Therefore, the findings of this study will enable the researcher to explore the possible relations that exist between first years' self-concept, self-efficacy, achievement motivation and mathematics achievement. Also, policy makers especially those in the Ministry of Education, NTC, GTEC, and the affiliated mother Universities will use the findings/recommendations to determine what needs to be done to enable Ghana's colleges of education to adequately prepare future mathematics teachers. Additionally, the results can also be used as a source of reference for mentors'/lead mentors in partner schools and other researchers intending to study on the same subject.

Delimitations

According to Simon (2011), a research study's delimitations are those aspects of the investigation that the researcher can control, which set its parameters and confines. Examples of delimitations include geographical location, objectives, focus and study purpose, research objective, and theoretical framework.

The study could have been conducted in all the public forty-six (46) Ghana's colleges of education, but focused on only 5 colleges drawn from Northern, North-East, and Upper West regions. Delimiting the study to only these three regions, however, does not necessary imply that the problem is unique to the region. The study focuses on all first-year pre-service teachers in the public colleges of education. The choice of first-years for the research was

due to the reason that, the foundation course – number and algebra, is compulsory to all of them. The research could have also covered a wider scope, but is delimited mainly to three affects (self-concept, self-efficacy, achievement motivation, and mathematics accomplishment). As such, Marsh (1986), Internal comparison and social comparison dimensions were employed to assess self-concept. Mastery, performance, and social goals sub-constructs from Mclnerney (1997) measured achievement motivation. Adapted instruments from Usher and Pajares (2009), were used to obtain information about students' mathematics self-efficacy.

Limitations

Firstly, the correlational research design I used could not determine whether any of the variables was able to have a caused on the other. This may not give a full picture of the variables as stakeholders might not be interested using it because of that.

The second limitation was that the questionnaire was given to the respondents to fill them on their own. It was possible for them to give answers that are considered favourable as a means to impress the researcher. Or some of the respondents may just copy the responses of friends. The validity and reliability of the respondents' responses may be impacted by this.

The third challenged was that in one of the schools there was a problem in getting a free time to conduct the test for the respondents. The test had to be conducted after school which the respondents reluctantly agreed to stay and write the test. This may also affect validity and as well as reliability of the exam findings as students are usually tired after school closes.

Also, the multi-stage sample method's use of purposive sampling had an impact on the capacity to generalise the study's findings. The results are only applicable to the chosen colleges and those with comparable characteristics.

Definition of Terms

Self-concept: Perspective of self-created from environmental observations and conclusions make up one's self-concept (Eccles & Wigfield, 2002). Mathematics self-concept is conceptualized in this study as pre-service teachers understanding of their strengths and weakness within themselves and in comparison, to their colleagues in mathematics.

Self-efficacy: Self-efficacy is an individual's assessment of their capacity to plan and carry out the necessary actions to achieve specific kinds of accomplishments (Bandura, 1997). A person's mathematics self-efficacy is his/her confidence in his/her capacity to accomplish in mathematics

Achievement Motivation: it refers to a persons' desire to attain high standards and to accomplish unique objectives in mathematics. It is the self-determination to mathematics success.

Pre-service Teacher: Students receiving basic preparation and training to become licensed professional teachers in Ghanaian at colleges of education.

College of Education: A facility that trains and prepares teachers for Ghana's basic schools.

Tutors: Qualified individuals who instruct future teachers at Ghanaian colleges of education.

Mathematics Tutor: a tutor who teaches mathematics at Ghanaian colleges of education.

Supported Teaching in School (STS): Each year of their training, student teachers receive excellent assistance from the STS during the school-based components. As a result, all partnership schools must have link tutors and qualified mentors who can monitor student teachers' progress toward reaching the National Teachers Standards (NTS).

Organisation of the Study

There were five chapters in the study. The background of the study is presented in Chapter One, followed by statement of the problem, purpose of the study and its significance. The chapter includes research questions, delimitation, limitations and organisation of the study. A review of the relevant literature is presented in Chapter Two. The methodology is thoroughly covered in Chapter Three, along with details on design, population, procedural sample, sampling, research instrumentation, data collection techniques, and the process for analyzing the data. The study's data are analysed in Chapter Four, which is followed by discussions of the findings. Summary, conclusions, and researcher's recommendations are covered in Chapter Five. There are also suggestions for future research in chapter five.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

This chapter‘s objective is to review literature on whether first-years in colleges of education achievement in mathematics is related to self-concept, self-efficacy, and achievement motivation. The evaluation of related literature will be devoted to the four constructs in relation to the topic under study using teacher made achievement test result in Introduction to Learning and Applying Number and Algebra. The structure of the reviewed literature is outlined into six sections. The theoretical framework is covered in the first section, while the second deals with achievement motivation of pre-service teachers in the study of mathematics. The third section covers mathematics self-concept and the fourth deals with self-efficacy. The fifth section also reviews related literature on pre-service teachers’ mathematics achievement. Finally, the sixth section of the chapter examined how related the constructs are with the aid of the conceptual framework of the study.

Research has consistently recognised the substantial role self-concept, self-efficacy and achievement motivation play in student’s performance at school and their experiences in the field of work (Arhin & Amoako, 2019; Obiero, 2018; Affum-Osie, Adom Barnie & Forkuoh, 2014). Consistent with these, much research has been done on the combined and unique relationship that exists between students’ affective disposition and mathematics achievement. According to Marsh and Seaton. (2013), self-concept, motivation, and self-efficacy of learners’ academic subjects are reliable indicators of their academic success in almost all of the participating nations in

the OECD's PISA and TIMSS assessment. Though others view the relationship as positive, other researchers held the notion that no correlation exist amongst these variables. For example, Lee and Kung, (2018), in their review of related literature, opined that the overall results show learners' mathematical self-concept and accomplishment are positively correlated. An indication that, performance in mathematics is high when self-concept learners tend to magnify their success, minimize their mistakes and persist in their mathematical task.

Also, a strong correlation between mathematics and achievement motivation is an indication that students have high desire to obtain better performance (McClelland, 1985), have the interest to involve themselves in tasks that is demanding, have good strategic ability and are action oriented (Gizaw, 2009). Conversely, students with low level of achievement motivation may not do task that is demanding or may tend to be poor planners in mathematics related courses like teaching, learning and applying number and algebra. The end result is that, such students' performance in mathematics becomes abysmal.

Theoretical Basis for the Study

The important concepts in this study are clarified by the theoretical framework. One cannot downplay the importance of a theory in research. Research is built on a strong methodology and a sound theoretical basis. A theory is a broad assertion that sums up and organizes information by proposing a comprehensive relationship between events. According to Kerlinger and Lee (2000), a theory is a collection of interconnected constructs (concepts), descriptions, and assertions that offer a comprehensive overview

of occurrences by defining the interactions of variables in order to explain and forecast the events. A theory aids in determining how constructs are related and also allowing researchers to predict from one construct to the next. Kivunja (2018), highlighted some important characteristics of a theory in his review of other authors' work. According to him, a theory must be logical and coherent, have precise variable definitions, apply to a specific area, and have precisely defined relationships among variables. It must also have concepts, themes, principles, structures, and it must have been founded on empirical facts.

Among the major disadvantages against theories is their inconsistency in nature. The initial purpose of the investigation is typically lost because many constructs and concepts must be aligned with the theoretical framework.

A research's theoretical framework serves as its blueprint or roadmap (Grant & Osanloo, 2014). The theoretical framework in the opinion of Ravitch and Carl (2016), serves as a roadmap for researchers as they situate and contextualize formal theories into their studies. The theoretical framework enables you to cite theories put forth by people who have much deeper knowledge of your subject than you do in support of what you say. These theories are frequently established as true or uncontested. This enables you to refine your data analysis. The main ideas in this study are defined by a theoretical framework, which also suggests relations between concepts and analyses pertinent hypothesis that are based literary works. There are various proponents of various theories, but for the purposes of this research, the discussion in the theoretical framework highlighted and placed into context the concepts; self-concept, self-efficacy, achievement motivation, and

mathematics achievement in the study. The framework also looked at the relationship among the variables and the use of the theory to investigate the linkages and relationship.

Motivational approaches, such as investment theory (Horn, 1982), the Achievement Goal Theory (Elliot & McGregor, 2001), socio-cognitive theory (Bandura, 1977), and Self-Determination Theory (Deci & Ryan's 1991, 2000) have been used by some researchers to look at whether academic motivation and academic achievement are related. Eccles and Wigfield (2002) motivational approach, which is Expectancy-Value Theory (EVT) of achievement motivation, is another perspective and relevant viewpoint that seems important and significant for the study of academic accomplishment. This theoretical approach has been explored by a lot of people in the educational field over the last decade (Eccles, 2005; Wigfield & Eccles, 2000; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). The EVT was predominantly adopted in my research in a bid to understand the relationship among the concepts. Other theoretical underpinnings of this study are theory of achievement motivation (McClelland, 1961), theory of self-efficacy (Bandura, 1997), and Eccles, Wigfield, Flanagan, Miller, Reuman, & Yee, (1989) self-concept theory. These other theories guide how EVT will be used to established the relationship between the first years in the colleges of education.

Expectancy-Value Theory of Achievement Motivation

Several theories and empirical investigations influenced the study; however, it was much situated and grounded in the expectancy-value model advanced by Eccles et. al, (1983). A number of beliefs served as the

foundation for the model choice. Firstly, Feather (1982) noted that, one of the earliest theories of motivating people is expectancy-value theory, which serves as the foundation for the majority of current motivational models. This study also relied on the model because of its multi-functional ability. The scope of contemporary motivation theories, most often overlaps (Wigfield & Eccles, 2002). Some are thorough and cover a wide range of components of motivation (e.g., expectancy-value theory (Eccles & Wigfield, 2002)), whereas others such as theories of self-efficacy (Bandura, 1997) and self-concept are more specific. Finally, the theory has proven to be an all-inclusive and important theory to explain students' learning strategies, behaviours, persistence and achievement in the educational setting (Eccles & Wigfield, 2002).

According to the expectation value hypothesis, pupils will exert extra commitment in pursuits that they concurrently value and believe they can achieve in (Eccles & Wigfield, 2002). The theory states that there are two key divisions to motivation, and that the interaction between these divisions is crucial to the growth of human development and motivation. Expectations for success and task value are the two key components. Expectation for success typically relates to belief a person holds that doing a task will result in either achievement or failure, whereas task value is defining as the comparable allure of completing a task successfully or unsuccessfully (Wigfield & Eccles, 2000).

As said by Eccles (2009), individuals view a specific activity as being linked with particular attributes, and they will choose tasks that match the attributes they perceive in themselves. Students mostly want a match between the traits they perceive in themselves with their courses or subjects of study.

People will choose projects based on their gender that will let them demonstrate who they are (Jones & Hite, 2020). Depending on their sex, students most at times choose tasks that will let them express their strengths.

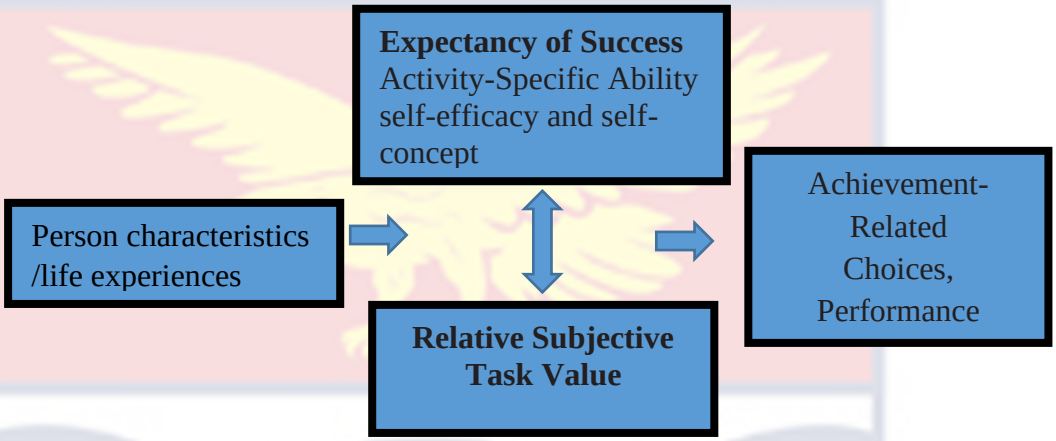

Figure 1: Condensed model version of expectancy-value of achievement related choices and performance.
Source: Eccles, 2011.

The current research concentrated on parts of the illustration that deal with success expectancies and task value (see Figure 1). Performance is believed to be directly related to expectancy and value principles which the current investigation finds to be of tremendous interest. It is crucial to comprehensively review these two components so far as pre-service teachers' mathematics achievement is concern in order to make use of this framework to self-concept, self-efficacy and achievement motivation.

Success Expectations Component

Expectations for success, according to Wigfield and Eccles (2000), are the individuals' opinions and judgement on how well they believe they will perform on a particular assignment. This component concerns itself with whether the individual is able to undertake the task and succeed in it. Self-efficacy beliefs are one of the many factors that affect expectations for success

in general (Eccles, 2005), a person's judgement of the degree of toughness of certain tasks to one (Eccles, 2007), self-concept, and expectations of important others, such as, parents and instructors (Eccles *et al.*, 1983). Moreover, this research work will concentrate on how expectations are influenced by self-concept and beliefs of self-efficacy. Self-concept and self-efficacy beliefs are related to research in the area of expectations, performance, and persistence in tasks requiring achievement (Eccles, 2005). Ability beliefs and expectancy beliefs are the two kinds of success expectancy (Jones & Hite, 2020; Wigfield & Eccles, 2000). Contrary to expectations, according to Jones and Hite (2020), mathematical beliefs are measured similarly to measures of mathematical self-efficacy (Bandura, 1997; May, 2009). Additionally, Eccles et al. (2000) argued that even though anticipation and self-concept are conceptually separate construct, in real-world achievement situations, they are highly connected and practically similar. The expectations under consideration in this study were mathematics self-concept and self-efficacy.

The Component of Task Value

Value component relates to the numerous justifications for students for taking part in an activity or not taking part and the reasons assigned to the justification. The value component, which shows people's views in determining a purpose or motive to accomplish a specific work, aligns to the query "Do I want to do this task and why?" to best encourage students' achievement behaviour (Eccles *et al.*, 1998). The value a person allocates to a task is arbitrary since conceptions differ from person to person based on their own emotive memories, self-concept of abilities, anticipated difficulties, and personal ambitions (Wigfield & Eccles, 2000). When someone values a

particular behaviour, he/she is most likely to part-take in that task. The several components in the modern EVT model are the value components of attainment, intrinsic, utility, and cost.

Intrinsic value: The intrinsic value is indicated by the interest one gains for engaging in a task. Intrinsic value in the opinion of Ryan and Deci, (2000), is comparable to the ideas of interest and intrinsic motivation (Schiefele, 2009). Students who genuinely enjoy an activity are more likely to stick with it and put their all into it, which improves learning results.

Attainment value: A task's relevance for the confirmation an individual's social and personal identity is connected to its attainment value, which is the personal significance of completing it properly (Eccles, 2009; Eccles & Wigfield, 2002). Activities carried out with pleasure are seen as intrinsically driven, whereas an individual's reputation serves as attainment value. For instance, a student can have an excellent attainment value for a course like further algebra since mastering the course enables him or her to validate significant aspects of self. This element is comparable to the idea of mastery approach goals, which is defined in achievement goal theory (Nicholls 1984) as performing an activity in order to achieve a goal rather than doing it for its own sake.

Due to learners better developed identities in secondary school and colleges settings, achievement value becomes important.

Utility value: A task's utility value is determined by how well it fits into a person's varied short- and long-term goals and ambitions. Even though an academic assignment lacks intrinsic value, it might still have high utility value via facilitating personal gains (Eccles & Wigfield, 2002). For instance, a

student studying biology as a major in high school would not find mathematics intrinsic worth, yet taking mathematics courses could be an advantageous as it would enable the student to study medicine.

Cost: Cost is a term used to describe the perceived drawbacks of performing a particular task in terms of the psychological costs connected with it, such as performance anxiety and failure fear, the eagerly awaited effort required for success and the potential loss of opportunities given that choosing one course of action typically entails giving up other options (Eccles & Wigfield, 2002). Eccles and Wigfield assert that the first type of cost is associated with the costs of failure, whereas the other two types of cost are associated with the costs of success (e.g., giving up time and energy for valued alternatives). The task value factor that has received the least research attention is cost.

In essence, many personal, cultural, and social influences over time impact the people's expectation and subjective task value (Eccles, 2005). The expectancy-value theory holds that an individual's cultural/social milieu (e.g., relatives, peers, and teachers) as well their abilities and previous accomplishment-related experience all influence social roles and cultural stereotypes of subject matter, professional traits, gender, and views and behaviors of socializers. Personal factors include one's ideas about their own abilities, their impressions of the opinions of others, expectations, social roles, and stereotypes, as well as how difficulty they consider particular tasks to be. Goals, self-schemata, and emotional memories, one's own prior experiences, and the numerous social factors are all examples of personal influences (Eccles, 2011).

One of the significant questions is the relationship that exists between competency beliefs and task-value. According to self-efficacy theory and Eccles model, ability self-concept and self-efficacy beliefs should influence task values (Bandura, 1997). Additionally, under the expectancy-value paradigm, an individual's self-efficacy expectations and the inherent worth of the academic assignment have a direct impact on their ability to achieve (Wang & Tsai, 2016).

The section of the model that discusses students' achievement beliefs and values and how they relate to achievement actions is shown in Figure 1. According to Eccles *et al.* (1983), expectations for success on achievement tasks and subjective value that students place on success on such tasks are the two factors that most directly influence students' performance, perseverance, and choice of achievement task. The other achievement related beliefs, such as the individual's achievement objectives, self-efficacy and self-concept, and their task-specific beliefs, have the most influence on the student's expectations and values. It is possible to systematically investigate the first year pre-service teachers' achievement motivation, self-concept, self-efficacy, and accomplishment in mathematics using the framework of expectancy-value model.

Expectations and values have the biggest impact on achievement-related decisions and performance, when looking at the model in Figure 1 from right to left. In turn, one's self-concept, self-efficacy, and achievement motivation have an impact on these beliefs associated to achievement. It's been shown that academic self-concept predicts academic success more accurately than value beliefs (Wigfield & Eccles, 2002). Academic self-

concept and academic performance seem to be more consistently related, and the relationship tends to be reciprocal, in subsequent levels of schooling. Marsh and Craven's (2006) model of reciprocal effects explains the connection between earlier self-concept and later achievement and later self-concept. This reciprocal effects theory has garnered support from a number of empirical studies using varied sample of adolescents for its comprehensiveness (Marsh & Craven, 2006; Guo et al., 2016).

According to Akindipe (2015), various academics have employed the expectancy-value theory of motivation to grasp learners' proficiency in mathematics. When a student has what it takes to excel in mathematics and also believes that the topic is extremely valuable, they are more inclined to listen, contribute, try more difficult questions, and achieve well in the subject. Students who do not think they can achieve in mathematics and who think the subject doesn't matter to them, on the other hand, are different.

The above literature reviewed has shown that it is possible to interpret expectancy of success and value component in the model of expectancy-value. It is also revealed that both components with their correspondences from the three affects (achievement motivation, self-concept, and self-efficacy) are vital predictors of accomplishment. The development of concepts in the area of self-concept, self-efficacy, and achievement motivation in mathematics education are all highlighted in the subsequent section.

The Concept Achievement Motivation

Students are beset by difficulties in algebra performance which require consistent attention. There are a lot of factors that can affect pre-service teachers' mathematics achievement. One of such most important factor is

motivation, which can affect pre-service teachers during their first year study of Algebra. According to Mahato and Barman (2019), motivation is what drives someone to perform in a particular way. Pre-service teachers act in a way is as such directed by how motivated they are. Motivation is centered on individual's emotions and accomplishment related goals. David McClelland (1961) is most noted for describing three types of motivational needs, namely: (1) Authority/power motivation (n-pow): the n-pow individual is authority motivated; (2) Affiliation motivation (n-affil): the n-affil individual is driven to communicate with others and has a need for friendly relationships; and (3) need for achievement (n-ach). The n-ach person aspires to success, the accomplishment of demanding yet achievable goals, and job/task advancement. The need for success takes precedence over all others, according to Chimezie, Cbibuike, Ndidi, and Emmanuel (2019), since it makes others' needs come true (need for power and affiliation). The need for achievement is the major factor bringing achievement motivation into existence (Erdogen et al., 2011).

Motivation for achievement is a need that is based on a person’s desire to perform well in a certain task (Mahato & Barman, 2019). It is this desires and motives that derives a person towards a particular life goal, so as to finally be able to succeed in learning and achievement in a subject like mathematics. Achievement motivation is among the different forms of motivation, it is centered on becoming successful and fulfilling all of our wishes in life. It is the need for success or the pursuit of excellence (Harackiewicz, Barron, Carter, Lehto & Elliott, 1998).

Achievement motivation refers to the desire to succeed rather than the accomplishment itself. This desire is considered as intrinsic in nature. Achievement motivation, as defined by Chetri (2014), is the mindset toward achieving rather than the accomplishments itself. Because the incentive is delayed, it might be seen as prolonged self-motivation. Students who have a strong desire to succeed or students who are highly achievement motivated are more likely to establish more difficult goals than students who have low levels of achievement motivation (Davids, 2015).

A person who is achievement motivated is more inclined to demonstrate consciousness, an optimistic perspective, optimism, confidence, and trust in a brighter tomorrow, according to McClelland et al. (1953), whereas a person who lacks achievement motivation would show general cynicism, skepticism, and hopelessness. Singh (2011) outlined the following characteristics of achievement motivated students:

1. They take care to only take on projects that they are capable of completing;
2. They would rather work on a problem than leave the result up to chance;
3. They are more focused on their own success than on the rewards of success;
4. They enjoy life, are goal oriented, and perceived themselves as in charge.

Student who showed such characteristics can be said to have high overall achievement motivation. Such students are likely to be successful in the study of mathematics (p. 40).

The connection among academic accomplishment motivation and academic achievement has been the subject of numerous researches. One of the main frameworks for examining accomplishment motivation is expectancy-value theory (Guo, 2016). According to the expectation-value theory, people's goals have an impact on their expectation of success (or expectancy) (e.g., objectives for learning activities). Conley (2012) linked accomplishment goal theory and expectancy-value theory constructs in his study. The approach to motivational goals that emphasizes both mastery and performance goals has historically drawn the greatest attention. According to Ames (1992), these motivational achievement goals or achievement goals for short, were some specific motives that students had for their achievement related behavior. These goals can be used to explain how students will react to, approach, or engage in academic tasks of various kinds. Ames (1992) came to the conclusion that goals have power to impact or encourage students' academic behaviors regarding how to complete assignments or other classroom tasks. Achievement goals were described as integrated patterns of learners' views regarding their motivation for participating in a learning assignment in another definition offered by Pintrich and Schunk (1996). In an accomplishment setting, goals were expected to provide a framework for learners' experiences and interpretations, according to Elliot (1999).

The two main goal orientations that have been recognised as operating in the realm of motivation for achievement are mastery goal orientation and performance goal orientation, as previously mention (Ames, 1992; Dweck, 1999). Alternatively, the two orientation goals can be called "task-involvement goal orientation and ego-involvement goal orientation" (Nicholls,

1984) or "learning goal orientation and performance goal orientation" (Dweck, 1999), respectively. For the purpose of this study, the two concepts will be referred to as mastery goal/general and performance goal/general.

Mastery goals (general) measures a student's perception of how mastery oriented they are. Research shows that when mastery goals is adopted by students, they select challenging task and are more concerned with their own progress than with the intention of performing better than others (Sekreter & Doghonadze, 2015). They also prefer circumstances where they develop new skills and knowledge (Nicholls, 1984). Mastery aim was described by Urdan and Mestas (2006) as a teenager's drive to discover, advance, and gain proficiency. Mastery oriented learners believe that high ability and self-competence are realized through improving one's knowledge, understanding and skills. Their motivation tends to center on intrinsic motivation because they engage in academic activities due to the enjoyment they get from them.

Other researchers, also separated mastery goals into mastery approach and mastery avoidance (Was, 2006; Brophy, 2005). Was (2006) states that while it might be challenging to discern the two mastery elements as independent, data analyses of the implemented indicators will not make an effort to do so. Evidence also points to the fact that mastery approach and mastery avoidance are adaptive in the academic field (Seaton, Parker, Marsh, Craven & Yeung, 2014). As such, a general mastery orientation is captured as one subscale within the bigger measure. Growing evidence is available with reference to the positive impact of mastery-approach on self-efficacy (Hulleman & Senko, 2010; Pintrich, 2000). Seaton et al. (2014) found some evidence of reciprocal relationship in mastery goal and achievement in their

study involving 2786 Australian High School students. They also found that mastery goal orientation in arithmetic's was a positive predictor of self-concept.

Performance goals (general) measures a student's perception of how performance oriented they are. Students who are performance oriented assess their abilities in comparison to other students' ability levels. Performance oriented students perform task they are highly effective at for the purposes of trying to outperform their colleagues (Sekreter & Doghonadze, 2015). Related to this, persons with performance goal concentrate on the self, and opt for circumstances where their talents can be exhibited in order to make comparison with other students (Nicholls, 1989) and obtain positive judgment from parents, teachers, and colleagues or avoid bad judgment of their competence (Ames, 1992). As such, one can conclude that performance goal students' motivation tend to focus on extrinsic motivation because they engage in academic task to obtain reward (approval, good judgment, good grades) or to avoid punishment (disapproval, negative judgment, bad grades). Edwards (2014) and Was (2006) separated performance goals into two, that is, performance approach and performance avoidance. For the purpose of this study, the two factors will be considered as a single subscale. Previous mathematics high achievement orientation is a substantial positive determinant of mathematics accomplishment and mathematics self-concept (Seaton et al., 2014). A 2013 temporal ordering study by Paulick, Watermann, and Nuckles revealed a negative reciprocal link between give it the ability goals and achievement. Their conclusions diverged significantly from those of Seaton and his associates. Although they don't get as much emphasis as mastery and

performance goals, global, valuing, and social goals are nonetheless important kinds of goals (Dowson & Mclnerney, 2001).

Social goals measure a student's impression of their level socially orientation. The term perceived social purposes of trying to achieve academically is used to describe social goals (Urdan & Maehr, 1995). Since obtaining competence (defined either interpersonally or intrapersonally) is the main focus, mastery and performance goals have been seen as being tied to competence. Socially motivated objectives can be considered. The motivation to succeed comes from a variety of societal issues. When compared to alternative theoretical perspectives of social goals made by other authors, the idea of social aims stands out (Ryan and Shim, 2008 & Wentzel, 2000). The primary focus of Wentzel's (2000) concept of social goals is the social objectives that students are aiming to accomplish in classroom. As a result, she requests that learners respond to statements which involve how frequently they share their understating of mathematical concepts with their colleagues instead of emphasing specific study goals, concept of social goals, emphasis is placed on inclinations toward social competency rather than specific study goals (see also Mouratidis & Michou, 2011). Achievement motivation, according to Maehr (as cited in Awan *et al.,* 2011) is mostly social psychological in nature.

The main problem for people pursuing social goals is those related to wanting to succeed in academic context are for social reasons (Awan, *et al.*, 2011). A careful study of literature all point to the fact a limited positive correlation exists between social goals and academic achievement. Various findings from the few studies try to explain the relationship (Covington, 2000).

Whereas *valuing goal* measures how much a student/person attaches worth to a particular object, phenomenon, or behaviour at school, *Global goals* on the other hand, measures a student's perception of how motivated they are at school. Brown (as cited in Daskalovska, Gudeva & Ivanovska, 2012) explains that global motivation refers to the overall orientation to learners towards the learning of a second language. As such, global goals in the field of mathematics are the general orientation to learners towards the learning of mathematics.

From the literature analysed above there is clear evidence that both mastery orientation and performance goal orientation help students achieve high academic performance. However, mastery goals approach is mostly considered in most literature as the best approach to learning than the performance goal orientation. This is because the mastery goal approach is related to a number of positive learning attitudes and effective learning strategies. For example, the belief that effort leads to success, attributing success and failures to internal controllable factors and showing of preference for challenges and risk taking are excellent stimuli that enable students to do well in academic work.

This study will consider only the first three elements motivation for achievement (social, mastery, and performance goals) as well as their correlation with academic achievement of mathematics. Global and values goals will not be considered because a careful review of literature show how limited they are in terms of achievement motivation.

On domain specific levels, several studies place a great deal of emphasis on domain specific achievement motivation when predicting

academic achievement (Michel, Steinmayr, Frenzel & Ziegler, 2020). The current study for instance is on mathematics achievement motivation.

Self-Efficacy Theory

The central idea of Albert Bandura's social cognitive theory is self-efficacy because it is critical and serves as the foundation for students' motivation, personal accomplishment and learning (Pajares, 2005; Schunk, 2003). Self-efficacy is a cognitive concept that describes people's view about their capacities to perform the activities required to attain desired results (Bandura, 1986). Self-efficacy is said to be in correspondence with statements like: Can I do this task? That is, expectancy component of EVT. It is one's belief in his/her personal ability to effectively perform specified tasks. According to Cherry (2013), self-efficacy is the conviction in one's ability to plan and carry out strategies that are necessary to confront potential scenarios. As such, self-efficacy is an individual's belief he or she holds about specific situations. Depending on how a person perceives their abilities in connection to a particular task, self-efficacy beliefs can have good or negative impact on their behaviour. For instance, compared to someone who doubts his or her own talents, a person with high self-efficacy will most likely engage, work tirelessly, and persevere for long in the face of failure, obstacles, and difficulties.

According to Davids (2015), people are more inclined to set tough objectives for themselves and may be more dedicated to achieving those goals if they have stronger self-efficacy beliefs. In mathematics education, academic self-efficacy is significant due to the fact that learners with low self-efficacy

are more likely to ignore areas they believe they will perform poorly (Wiginton, 2013).

Self-efficacy in mathematics refers to a person's confidence in his or her ability to carry out mathematical tasks successfully (Ampofo, 2019). It conveys a person's level of self-assurance and expectation over his or her capacity to tackle a certain mathematical problem. In general, it has been found that students' self-efficacy is strongly correlated with their choice of mathematics courses and career paths (Vukovic, Roberts & Green, 2013). It conveys a person's level of self-assurance and expectation over his or her capacity to tackle a certain mathematical problem.

Agbornu and Edekor (2020) looked at the connection among senior high school students' mathematical proficiency and self-efficacy in the Central region of Ghana. According to the study's findings, there is a connection between students' mathematical accomplishment and their perception of their mathematical ability. Louis and Mistele (2011) found that self-efficacy is still a good predictor of the accomplishment scores in early adolescents pursuing mathematics and science, despite the disparities in self-efficacy levels between genders.

In this study, the researcher conceptualised mathematics self-efficacy to mean the perceived competence in the area of mathematics in general and more specifically in number and algebra.

Sources of Self-Efficacy

People interpret information largely from four sources to construct their idea about their own abilities according to Bandura (1994): mastery experience, vicarious experience, social persuasions, and physiological

reactions. The results of one's own performance or mastery experiences seem to be the most important source for many people (Pajares, 2009). In essence, people's perceptions of the effectiveness of their actions are influenced by how they quantify that impact and how well they comprehend. Self-efficacy is increased when a task is completed successfully, whereas it is decreased when a task or difficulty is not successfully handled.

Students need to develop their efficacy beliefs through the vicarious experience of watching others execute tasks in addition to analyzing the outcomes of their mastering experience. Peoples confidence in their own talents are influence by watching the triumphs and failures of peers they judge to be similarly competent (Cherry 2013).

The verbal cues and social pressures that people experience from others – intentional or not – have an impact on how they perceive their own efficacy. These messages can encourage people to put up the additional work and perseverance necessary for success, which will lead to continued growth of experiences and self-efficacy.

Information about efficacy beliefs can be gleaned from physiological and emotional states including stress and anxiety as well as mood. In general, self-efficacy is strengthened by optimism or a good mood whereas it is undermined by a sense of hopelessness. Teenagers who have high levels of self-efficacy will find the emotional state to be stimulating, while those who are overcome with self-doubt may find it to be debilitating (Cherry, 2013; Pajares, 2009). There is the need for research to be conducted to assess the extent to which self-efficacy impacts students' performance in mathematics

given its importance in student learning and its effects on mathematics accomplishment.

Self-Concept Theory

One of the most important elements influencing students' academic success is their self-concept (Laryea, Saani & Dawson-Brew, 2014). Self-concept is a complex concept process that relates to one's perception of oneself and is linked to many varieties of personal traits including physical appearance, self-ability, goals, values, and self-esteem (Takaria & Palinussa, 2020). People's self-concept is their opinion of themselves as a result of their perceptions and abilities. It is one's self-perception. Takaria (2015) defines self-concept as an individual's opinion of himself or herself, as well as an outsider's assessment of one's own excess, inadequacy, potential, and attitude. A dynamic perception of oneself is referred to as one's self-concept. Individuals' awareness and expectations of himself or herself in achievement circumstances are referred to as academic self-concept (Alhassah, 2011). Self-concept does not have a clear-cut definition. It is more accurately described as a set of remarkably constant and distinct behavioral patterns that characterize a person and his or her responses to the environment, although some scholars refer to it as a construct closely related to personality. Some see it as self-evaluations that are domain-specific (Ayodele, 2011).

Afgani, Suryadi, and Dahlan (2018) define self-concept as a subjective experience of himself or herself that has the power to affect his or her existence. That perspective may be how that person sees him/her-self. This evaluation results form a mental evaluation of a person's characteristic, which may be good or negative. An individual self-concept can be discovered by

looking at their activities, such as their interest in learning mathematics. The way a person perceives the world is shown by how enthusiastically, diligently, confidently, and highly motivated they are to answer various mathematical problems.

According to Lone and Lone (2016), scholastic performance is the result of education and measures how well a pupil, instructor, or school has accomplished its educational objectives. Self-concept is the entirety of a person's choice, views, and cognitions about themselves. Academic achievement or performance is the level of competency reached in some given place, in relation to scholastic and academic task. Self-concept, on the other hand, can simple be viewed at as a person's views, attributes, who and what the self is.

Crawford (2013) found in his research that while students' self-concept improves their academic success, the amount of work they put into studying adds considerably to students' self-concept in enhancing their academic performance (as stated in Agbornu & Edekor, 2020). Laryea, Saani & Dawson-Brew, (2014) also corroborated Crawford study and opined that self-concept per se cannot directly determine learners' academic achievement, students' efforts during their private studies is the key determinant factor. According to Khalaila's (2015) research, test anxiety and intrinsic motivation were the two main environmental and motivational elements that accounted for the relationship between academic accomplishment and self-concept. Because their self-concept indirectly caused them to have stronger intrinsic motivation and/or less exam anxiety, people who believe they are academically competent got better grades and performed better.

Self-concept can be distinguished from self-esteem, according to Lone and Lone, (2016) and Umar and Imam, (2019): self-concept is a conceptual or interpretive aspect of one's self (for example, I am fast in working astatistics) but self-esteem is evaluation and judgemental (for example, I felt happy any time I score high in statistics). The two phrases common usage as synonyms has cause much confusion and dispute (Marsh & Martin, 2011). According to Afgani et al. (2016), self-concept is composed of a range of factors/elements. The following factors can be used to evaluate people's self-concept: 1) the person's perspective on her or his abilities, 2) the individual's attitude and beliefs, 3) the individual's assessment of himself or herself, 4) the individual's contemplation of the future. The aforementioned statements may directly or indirectly impact on each learner.

Shavelson, Hubner, and Stanton (1976) presented a complex, hierarchical framework that divided general self-concept into academic and non-academic dimensions in an effort to model the connection between student accomplishment and self-concept. The self-concepts of social, emotional, and physiological categories are referred to as non-academic self-concept (Yang & Wong, 2020; Marsh & Seaton, 2013). Students may develop social self-concepts based on their interaction with peers and teachers. Students may develop this domain for their emotional self-concept depending on the specific emotional states they experience on regular basis. Students' opinions of their abilities and attractiveness are mostly considered while discussing their physical self-concept.

Yang (2017) updated self-concept model and designed the extended model of self-concept. Self-concept in academia and elsewhere now include career-related areas. According to Yang and Wong (2020), teenagers' self-concepts of their profession-related talents and passions may grow based on the leadership training programs offered by their institutions and their own desires for professional growth.

Academic self-concept is the belief in one's own abilities and successes in logic and/or learning (Timmerman, Toll & Luit, 2017). Academic success and academic self-concept are actually similar. More academic accomplishment encourages greater achievement, creating a positive feedback loop, claim Parker, Marsh, Ciarrochi, Marshall and Abduljabbar (2017). Academic self-concept and self-efficacy were the main predictors of 14 psychosocial variables in PISA 2000 (Marsh, Trautwein, Lüdtke, & Köller, 2008).

Numerous studies have looked into the connection between self-concept and achievement or success in any learning situation. The majority of these studies back up the idea that self-concept is a crucial enhancer of educational outcomes and that a changing one’s self-concept affects one’s ability to succeed or achieve academically (Ayodele, 2011). Academic self-concept has both directly and indirectly impact on performance and Studies from six prior TIMSS cycles, as per Hooper et al. (2017), have demonstrated a high connection to students' academic self-concepts and their success. This suggests a two-way relationship; rising self-concept academically raises accomplishment levels, and vice versa (Timmerman, Toll & Luit, 2017). Academic success can influence academic self-concept, or the other way

around, in a manner akin to the "chicken–egg" dilemma. A mathematical framework suggests that academic achievement and academic self-concept are direct determinants and complement in order to reflect this relationship: greater accomplishment will result in improved academic self-concept, and greater achievement will result in improved academic self-concept. Based on certain subjects, the academic self-concept is multi-dimensional and hierarchical (Shavelson et al. cited in Dramanu & Balarabe, 2013). Among the different school subjects are self-concept related to arithmetic, English, history, and science.

Mathematics self-concept is a crucial construct that pre-service mathematics instructors must acquire during their study of mathematics, according to Takaria and Palinussa (2020). A person's view in his or her capacity to excel well in mathematics or confidence in his or her capability to acquire mathematics is referred to as their mathematics self-concept (Erdogan & Sengulb, 2014). Research repeatedly demonstrates a link between mathematical self-perception and proficiency (Alhassah, 2011). The interaction between mathematics self-concept, assessment and mathematical anxiety, achievement motivation, and mathematics achievement in normally developing 12 – 14 year-old teenagers from high school in the Netherlands is examined Timmerman *et al.,* (2017). According to regression studies, the only factor that significantly and exclusively contributed to the variance in mathematics results is mathematical self-concept. When Parker et al., (2014) examined that mathematics self-efficacy and self-concept were determinants for the long-term success and that mathematical self-concept was consistently

related to enrolling in post-secondary courses in STEM while mathematics self-efficacy may not have been. Other studies hold contrary views.

According to Agbornu and Edekor (2020), students' mathematics perceptions (self-concept) of their own abilities in mathematics were unrelated to such abilities. In addition, students' self-concept is perceived positively by students; however, this self-concept does not directly predict students' academic performance (Laryea, Saani & Dawson-Brew, 2014).

According to Eccles (2008), data suggests that success expectancies and ability self-concepts are intimately related entities, making it somewhat challenging to separate them. Guo, Nagengast, and Marsh, (2016) also added that expectancy-value thinkers has come to the conclusion that expectations of success self-concept in academia really aren't empirically distinct. As a result, modern EVT research frequently use of academic self-concept.

In Ghana, little study has been done on the topic, especially with first years at the Colleges of Education level. Unfortunately, the majority of research efforts and conclusions on the influence of self-concept on college accomplishment have been come from the countries of the west.

Mathematics Achievement

Over a century has been spent studying the idea of achievement. There are currently a lot of explanations and definitions of achievement, although researchers have attempted to provide a single definition. There are now numerous ways to describe achievement. The definitions, features and breadth change over time and among persons (Kaya, Juntune & Stough, 2015).

Achievement is what a person gains as a result of learning or what they learn. Achievement is also defined as people's level of skill in a certain task. Intellectual and nonintellectual variables are the products of this competence, although this study will focus on the former. Accomplishment, according to Niemi (1999), is the mastery of key ideas and principles, significant facts and claims, talents, expertise, and the incorporation of information. Sometimes, achievement is fractionated into knowledge divisions.

Academic achievement is grouped into two categories: low achievement and high achievement. It describes a student's level of academic proficiency. Low achievement is defined as a standard of learners' performance that is lower than expected. For instance, when there is a noticeable discrepancy between anticipated achievement and actual worth with the level of academic accomplishment being lower or in the center, we consider it as low achievement. Conversely, high achievement describes kids that above expectations in their academic achievement. For instance, when low or mid-intelligent pupils outperform expectations in terms of their academic accomplishment; they are high achievers (Cheng, Wanh & Liu, 2019).

In this modern day, mathematics achievement is an important part of academic achievement (Pandey, 2017). Mathematics achievement is a student ability to carry out an activity in the subject mathematics. It is important to remember that scores on mathematics achievement tests are meant to measure mathematics achievement. Thus, it is how well learners perform on test created by their teachers or on standardize accomplishment test administered by an examination body.

A variety of methods have been used by researchers to assess educational achievement. School-based assessments such as final grades, grade point average, and teacher evaluations can be used to evaluate achievement.

Conceptual Framework

The primary self-sufficient and totally reliant variables of the study, as well as their relationships are described in a conceptual framework (Ogula, 1998). The conceptual framework was created to support the research procedures and aid in data collection in light of the theoretical context. As can be seen in the conceptual model as below in Figure 2, a framework of the relation among first years' in the colleges of education self-concept, achievement motivation and mathematics accomplishment was developed and utilised to carefully analyse data in this research. The condensed Eccles expectancy-value model is modified into the conceptual framework below for this study. The expectancy-value theory modelled the achievement related choices and performance as a dependent variable. As shown in the conceptual framework below, the achievement related choices and performance have been modified to be first years' achievement/performance in learning mathematics. Also, expectancy of success and relative task value was modelled as independent variables. The conceptual framework's independent variables include self-concept, self-efficacy and achievement motivation. The conceptual framework also hypothesized the model that is used to show individuals' characteristics (sex and Programme of Study difference). The analysis determined whether there is a significant disparity between male and female students' (self-concept, self-efficacy, and achievement motivation)

mean mathematical test outcomes. Finally, the conceptual framework involved pre-service teachers' programme of study, which is use to check if it has any significant difference with their mathematics achievement test score.

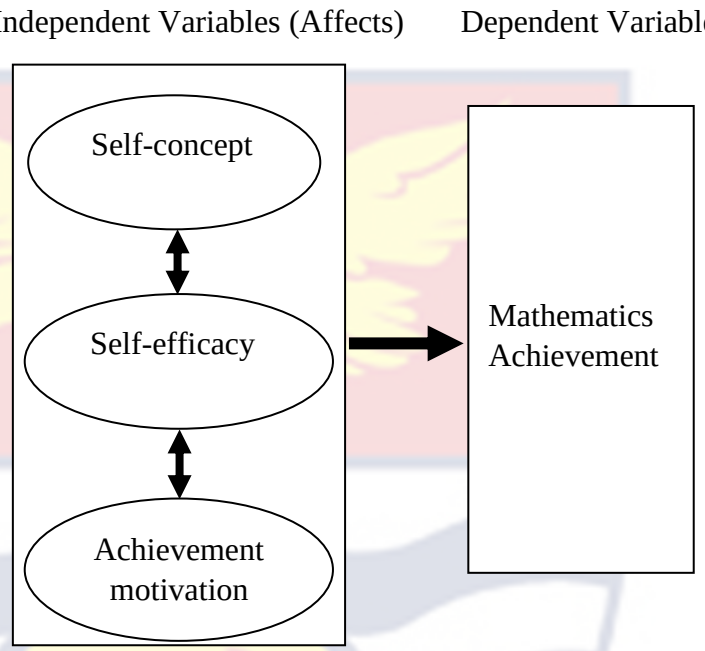

Figure 2: A conceptual framework for the research.
Source: Self constructed

Figure 2 shows that the independent variable column is made up of self-concept, self-efficacy, and achievement motivation while the dependent variable consists of only mathematics achievement. Sex and programme of study are other demographic factors in the framework which were used to show their significance in relation to the dependent and independent variables, respectively. This study's conceptual framework is made up of the connections between self-concept, self-efficacy and achievement motivation and the mathematics achievement. Double arrow headlines indicate the possible relationship among the independent variables while the single arrow line represents the link between each of the predictor and the dependent variable. The theoretical analysis suggests that there may not be a direct relationship involving these independent variables and the dependent variable.

The relationships that exist among the elements of the conceptual framework are discussed in the subsequent sections.

Mathematics Achievement and Self-Concept

Several research works looked into the association between self-concept and academic accomplishment or success in mathematics (Erdogan & Sengul, 2014). Numerous research back up the idea that self-concept is an important facilitator of academic success in mathematics and that changes in self-concept, whether good or negative, tend to be related to changes in academic outcome (Sikhwari 2014; Timmerman *et al.,* 2017).

For mathematics to be precise, mathematics outcome was strongly positively linked with mathematics self-concept in a longitudinal study of Australian youth with a mean age of 15 (Parker, Marsh, Ciarrochi, Marshall, & Abduljabbar, 2017). This finding falls in line with McWilliams, Nier, and Singer (2013) study which discovered a stronger correlation between mathematics outcome and mathematics self-concept is than academic self-concept. As such, research on domain-specific achievement and self-concept seems to be necessary.

Mathematics achievement in certain high schools in Nigeria, most especially the south-western part is associated with academic self-concept, claims Yara (2010). Yara continued by claiming that there is a quantitative relationship between academic success and self-perception. Timmerman *et al.*, (2017) study on 108 adolescents from secondary schools in the Netherlands, the only factor that significantly and uniquely contributed to the variance in mathematics achievement was the student's perception of their own arithmetic abilities. In another study by Adegoke (2015), he found a positive and

statistically significant association between learner's accomplishment and self-concept in mathematics. Higher mathematical self-concept was found in high ability kids compared to low ability individuals.

Dramanu and Balarabe (2013) examined the connection between academic self-concept and academic achievement in junior high school (JHS) learners in Ghana. The participant's achievement was determined using the mean score for each student on four tests, that is, mathematics, English, social studies, and science. The researchers found a statistically significant connection among educational self-concept and achievement ($r = 0.306$).

The findings of a study by Ayodele (2011) that examined the connection among self-perception and mathematical performance as well as the effect of gender on self-perception and performance in mathematics indicated a moderate link between self-concept and mathematical achievement.

In their 2017 study, Izuchi and Onyekuru looked at the relations between academic motivation, academic self-concept, and academic achievement amongst 528 college students. College Students Academic Self-concept Questionnaire (CSACQ) served as the data gathering tool. The findings showed a favourable and significant connection between students' academic achievement and their self-concept academically. A higher self-concept was found to be directly linked to better academic accomplishment in a study conducted by Khalaila (2015) on a sample of 170 undergraduate nursing students at an academic college in northern Israel.

There are contradictory links between mathematical self-concept and academic outcomes despite the evidence supporting them. Self-concept did not

correspond with mathematics achievement, according to Agbornu and Edekor (2020) study of one hundred and fifty (150) students from the Central region of Twifo Hemang District. They came to a conclusion that it is unlikely for students' teaching, feeling, acting, and evaluation of their mathematical self-concept to interfere with their mathematics accomplishment.

Self-Concept as a Predictor of Mathematics Achievement

There is causal relationship between academic self-concept and (mathematics) achievement, according to a number of scholars, including Seaton et al., (2014), Moller, Retelsdorf., Köller, and Marsh (2011), and Green, Nelson, Martin, Andrew and Marsh (2006). The self-enhancement model, skill development model, and reciprocal effects model are a few of the models that support this claim.

According to the self-enhancement model, self-belief is one factor influencing academic success (Bofah, 2016). This model supports the idea that an improvement in pre-service teachers' self-belief, especially self-concept improved their achievement. This study believes that one's self-concept seems to have an impact on mathematics achievement.

Self-belief is merely seen as a reflection of scholastic achievement in the skill-development model (Bofah, 2016; Chen, et al. 2013; Chiu & Klassen, 2010). The skill-development model also proposed that the primary driver of improved self-concept characteristics was academic success. According to Chen, Yeh, Hwang and Lin (2013) as a result of achievement, the skill-development model is able to depicts academic self-concept. This model suggests that improving achievement skills is the significant method to boost self-concept academically.

The reciprocal-effect paradigm, which believes that prior academic accomplishment influences subsequent self-concept and prior accomplishment effects later accomplishment, is a compromise between the self-enhancement and skill-development models (Bofah, 2016, Chen, *et al.*, 2013; Parker *et al*., 2014; Seaton et al., 2014). These studies support the idea that academic self-concept and academic accomplishment are mutually reinforcing, so that a change in either in one promotes a comparable change in the other.

Self-concept and Gender Difference

The relationship between gender and self-concept was also examined in a number of additional studies. Among the varied and contrasting results are:

Male and female pupils in Ghanaian Junior High Schools did not have significantly different academic self-concept, according to the study's findings by Dramanu and Balarabe (2013). According to Dramanu and Balarabe (2013) research, male and female students exhibit difference perspectives about their academic aptitude and potential. The changing landscape of Ghanaian society in general and the educational sector in particular may have contributed to this outcome. Equal access to school, as well as financial and emotional support from the state, parents, and teachers, is provided to both male and female students. As a result, both sexes are currently more aggressive, adventurous, and open-minded in their pursuit of educational goals. Additionally, the results of Ayodele (2011) demonstrated that gender had no discernible impact on one's attitude towards mathematics. Additionally, Haciomeroglu and Bilgen (2013) found no evidence that gender had a significant impact on fourth grade students' level of mathematical self-concept. In their research on how male

and female secondary school pupils perceived their academic self-concept, Agarawal and Kumar (2015) discovered no gender differences that were statistically significant.

This conclusion contrasted with that of Awan *et al.*, (2011) who discovered a significant girls favoured self-concept (t=-4.024, p<.01). They investigated the relations between self-concept and drive for achievement The subjects included 336 secondary-level students from four governments and four selective schools in the Sargodha region (146 men and 172 women). It was suggested that teachers use motivational techniques to get pupils interested in activities in learning in order to improve their test scores.

Erdogan and Sengul (2014) discovered that there was a significant difference in mathematics self-concept scores of male and female students at the 0.05 statistical level of significance (t=10.21, p<.05). Male students were the group that the difference favoured in terms of the students' gender. The academic of the high school boys and girls (M=19.04, SD= 4.20 and M=20.37, SD= 2.59) was significantly different in a study by Lawrence and Vimala (2013) that looked at the relationship between self-concept and achievement motivation in 250 high school students Their findings also revealed significant relation between one's self-concept and motivation for achievement.

Self-Efficacy and Mathematics Achievement

Numerous studies have examined the link between students' mathematical achievement and self-efficacy views. In a 2007 study on increasing students' mathematics self-efficacy through teacher training, Siegle and McCoach found a significant correlation between self-efficacy and math achievement. Moreover, Liu and Koirala (2009) looked into how high school

students' confidence in their ability to succeed in mathematics affected their performance. The purpose of the study was to determine whether mathematics self-efficacy could predict mathematics achievement. The results indicated a positive relationship between high school students' mathematics self-efficacy and mathematics accomplishment. Among their recommendations for promoting high performance included giving appropriate feedback, using high achieving students as role models and also encouraging students to set realistic goals of learning. Their claim corroborated the findings

Pampaka, Kleanthous, Hutcheson, and Wake (2011) found out that mathematics self-efficacy is similar to learners' performance in mathematic performance and sex related matters, as well as their interest to further their studies mathematics. The total of 1779 students were selected from three separate data points. The first data point of students was from DP1 and the follow-up surveys of the other two data points was selected from DP2 and DP3. The Rasch rating scale was used to measure mathematics self-efficacy. It was also identified that gender difference existed with boys being more self-efficacious when a total measure is applied. The study also identified that programmes of study by students actually have a significant impact when it comes to their mathematics self-efficacy.

In a multiple statistical studies to find common trends by Richardson, Abraham, and Bond (2012), it was found out that the greatest correlate of academic achievement was self-efficacy as part of those studied, that is, overall self-esteem and self-concept though the later was not considered in the analysis. Due to the fact that effect size r is the most often used effect size

measure in studies of academic performance, they utilized it to reflect the direction and intensity of the relationship between GPA and its correlates.

Peters (2013) found in a multi-level analysis where there is a relationship that exists among student self-efficacy in mathematics and mathematics accomplishment, meaning a rise in mathematics self-efficacy also leads to corresponding rise in mathematics accomplishment. The sample comprised of 15 college algebra instructors and 326 college algebra students. The adult learning scale was administered during the initial stages of the term to assess the climatic nature of the classroom environment and was later given a revised mathematics self-efficacy scale questionnaires and end of semester questions in algebra to determine their mathematics achievement. Peters (2013) posits that an instructor been child-centered had no impact on the degree of association with pupils' mathematics self-efficacy and accomplishment. The same can also be said of a teacher who uses the lecture method. This he explained could possibly be due to adequate preparation a lot of the learners possess or due to stronger mathematics accomplishment

According to a study by Agbornu and Edekor (2020), students' mathematics achievement was connected with their mathematical self-efficacy. Two separate scales, that is, self-efficacy and self-concept scales, and a test on achievement were used to collect data. Stakeholders were cautioned by Agbornu and Edekor to consider the effect self-efficacy has on their mathematical accomplishment.

Bandalos, Yates, & Thorndike-Christ, (1995) found no connection between self-efficacy and mathematics accomplishment in their original hypothesized model. Among the other constructs (attritions for failure and success, mathematics self-concept, mathematics achievement, universal test anxiety and test anxiety with regards to collection and interpretation of data), it was only the worry component of test anxiety with regards to collection and interpretation of data that self-efficacy had a relation with. They posit that the lack of correlation may be due to collinearity in self-efficacy and mathematics self-concept. An indication backed by the alternate model was exchanging self-efficacy and self-concept functions resulted in a positive relationship with accomplishment.

Purzer (2011) conducted a sequential mixed-methods study to look at how team discourse, self-efficacy and accomplishment are related. Research findings revealed favourable and significant correlation between self-efficacy and examination success. In a prior analysis of data from Jones et al. (2010), it was discovered that engineering expectations and engineering self-efficacy were the main predictors of student engineering point averages (GPA).

The overall effect of this literature point out to the fact that there are contrary views shared by various researchers on the relation that exists between self-efficacy and arithmetic achievement.

Gender Difference and Self-Efficacy

Current research has produced inconsistent results. On the one hand, numerous researchers' studies have found a link between students' self-efficacy and gender, according to their findings. In a study comprising 450 (302 males and 148 females) students, it was revealed that male students had

significant higher mathematics self-efficacy and had higher mathematics achievement than their female colleagues (Naz, Shah & Rehman, 2016). According to Peters (2013), boys had greater self-efficacy scores in mathematics than did girls.

There are studies as well as research work that did not find a connection between self-efficacy levels by gender. The mean scores of pre-service teachers' mathematics self-efficacy between genders did not significantly differ, according to a study by Ampofo (2019). It was determined by Ayotola and Adedeji (2009) that there was no statistically significant difference between male and female mathematics self-efficacy among Basic 10 pupils in the Oyo State.

Relationship between Achievement Motivation and Mathematics Achievement

Achievement motivation is still a topic of much research that affects mathematics accomplishment, especially educational subjects relating to in science, technology, engineering, and mathematics (STEM) related academic fields. Sufficient literature reportedly exists on the association between achievement motivation and arithmetic accomplishment.

Obiero (2018) recruited 300 participants from chosen girls' schools to participate in a study on the connection between mathematics performance and achievement motivation among female learners in Kenya's urban secondary schools. According to the study's findings, among the female students who were studied, there is a positive but sluggish (0.12) non-significant (0.188) association between achievement motivation and mathematical performance.

Academic success and achievement motivation were found to be positively and substantially interrelated (Chetri, 2014). The relationship between teenagers' self-concept, drive for accomplishment, and academic success was studied in the study. The study consists of 480 boys and girls in the tenth grade from different government and non-government controlled schools who are between the ages of 16 and 17, from both urban and rural locations. Children's Self-concept Scale of Ahluwalia (1985) and Achievement Motivation Scale of Bhargava (1994) are the tools used to identify the variables that can be predicted. Academic performance on the student's final tenth-class exam was taken into account for the criterion measure.

Awan, Noureen, and Naz (2011) conducted research on the association between achievement motivation and performance in English and mathematics at the senior high level in the Sargodha district. There were 336 students in the sample (146 males and 172 females). Both the Academic Self-Description Questionnaire II (ASDQ II) by Marsh (1990) and the General Achievement Goal Orientation Scale (GAGOS) by McInerney (1997) were used to measure three different types of accomplishment goals, including mastery goals, performance goals, and social objectives. The study found a significant link between academic success in English as well as numeracy and achievement motivation.

Alam (2009) undertook a confirmatory factor study to investigate the link between inventiveness and achievement motivation and academic accomplishment. The results showed a favorable correlation between academic success and achievement motivation.

Some research suggests that there is little to no link between academic achievement and achievement motivation. In her 2014 study, Bala looked at senior secondary school students' academic success, nonverbal intelligence, and achievement motivation. For boys, girls, and the entire sample, the association between academic success and achievement motivation did not prove to be significant at the 0.05 level of confidence.

Ajogbeje, Borisade, Aladesaye, and Ayodele (2013) conducted a study on 268 college of education students who were taking mathematics as a part of their subject pairings to determine the effects of sexual preference, mathematics anxiety, and achievement motivation on college students' achievement in mathematics. They discovered a positive and significant link with both achievement motivation and performance in mathematics.

Academic achievement, accomplishment motivation, and academic self-concept were examined in a study by Affum-Osei, Adom, Barnie and Forkuoh, (2014). The Self-Concept Questionnaire (Cambra & Silvester, 2003) and Profile of School Motivation (McLnerney & Sinclair, 1991) were used, respectively, to measure the motivation and self-concept constructs. The West African Examination Council's (W.A.E.C.) Senior High Schools' past examination questions serve as a benchmark for measuring math proficiency. 30 objective-choice questions make up the test. This same results revealed a connection between academic success and achievement motivation that is favorable (Affum-Osei, et al., 2014). However, they came to the conclusion that there was no real correlation between the two, and as a result, there was no real effect on how well the students performed in basic arithmetic. The analysis above demonstrates that more research on college students in

institutes of education is necessary because there is still uncertainty on the links between mathematics achievement and achievement-motivation.

Gender Difference and Achievement Motivation

Over some years now, many researchers have researched on achievement motivation across different gender groups. Yet the literature seems not to overcome the challenge of settling on a single conclusion. Some of the studies are discussed below:

Maheswari and Aruna (2016) conducted a study on achievement motivation and gender disparities amongst adolescent students. Maheswari and Aruna (2016) used the Z-test to infer that there is a substantial difference between the respondents' genders with regard to desire for accomplishment at p0.05, which meant that the study hypothesis was accepted and the null hypothesis was rejected. 128 students from N.N. Ramanathan Iyyer High School in Nangavaram, Karur District, were chosen by the researcher using the census approach. According to the study's findings, female students felt more motivated to achieve than male students did.

Maheswari and Aruna (2016) used a descriptive design method, which is excellent for generalizing findings; however, the research is shallow because just a questionnaire was used to gather data. Also, the use of only N.N. Ramanathan Iyyer high school students leads to biases and as such findings may not apply to all high school students in Nangavaram, Karur District.

In addition, Liu and Zhu (2009) the “investigation and analysis on the achievement motivations of 278 Senior High School Students”, significant difference was found in accomplishment motivation of boys and

girls when Liu and Zhu (2009) studied students. The researchers indicated from their results that boys have higher achievement motivations than girls. Results of their study's discussion could not suggest any appropriate measure of addressing the issue. The result of Gupta and Mehtani (2017) indicated that boys and girls had appreciable relationship with achievement motivation which agreed with findings of Rani and Reddy (2019). Rani and Reddy (2019) conducted a study among 40 males and female students of different academic streams using purposive sampling. They discovered a big gap between students in the arts and sciences in terms of their drive for success.

In a study of 400 teenagers, Khan and Alam (2015) evaluated the self-concept and success motivation in relation to gender and looked at the significant relationship between the two. Self-concept was assessed using the Achievement Motivation (n-Ach) Scale, which was created in 1985, and the Achievement Motivation (n-Ach) Scale, which was created in 1984. The findings of Khan and Alam (2015) show that girls are more driven to succeed than boys, and an independent sample t-test at the level of confidence of 0.05 shows a statistically significant difference in mean performance scores for girls and boys. To develop high levels of adolescent achievement motivation, the study concluded that all stakeholders should provide a good environment. It is the same significant difference in gender with achievement motivation with those of (Awan, Noureen & Naz, 2011; Devakumar, 2018), but with specificity that the results of the participants were higher for the women than for the men, demonstrating that women are more driven to succeed.

Other researchers also disagreed with the influences in the sex difference and achievement motivation relationship. Some contend that

instead of relying on subtle variations between men and women, sex differences in success motivation are dependent on other factors like socialization and anxiety processes. For instance, it was found that gender was not a significant predictor of achievement motivation (Chetri, 2014; Chimezie, Cbibuike, Ndidi & Emmanuel, 2019) among adolescents. For instance, Chetri (2014) investigated how teenagers' motivation for accomplishment affected their academic performance. A sample size of 480 secondary school graduates from Sikkim's various schools who had been enrolled in various public and non-government-managed schools was gathered using stratified random selection techniques. According to Chetri's (2014) research, there are no appreciable gender differences in the motivation for achieving goals.

Differences in Mathematics Achievement Score and Programme of Study

The pre-service teacher's program of study is another element that appears to influence the academic success of institutions of education. Academic success and study plan are always given equal weight because variations in study plans for different college courses may be excellent indicators of students' educational success. Amasuomo (2014), for instance, conducted a study whose objective was to ascertain the academic effectiveness of two groups of students enrolled to a technical program in Nigeria with different entry qualifications and to identify if there were performance discrepancies between the groups. During the academic year 2011–2012, he conducted the study with 70 first-year technical students. Amasuomo (2014) finding concluded that differences exist on the performance of students with various entry certificates. This supported Kyoshaba's (2009) research, which found differences in the academic performance of applicants to faculties of

study. In order to determine whether the difference was significant, Kyoshaba (2009) used the correlation designed and also looked at the F value of 7.000, whose significance value of.000 is smaller than the alpha=.05. Yet, prior research has demonstrated that there were no appreciable disparities in academic achievement based on admissions histories. For instance, Adedapo (2020) investigated the impact of gender and admission background on the success of postgraduate distance learners in educational technology. Ex-post facto research was chosen, and no discernible difference was found among distance learners in the humanities, social sciences, or sciences.

Relationship between Programme of Study and Mathematics Related Affects

Many research studies have come out with varied findings on relationship between courses or programmes and affective variables. A review of literature has shown whereas this current study used the term programme of study which comprises jhs education, primary education and early grade education, other studies used *courses of study, streams of study, field of study or programmes* to mean the same term depending on the level of education. Thus, some of the studies that are consistent with the existing research are reviewed in this section.

College students' motivation for achievement is examined by Shekhar and Devi (2012) across gender and academic majors. Between the ages of 18 and 23, 40 males and 40 females were chosen using the purposive sample technique. Identifying whether or not there is (if there is) a difference in achievement motivation among pupils in the science and arts streams as well as between male and female students, the study used an achievement

motivation scale and a segment of the population questionnaire that was then analyzed using an independent sample t-test. The study found that science stream students are more motivated to achieve than arts stream students, which is a major discovery. Also, the study found a considerable disparity between male and female students' drive for achievement. In a similar study, science students reported high significant achievement motivation than social science, commence and humanity students (Upadhyay & Tiwari, 2009). Their study also found no significant difference with vocational courses.

Self-concept was discovered as having a numerically significant impact on various study options. For instance, studies by Trautwein, Ludtke, Koller, and Baumert (2006) and Matuvo (2012) similarly found that students enrolled in various programmes of study had significantly different self-perceptions statistically. Trautwein et al. (2006) investigated the relationship between self-esteem, academic self-concept, and accomplishment: How the classroom experience modifies the dynamics of self-concept. By examining the connection between distance learners' academic self-concept and academic accomplishment, Ajmal and Rafique (2018) reaffirmed the conclusions of Trautwein et al. (2006) and Matuvo (2012). 427 remote learners from the M.Ed. program and 373 from the B.Ed. program made up the sample. According to Ajmal and Rafique's (2018) findings, remote learners in the master's degree and Bachelor degree programmes have significantly different academic self-concepts. Results showed that master's degree students have a better sense of their abilities academically than Bachelor degree students. The study suggested holding appropriate workshops to improve students' self-concept.

Several scholars also focused on the field of study when examining self-efficacy. These researchers' findings suggest that learners from various fields of study, in particular, can have varying levels of self-efficacy. In a study on the relationship between perceived academic atmosphere and academic performance, Abd-Elmotaleb and Saha (2013) examined the function of academic self-efficacy as a moderator variable. The subject area can be divided into two categories, theoretical and practical, as per Abd-Elmotaleb and Saha (2013). Researchers discovered there was no highly significant connection amongst learners' self-efficacy and their subject of study.

Yet, there were definite disagreements with Filippou's study (2019). Filippou (2019) conducted research to determine whether students' self-efficacy in international master's degree programs in Finland varies according to their topic of study and country. The college self-efficacy assessment, which has three subscales, was used to gather the data. These subscales include dormitory self-efficacy, program self-efficacy, and social self-efficacy. According to Filippou (2019), students majoring in the humanities had a statistically significant better level of total social self-efficacy than students majoring in business and information technology.

Summary of Literature Review

The review of the literature on the subjects covered by the study was completed. Theoretical framework, motivation for achieving goals, self-concept, and self-efficacy were among the key aspects examined. The section also looks at pertinent studies on kids' mathematics proficiency and uses the conceptual framework of the study to critically examine the connections

among the concepts. Also, the theoretical frameworks for this investigation were offered. Literature on the effects of sex and program of study on the variables was also investigated. To make the literature useful for this study, it was reviewed and operationalized. This demonstrates the lack of research on self-concept, motivation for achieving goals, self-efficacy, and mathematical accomplishment at colleges of education.

CHAPTER THREE

RESEARCH METHODS

Overview

The chapter provides a discussion of the methodology that was used. Five portions make up its subdivisions. The first section discusses the research paradigm of the research and design, and the demographic, population, sample, and sampling technique are covered in the second section. The research instruments were examined in the third segment. Data gathering and analysis process is covered in the fourth and fifth sections, respectively.

Research Paradigm

The philosophical perspective that underpins this study is positivism. Positivists subscribe to a worldview in which causes (likely) determine outcomes or consequences. Quantitative research method falls under the paradigm of positivism. Positivism suited my study because it allowed me to separate myself from the respondents due to the purely quantitative data I got from the research instruments. My study was also based on relationships between constructs that are more than two. Finally, I considered this paradigm because I am positive that pre-service teachers' actions in our colleges are explained by norms they are exposed to in their interaction with colleagues, tutors, and the teaching and learning.

Research Design

In this investigation, a correlational study design was employed. According to Creswell (2012, p. 338) "Correlational designs provide an opportunity for you to predict scores and explain the relationship among variables." By examining a sample of a population, correlational design offers

a numerical depiction of trends, attitudes, or opinions of that population. The quantitative method examines relationship between variables to evaluate objective theories (Acheampong, 2018). The essence of the correlational research design was to enable the researcher answer the research questions without any ambiguity aided with quantitative evidence obtained.

The correlation method was adopted because the study was conducted to find out whether there is existence of connection between self-concept, achievement motivation, self-efficacy and students' mathematics accomplishment on another hand. The study also sought to find out which of the independent variables (self-concept, self-efficacy, and achievement motivation) is better predictor of mathematics accomplishment. It will be crucial to employ the correlation method, which will genuinely give findings that can be statistically examined, taking into account the nature of the variables involved.

Plans and procedures for conducting research are known as research design, and they can range from generalisation to specific strategies for gathering and analysing data. The research design is the full approach a person chooses to combine the numerous research activity components in a cohesive and orderly manner, ensuring that one is able to answer the research topic; it serves as the yardstick for collecting, measuring and analysing data (De Vaus, 2001). As a result, the correlational design comprises a summary of the researcher's steps, from developing the hypothesis and considering its operational consequences through conducting the final data analysis.

The direction and strength of the connection between two (or more) variables, the strength of the relationship based on the determining coefficient (p values, effect size, or the size of the coefficient), an acceptable statistic for analysis, the expected result, and whether correlational results can be displayed in a matrix or graph were all factors I considered when evaluating and assessing an excellent correlational study.

Study Area

Five colleges in Ghana's Northern, North East, and Upper West regions participated in the study. These regions are part of the 16 regions of Ghana found in the Northern part of the country. I chose the Northern part of Ghana due to proximity. I also relied on my connection with the Colleges and Tutors in getting access to the pre-service teachers. The regions are bordered by Burkina Faso to the North, Ahafo Region to the South, La Cōte D'Ivoire to the West and Togo to the East. Farming and livestock rearing are the dominant occupation of the residents of the regions. All the colleges are mixed and offer at least one Bachelor of Education (B.Ed.) programme (i.e., B.Ed. Early Grade/Childhood, B.Ed. Primary or B.Ed. JHS Education) in Basic Education.

Population

A population is made up of all the individuals being examined, whether they are humans or not (Bluman, 2007). It is vital to identify the population of the study so that an appropriate sample size can be taken. The target group for this study was all first-years from Northern, North East, and Upper West regions public colleges of education of the 2020/2021 academic year. This group of pre-service teachers is all involved in learning mathematics at the colleges since mathematics is compulsory for all first-

years. The focus was also on first-years because, there are also some second and third year pre-service teachers who do not offer any mathematics course due to their area of specialisation. The five selected colleges of education have been referred to as College A, College B, College C, College D, and College E in this study.

The first-years (accessible) population from which samples for the study were selected included 275 (125 JHS Education, 80 Primary Education and 70 Early Grade Education) from College A, 380 (270 JHS Education, 80 Primary Education, and 30 Early Grade Education) from College B, 245 (190 JHS Education and 55 Primary Education) from College C, 170 (90 JHS Education, 55 Primary Education and 25 Early Grade Education) from College D and 240 (150 Primary Education and 90 Early Grade Education) from College E. The total accessible population of these sampled Colleges was 1310 first-year pre-service teachers from which samples were selected.

Sample and Sampling Procedure

In order to collect data for this research, a sample is chosen that is representative of the entire population that will be treated. A sample is a segment of the study population that a researcher is planning to examine in order to draw conclusions about the target population as a whole (Creswell, 2012). The five institutions of education in Ghana's Upper West, North East, and Northern regions made up the sample for the study. For the study, only first-year students were chosen. The second and third-years were left out of the study because of the specialisms and specialist programme undertaken at their levels. The fourth years were also in their out programme for their

teaching practice. The process of selecting the sample suitable for the population is called sampling.

A multi-stage sampling method was used. This comprised convenient and stratified sampling. These colleges were conveniently sampled for the study because of easy accessibility and closeness to the researcher. The researcher selected these colleges to prevent the possibility and risks of travelling long distances. All the five colleges like all other colleges in Ghana offer Bachelor in Basic Education programmes (i.e. B.Ed. Early Childhood Education, B.Ed. Primary Education or B.Ed. JHS Education). I also used purposive sampling because all the colleges involved offer Algebra as a foundation course.

After that, a sample was chosen from each strata using stratified sampling. This was done to help the researcher get members that were approximately representative of the population. The sample size was calculated using the table by Krejcie and Morgan (1970) to ensure that it was proportional to the population of first-years in each selected college of education (stratum). This implies that College A had 160 first-years, College B had 191 first-years, College C which has a population of 245 students had 150 first-years, College D had 118 and College E had 148 first-years. These sample sizes are based on recommendations by Krejcie and Morgan (1970).

Since stratified random sampling also involves proportionality, the proportions to be used in each college for the programme of study were calculated by the researcher using straightforward percentages. For example, to calculate the programme proportion for College C, the proportion for Primary Education of 55 student teachers was divided by the first years

(accessible) population in the college multiple by college sample size ($\frac{55}{245} \times 150 = 33.67 \approx 34$) while the proportion for JHS Education of 190 student teachers was divided by the first years (accessible) in the college multiple by college sample size ($\frac{190}{245} \times 150 = 116.33 \approx 116$). The same procedure was used for the remaining four colleges, thus from College A, a sample of 73, 46 and 41 pre-service teachers were selected from JHS education, primary education and early grade education respectively. From college B, a sample of 136, 40, and 15 was selected from JHS, primary and early grade education pre-service teachers, respectively. From College D, a sample of 62, 38, and 18, were selected from JHS, primary and early grade education pre-service teachers, respectively. Finally, a sample of 93 and 55 pre-service teachers from College E, was selected from primary and early grade.

Finally, the list of first-year pre-service teachers was obtained from each college and random numbers were generated from excel to select the sample unit in each programme of study from the colleges. Every individual within the population has a chance of getting selected for the sample using this method. 767 respondents were chosen as the sample size from the five colleges.

Data Collection Instruments

The research instruments that aided the collection of quantitative data from respondents were questionnaire and achievement test (using Introduction to Learning and Applying Number and Algebra). In other to measure the relationship between the three factors on first year pre-service teacher's achievement, the study required a sound instrument. The statements on the questionnaire were closed ended from three instruments. The Self-Concept

Scale (SCS) questionnaire, Self-Efficacy questionnaire and General Achievement Goal Orientation Scale (GAGOS) questionnaires were modified to have a uniform five-point Likert scale. Questionnaire that were originally constructed to be general in nature were reconstructed to relate to mathematics. To make them more understandable and relevant to this study, several of the statements were slightly reworded. The study uses a questionnaire since it gave the researcher the chance to sample the opinions of a bigger group. The sections that follow below go into greater information about these instruments.

Research Questionnaire

For the self-concept construct, the researcher adapted self-concept questionnaire from Self-Description Questionnaire II (Marsh, 1990) and Mathematics Self-Description Questionnaire (Adegoke, 2015). The preamble (When compared with my classmates:) in (Adegoke, 2015) questionnaire was removed entirely and also, the word "maths" used in all the statements were replaced with "mathematics". Finally, the four point Likert scale was also change to five points. The adapted questionnaires recorded a high reliability (Cronbach alpha) of 0.51 to 0.82 in all previous studies reviewed in literature. Amongst the 21 statements used in the present study, 11 statements adapted from Self-Description Questionnaire II measured internal comparison and the remaining 10 from the Mathematics Self-Description Questionnaire (MSDQ) measured social or external comparison. Marsh (1986, 1990) developed the E/I model, that is, External/Internal reference model. The objective of this model was to determine the variance between verbal and mathematical academic self-concept scores, which are virtually uncorrelated. The internal

(intra-individual) reference is also formed when students compare their own effectiveness in one school subject with their own accomplishments in other school subjects. The external (social comparison) reference is formed when students compare their perceptions of their own accomplishments in a particular school subject with the accomplishments of other students in the same school subject.

Regarding the self-efficacy factor, sources of mathematics Self-Efficacy Scale was adapted (Usher & Pajares, 2009; Lim & Chapman, 2013). Statements were based on the four sources of self-efficacy described by (Bandura, 1997) as sub-constructs (mastery experience, vicarious experience, verbal experience and lastly physiological and emotional arousal). The first three scales which are comprehensive and widely used were adapted from Sources of Middle School Mathematics Self-Efficacy Scale by Usher and Pajares (2009), whereas the Physiological and emotional arousal scale is made up of the Fennema-Sherman Math Anxiety Scale-Revised (FSMAS-R) (Lim and Chapman, 2013). The FSMAS-R was chosen because of it wide usage in measuring physiological and emotional reactions (Benaoui, 2016; Hampton & Mason, 2003; Usher & Pajares 2009). In studies by Benaoui (2016), and Usher and Pajares (2009), Cronbach's alpha score for physiological and emotional reactions was 0.94 and 0.87 respectively. A careful study of Bandura's Physiological and Emotional Reactions source revealed that though used by him as one, it can be measured with different questionnaires. The main reason for the separation is because emotional statements talks about the feeling of a person whereas physiological statements talks about ones thinking and physical ability. The statements were written as first-person statements. The

modified questionnaire which originally contained 12 statements now has 11 statements, after two statements were removed and one of the statement (i.e., "Just being in mathematics class makes me feel stressed and nervous") was split into two (i.e., "I feel stressed when I am in a mathematics class" and "I feel nervous when I am in a mathematics class"). Pre-service teachers were asked to rate their responses in a five point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree) though Usher and Pajares original statements were on a six point Likert-type scale from 1 (definitely false) to 6 (definitely true).

Finally, the achievement motivation questionnaire was from the General Achievement Goal Orientation Scale (GAGOS) (McInerney, 1997). Achievement motivation was measured using 3 sub-constructs containing 18 statements. The original GAGOS was constructed to measure three broad motivational goals, namely; mastery goals, performance goals, and social goals. To measure domain specific achievement motivation, mathematics domain statements were constructed by including mathematics. The GAGOS consists of 5 statements measuring general mastery, 8 statements measuring general performance, and 5 statements measuring general Social orientation. Due to modification of the items, they were given to my supervisor to review to ensure content validity. The GAGOS questionnaire is used extensively by researchers to measure achievement motivation (Awan et al., 2011; Elliot and McGregor's, 2001; Dowson & McInerney, 2001). In the study by Awan et al. (2011), all 3 sub-constructs reliability measures ranged from 0.613 to 0.831.

The questionnaire was broken down into four sections, numbered *A* through *D*. Part *A* was on the demographic characteristics of the participants

like sex, age and name of institution. Part *B*, *C*, and *D* contain statements on self-concept, self-efficacy and achievement motivation respectively. The respondents were required to indicate their agreement or disagreement level to a five-point Likert scale type statements. According to Barua (2013), likert-type scale allowed the respondent to classify their feeling on questionnaires on their agreement or disagreement levels. To aid the analysis, responses to questionnaires were assigned these values: strongly disagree 1, disagree 2; neutral 3; agree 4; and strongly agree 5. The 5-point Likert scale allows for lower margin of error and avoids respondent bias due to the neutral option it contains. This scale type also increases the response rate and reduces respondents' frustration levels. Negatively worded items (self-concept items: 1, 3, 4, 7, 9, 13, 15, 17, 20 and self-efficacy items: 4, 19, 20, 22, 25, 26, 28, 29) attracted reverse coding (refer to Appendix A).

Tutor-made Achievement Test

To gather data on achievement in mathematics, the researcher used achievement test scores on Learning, Applying Number and Algebra course (Refer to Appendix B). The achievement test was set with reference to the course learning outcome as stipulated in the first year second semester of the four year B.Ed. curriculum. The achievement test was chosen over other types of test because it provides immediate feedback about students' progress. An objective test was utilized in order to cover more content. The objective test contained 20 multiply choice questions. The test was marked out of 100% and a score of 50% is considered average. This course was chosen by the researcher since it was a foundation course and as such compulsory for all

level 100 pre-service teachers. Also, the items were given to my supervisor to determine their face validity after which they were piloted.

Data Collection for the Pilot Study

The 18 statements of Achievement Motivation, 21 statements of self-concept and 29 statements of self-efficacy (total of 68 questionnaires) was piloted at a college of education (College X) in Upper East region of Ghana. College X was purposely chosen because it has all the characteristics as the sampled colleges for the research and it is a college outside the Upper West, North East and Northern Regions. These colleges together with the other selected colleges of education started the four-year B. Ed. programme in the same year and also use the same curriculum. Aside familiarity to the researcher, this college admits pre-service teachers from the selected regions that were used for the study. An introductory letter was presented to the principal through the college mathematics Head of Department. The instruments were piloted on 70 pre-service teachers in 13th February, 2022 after an advanced noticed was given to the students.

The piloting of the achievement test took most students 35 minutes to hand over their scripts without been asked to do so and as such 30 minutes was stipulated as the average time for administering the achievement test for the main study. Pre-service teachers' views were sort after the achievement test, some complained that due to the strike action embarked by CETAG they could not cover much of the content in one of the questions. As such, the researcher checked the content covered by the colleges that took part in the main study to come out with the final questions for the main study.

Also, the piloted questionnaire lasted between 10 – 25 minutes and pre-service teachers indicated their level of agreement on a 5- point Likert scale. Administration of the questionnaire was personally done by the researcher to the students and high rate of response was achieved. This was largely successful due to the assistance given from two tutors in the Mathematics Department. However, one of the pre-service teachers that started the piloting at the beginning left and there was also missing values from 1 respondent's statement. As such, only 68 out of 70 (97%) of the data collected were used for analysis for the purpose of raising questionnaire validity and reliability.

Validity

A research variable usefulness is referred to as its validity (Drost, 2011). Mostly, investigators are always interested in knowing whether what they are measuring is what they intended to assess. The main instruments (i.e. the questionnaire and achievement test) were given to my supervisor for content and face validity assessment. This is because expert judgement and opinion can also determine content and face validity. Face validity is extent a test item appears to assess what it intended to assess. My supervisor approved that the instrument had content and face validity after vetting.

Reliability

According to Creswell (2012), reliability refers to the consistency or stability of an instrument's measurement. Results should be nearly equal once researchers use the instrument several times at various intervals. Further, if a question is asked again and is directly related to it, people should consistently

respond in the same manner. A proper understanding of reliability should capture: equivalence, internal consistency and stability.

The Cronbach alpha method was the focus of the study with regards to calculating for reliability though there are other types of internal consistency measures, namely the Spearman–Brown formula and Kuder-Richardson split-half method (Creswell, 2012). The average connection between all the components that constitute the instrument's scale can be estimated using Cronbach's alpha. In terms of reliability, the Cronbach alpha method is the most important figure and presupposes that all items are equal for determining a questionnaire internal consistency (McMillan & Schumacher, 2006), although the alpha generated from Cronbach's equation has been abused without question in literature (Agbo, 2010). The Cronbach Alpha is used for questions that one need not make a decision whether the answer is right or wrong, survey research, and questionnaires with optional answers for each item. For the purpose of this study, the items are scored as continuous variables (Strongly agree to strongly disagree), hence, the need to calculate for Cronbach Alpha. It is also important to note that Cronbach Alpha has some limitations. For instance, a substantial number of items can result in a high alpha coefficient even if the items are not internally consistent (Streiner, 2003). It goes without saying that it is incorrect and unjustified to use alpha as the only measure of dependability under the absurd belief that it is adequate proof of internal consistency (Agbo, 2010).

The alpha coefficient of a minimum of 0.70 by Nunnally served as the measure of both the main constructs and sub-constructs (Pallant, 2011). According to Cronbach (1951), the developer of the method, if there are

multiple factors, Cronbach's alpha should be calculated separately for items relevant to each component. That is, a research questionnaire with different sub-constructs should calculate separate alpha for the different sub-constructs.

Cronbach alpha's coefficients were determined using SPSS. The Cronbach alpha's values of the constructs and sub-constructs are discussed as follows. An analysis was run to obtain the reliability coefficients for the constructs, sub-constructs. With regards to the self-concept construct, there were 21 items. During the interaction with the respondents after the pilot testing, they complained of the difficulty they had understanding item 18 which was, *"My teacher calls my name more often than other students during mathematics class"*. As such, that item was removed entirely leaving with 20 items on the self-concept construct. The self-concept construct with reliability coefficient of 0.917 has two sub-constructs: internal comparison (11 items, $\alpha = 0.873$) and social comparison (10 items, $\alpha = 0.862$). This was within the producers' specification of 0.58 to 0.82 (Marsh, 1990 and Adegoke, 2015). Also, the self-efficacy construct with reliability coefficient of 0.926 has five sub-constructs: mastery experience (6 items, $\alpha = 0.882$), verbal persuasion (6 items, $\alpha = 0.828$), emotional reaction (6 items, $\alpha = 0.704$), vicarious experience (6 items, $\alpha = 0.720$) and physiological reaction (5 items, $\alpha = 0.735$). The achievement motivation construct with reliability coefficient of 0.863 has three sub-constructs: mastery goals (5 items, $\alpha = 0.722$), performance goals (8 items, $\alpha = 0.807$), social goals (5 items, $\alpha = 0.746$). Reliability measures (Cronbach Alpha) for all the 3 sub-constructs ranged from 0.613 to 0.831 (Awan et al., 2011). The overall Cronbach alpha for the 68 initial items was 0.958 which is within the acceptable range (Pallant, 2011).

After the deletion of the ill-aligned item "*My teacher calls my name more often than other students during mathematics class*", the Cronbach's α coefficient was α = 0.947 for the retained 67 questionnaire items. A reliability coefficient of 0.9 and above is an excellent reliability (Hinton, McMurray & Brownlow, 2014). It is safe to use the findings from this study's instrument because they are regarded as dependable.

Data Collection Procedure

Prior to administering the questionnaire, the researcher visited the colleges selected, seek permission from the principals and introduce him-self and the purpose of the visit with the aid of a letter of introduction from his department. The questionnaire lasted between 30 minutes and pre-service teachers indicated their level of agreement on a 5- point Likert scale, while the achievement test lasted for 15 – 20 minutes. The instruments for the study were serially coded uniquely for the respondents and the purpose is to enable the researcher match each pre-service teacher's questionnaire appropriately with their achievement scores in mathematics. The confidentially of the respondents' identities and the findings was guaranteed.

To increase a high return rate, administering and collection of the instrument was done in person with the help of some tutors of the colleges after taking them through some training on the process involved in the administration and collection of the questionnaire. The training was necessary due to the challenges that the researcher endured during the piloting stage. Nwana (1996) outlined the requirement that prior arrangements be made with respondents in order to guarantee accuracy of the information provided. Thus, a week's prior notification was given by the researcher. The administration

and collection of the completed questionnaires lasted between March and April, 2022. I used one week to visit each college since the participating colleges are in different regions and municipalities. The proposed sample for this study was 767 first-year pre-service teachers. However, after data has been collected for the study, the final sample obtained consisted of 99.6% (764) first-years due to the absence of three respondents. The return rate of the questionnaire for the 764 first-years was 100% from the sampled colleges. Based on the opinion of Tabachnick and Fidell (2007), that if there are only few cases with missing data and they seem to be scattered subsample of the entire sample, deletion is a good option. For the purpose of this study all 764 respondents' data were analysed due to absence of missing cases which might be due to more time and cross checking of the questionnaire upon submission.

Ethical Issues

The importance of ethical considerations in research must not be underestimated. The ethical guidelines stipulated by the APA code (2002) and the UCC Institutional Review Board (IRB) was strictly adhered to in terms of confidentiality, right to withdrawal, respect for respondent's rights and dignity and protection of dignity, and voluntary participation. The purpose of the research work was stated clearly to indicate what it was about and how the data will be treated. All respondents were encouraged by this assurance and respect of their confidential to contribute massively in their response.

Data Processing and Analysis

The Statistical Package for the Social Sciences (SPSS-26.0), a statistical data analysis program, was used to collect, organize, modify, classify, and code questionnaire responses into a coding sheet. To facilitate

data analysis, respondents selected the items on a five-point Likert scale, with 5 denoting strong agreement, 4 denoting agreement, 3 denoting undecided, 2 denoting disagreement, and 1 denoting severe disagreement. This scale was turned around for analysis when statements were phrased negatively. The minimum score a pre-service teacher could obtain on all the variables was 67 points (1 x 67) and the maximum will be 335 points (5x 67). As such, the minimum score for a pre-service teacher on self-concept for example, was 20 points (1 x 20), while a score of 100 points (5 x 20) maximum. Minimum score a pre-service teacher could obtain on self-efficacy was 29 points (1x29), while the maximum score was 145 points (5x29). Lastly, the minimum score for a pre-service teacher can obtain on achievement motivation was 18 points (1 x 18), while the maximum score was 90 points (5 x 18). The achievement test was scored out of one hundred (100) marks.

In this piece of research, two stages of analysis were carried out. The initial analysis, or diagnostic analysis, was performed to gauge the data's appropriateness for additional investigation. Descriptive and inferential statistics were employed in the second analysis, which was derived from the study's objectives and the literature review for the study.

Diagnostic Analysis

Achievement test scores were subjected to sample size test, normality test (using Kolmogorov-Smirnov and regression standardized residual plot) assumptions, multi collinearity (using scatter plot, correlation test, Variance Inflation Factor and Tolerance) assumptions, and homogeneity of variance assumption.

Descriptive and inferential analysis

For the purposes of easy understanding and interpretations, descriptive statistics and inferential analysis (sample size test, normality test) were determined for the achievement test, self-efficacy, self-concept and achievement motivation. The assumptions guiding inferential analysis were all ensured to prevent bias results. The statistical techniques used in addressing questions of research are discussed below.

Pearson product-moment correlation

Correlation analysis is used to describe the magnitude and direction of the linear connection between two variables (Pallant, 2011). To assess the strength of the linear link between two variables, studies utilized a metric known as the coefficient of correlation. The correlation coefficient, which was calculated using the sample data, assesses the degree and direction of a linear relationship that exists between two variables (Bluman 2007). Researchers have access to a wide range of correlation coefficients based on the information type and level of measurement. One of the correlation coefficient types utilized in this work is the Pearson product-moment correlation coefficient (*r*) created by Karl Pearson. A correlation coefficient ranges from -1.00 to +1.00 and indicates the strength and direction of a linear link between two variables or score sets with 0.00 denoting no relation of any kind (Creswell, 2012). A value of *r* close to +1 implies a strong linearly positive relationship between the variables, whereas a value of *r* close to -1 indicates a strong linearly negative correlation between the variables.

Before conducting Pearson product moment correlation, I ensured that several assumptions common to this technique were met. Scatter plots

showing respondents' self-efficacy, self-concept, motivation for achievement, and their arithmetic accomplishment to check whether linear relationship exist between each of the two variables (as shown in figure 9). The variables in the designed were interval (continuous) and variable was also normally distributed (as shown in figure 3, 4 and 6). Also, outliers should be minimal if not completely removed, because most of the achievement test scores shown in figure 7 fall within the – 3 to +3 range. Finally, the score variability for the two variables was fairly even (Homoscedasticity of data). All the above assumptions were met in this study. The Pearson correlation coefficient (*r*) was applied to compute the size and direction of the link between each of the three affective variables and mathematics achievement.

There are additional numerical measurements that enable exist me to define relationships when there are more than two variables at play. Multiple regression, ANOVA, and Independent sample t-test were a few of the well-known statistics I employed in this study.

Multiple Regression

Multiple regression, called a multiple relationship is used to predict one dependent variable from two or more independent variables. According to Brace, Kemp, and Snelgar (2009), multiple regression is an analytical technique used to forecast a person's performance on one variable based on that person's performance on a number of other factors. Under this research, it was found that mathematical self-concept, mathematical self-efficacy, and mathematical achievement motivation may all predict mathematical achievement.

Assumptions underlying linear regression

The under listed assumptions must be met before conducting multiple regression analysis:

Assumption of Sample size: Cohen, Manion and Morrison (2018) make the following assumption about sample size "a large sample helps the researcher to achieve statistical power" (p. 749). Pituch and Stevens (2016) maintained that, power is not a problem when the sample size is significant (for example, 100 individuals or more per group). As a result, it is crucial to be highly aware of the danger of weak power, which may greatly alter the results, while carrying out a research with small sample sizes ($n \leq 20$). The sample size in this study, 767, is sufficient for the analysis.

Assumption of multicollinearity: One of the way of ensuring that the multi-collinearity assumption is not violated is the use of Pearson's correlation coefficient matrix. Table 1 revealed the non-existence of multi-collinearity, because the correlation coefficient for each pair of the independent variables are below 0.9 (Field, 2018; Pallant, 2011). Thus, the case of multicollinearity assumption was not violated.

Table 1: Independent variables of Tolerance and Variance Inflation Factor (VIF)

Independent Variables	Part	Tolerance	VIF
Self-concept	0.081	0.400	2.501
Self-efficacy	0.081	0.363	2.756
Achievement motivation	0.167	0.756	1.323

Source: Field data (2022)

To do further checks in identifying multi-collinearity for the purposes of making sure it has not been violated, VIF values were also calculated. Tolerance is the proportion of the independent variable's fluctuation that cannot be elaborated by other independent variables, while VIF indicate whether the any of the independent variable has a strong linear correlation with the other independent variable(s) (Awoniyi, 2018; Pallant, 2011). Table 1 shows the Independent variables of Tolerance and VIF.

According to Pallant (2016), if the Tolerance value(s) is less than .10 and the VIF value(s) is more than 10, that would be a great concern. A sign that the multiple correlation with other variables, suggesting the possibility of multi-collinearity. Table 1 showed that the multi-collinearity requirement has not been broken by tolerance or VIF. This results have therefore supported the Pearson's correlation coefficient between the three independent variables which are all below 0.9 (see Table 1) and as such none of the inter-correlated items was deleted from the model.

Assumption of normality: The values of the trimmed mean (58.99) and original mean (58.98) are very similar. Since the values of the two means are not different the cases in the data file are retain (Pallant, 2011). The Kolmogorov-Smirnov statistic of sig. value of 0.00 (sig, value less than 0.05) violated the assumption of normality which according to Pallant (2011) "is quite common in larger samples" (p. 63). The residual (differences between the predicted dependent variable and obtained scores) must be normally distributed, have linearity (straight line relationship).

Graphically, the normal Q-Q Plot of Achievement Test Scores (in figure 3) followed the diagonal line closely and the box plot (in figure 4) shows an absence of outliers.

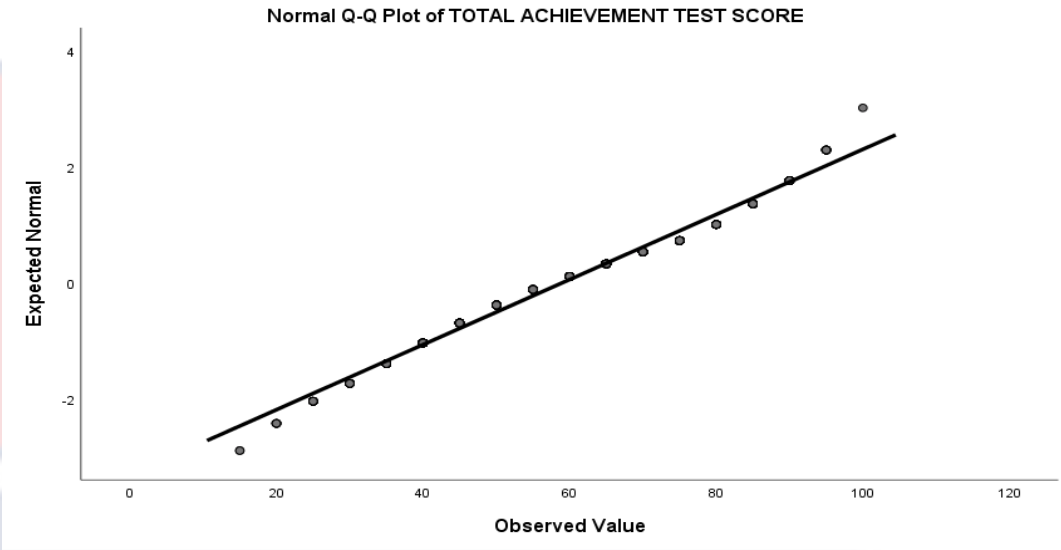

Figure 3: Normal Q-Q Plot of Total Achievement Test Scores

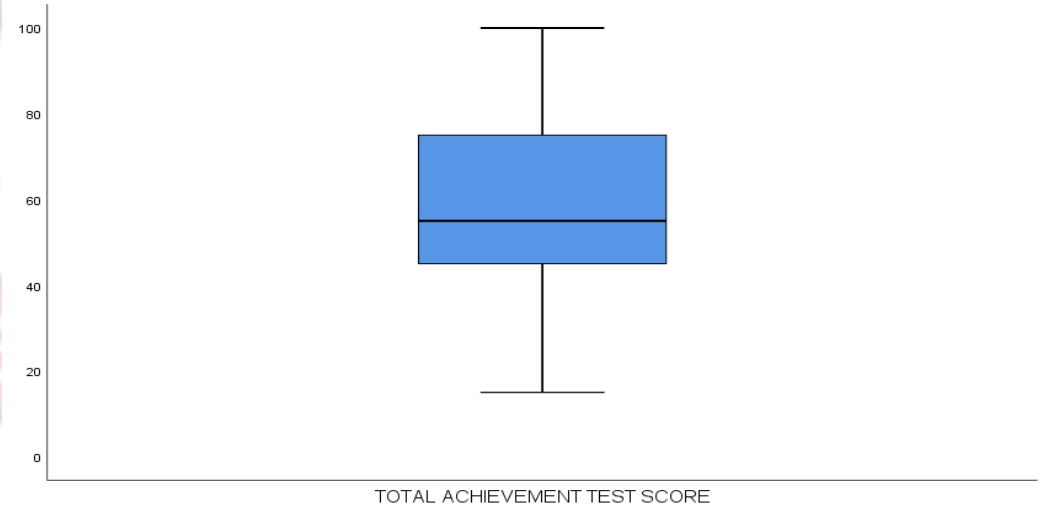

Figure 4: Box Plot of Total Achievement Test Scores

Also, in checking the suitability of data for regression analysis, the residuals were subjected to normality test. Figure 5, 6 and 7 display the Normal P – P plot of regression standardized residual, Histogram of regression standardized residual and Scatter plot respectively.

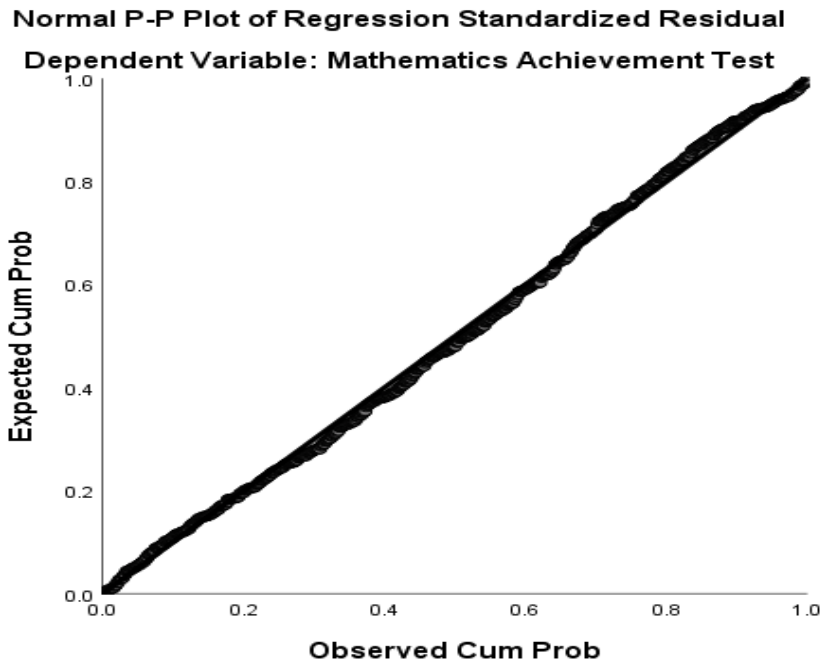

Figure 5: Normal P – P plot indicating regression standardized residual of achievement test

A closer look at the Normal P-P plot, which represents the regression-standardized residual, revealed no significant departure from normality. About all of the dots are located on a line running from bottom left to right up.

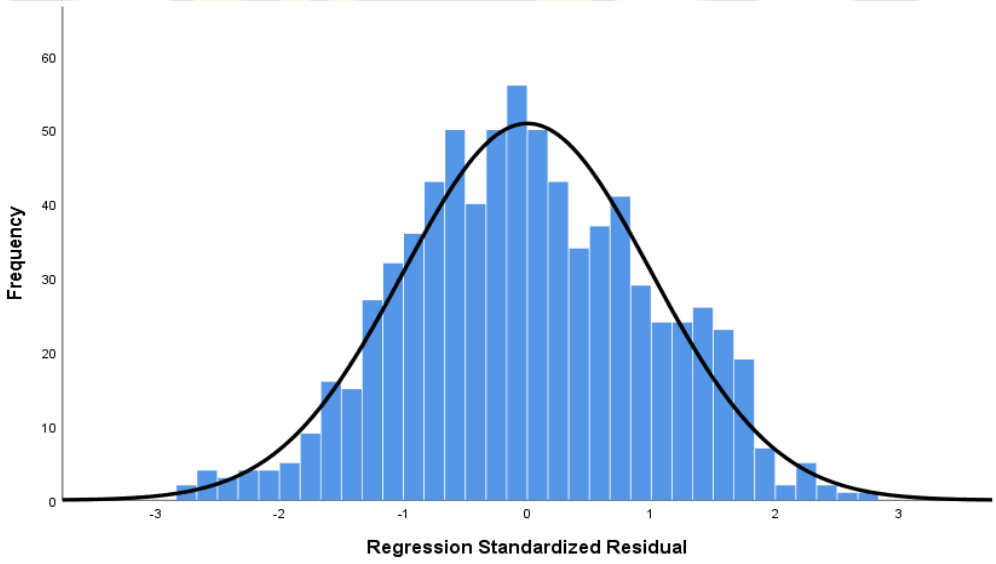

Figure 6: Histogram with a line illustrating regression standardized residual

The histogram illustrated in Figure 6 indicates that the residual of pre-service teachers' achievement is normally distributed, thus fulfilling a crucial prerequisite for carrying out a linear regression analysis.

Assumption on outliers: Finally, from Figure 7, the scatterplot was examined for the existence of outliers. The scatterplot revealed the existence of six extreme cases with residual values less than -3.3 benchmark. In spite of that, the few outliers were ignored because of the large sample size (Tabachnick & Fidell, 2013).

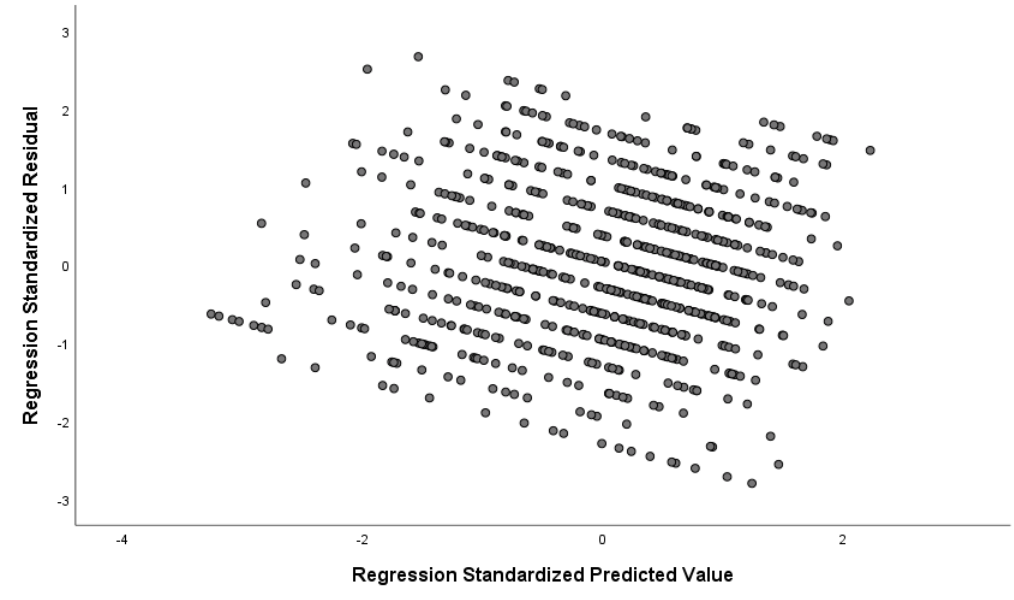

Figure 7: Scatter plot showing regression standardized residual of achievement test scores

From Figure 7, the regression standardized residual is approximately rectangular distributed with concentration of achievement test score along the center suggesting that the normality assumption, linearity, homoscedasticity, and independence of residuals were not violated. As a result, since the data did not violate the normality test I used the parametric test.

Independent sampled t-test

The distinct samples for comparing the means of two separate variables, the independent sample t-test is a parametric test (that makes predictions about group from which the sample is obtained) (Pallant, 2016). One categorical independent variable with two unique categories and one continuous dependent variable should make up these variables.

Assumptions of independent sample t-test

Assumption of normality: According to this presumption, the dependent variable should have a roughly normal distribution. Moreover, a continuous scale should be used to assess the dependent variable. Instead of using a categorical scale, the continuous outcome parameter is evaluated at the interval or ratio level.

Assumption of independence: To satisfy this assumption, you need two independent, categorical groups that represent your independent variable.

Homogeneity of variance assumption: Homogeneity of variance, obtaining random sample from the population to ensure data measurement are not influencing one another. Homogeneity of variance is another assumption for t-test and ANOVA but SPSS performs Levene's Test for Equality of variances as part of the analysis. The results of this study showed a non-significant statistical values of $p < \alpha = .05$. This indicates that the homogeneity of variance assumption for the two groups was not violated, hence, the variance for the two groups are equal.

One-way ANOVA

ANOVA is used when comparing means involving three or more large samples. Pallant (2011) opined that "one-way between-groups ANOVA is

used when you have one independent (grouping) variable with three or more levels (groups) and one dependent continuous variable" (p. 243). In order to meet the assumptions of one-way ANOVA two variables were involved, that is, one continuous dependent variable (mathematics achievement) and one categorical independent construct with three or more levels (programme of study). The groups of the programme of study were three, namely primary education, early grade education and JHS education.

Based on the data analysis tools/techniques discussed with their assumptions above, it was established that all the assumptions were met. Then, in the order that they were posed in the first chapter, the hypothesis and research questions were addressed.

Chapter Summary

In the chapter, the approach employed for the study was covered. It used a correlational study design. As a result, the study was conducted using the positivism paradigm, a quantitative research method. A multi-stage sampling technique was employed for the study. This included purposive, proportional sampling and simple random technique sampling. The results from the questionnaire and the teacher-made achievement exam were analyzed using descriptive and inferential statistics. Data is gathered, arranged, summarized, and presented in a relevant way using descriptive statistics, like diagrams, graphics, or tabular. Making predictions, running estimations and hypothesis tests, identifying correlations between variables, and making sweeping statements from samples to populations are all parts of inferential statistics. The next chapter will examine the methods used to gather and analyze the data in a bid to respond to the hypotheses and questions.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter includes a discussion of the research results. It contains information about the respondents' background, followed by results and a discussion of the results. The study aimed at finding whether first-years in colleges achievement in mathematics is related to self-concept, self-efficacy, and achievement motivation. The data was collected from first-year respondents using tutor-made achievement test and questionnaire items.

Demographic Profile of Respondents

The proposed sample for this study was 767 first-year pre-service teachers. However, after data was collected for the study, the final sample obtained consisted of 764 respondents due to absence of three of them. The return rate of the questionnaire for the 764 first-years was 100 percent. Five colleges were sampled in the Upper West region, the North East region, and the Northern region for the study. The current initial B.Ed. curriculum for the colleges of education offers three programmes of study (JHS education, primary education, and early grade education). Pre-service teachers are offered admission to study these programmes based on their second circle level results and the type of programme run in the institution. The colleges and their respective programmes cross tabulation is presented in Table 2.

Table 2: Respondent's college and programme cross tabulation

College	JHS Education (%)	Primary Edu. (%)	Early Edu. (%)	Total (%)
College A	72 (45.3)	46 (28.9)	41 (25.8)	159 (20.8)
College B	136 (71.2)	40 (20.9)	15 (7.9)	191 (25.0)
College C	116 (77.3)	34 (22.7)	0 (0.0)	150 (19.6)
College D	61 (52.1)	38 (32.5)	18 (15.4)	117 (15.3)
College E	0 (0.0)	92 (62.6)	55 (37.4)	147 (19.2)
Total	385 (50.4)	250 (32.7)	129 (16.9)	764 (100)

Source: Field data (2022)

Table 2 shows that JHS education represents 385 (50.4%) with the majority of the programmes of specialisation, followed by 250 (32.7%) respondents for primary education. The lowest of 129 (16.9%) from early grade education is a cause for concern due to the increased enrolment figures in early childhood education recently in the country. From the table, it can be realised that out of the 764 respondents, 191 were sampled from College B, the largest, while College D had the lowest, with 117 respondents. Another revelation was that College C does not offer primary education and College E does not offer JHS education programmes.

In order to comprehend the demographic characteristics of the five colleges purposefully selected, the researcher further examined the data on the age and gender of respondents. Gender, as used here refers to the male and female differences in the colleges of education. The purpose of the demographic information is to have a good idea of the characteristics of the population. Table 3 shows the gender and age distribution of respondents in the study.

Table 3: Respondent's Age and Gender Distribution

Age group	Male (%)	Female (%)	Total (%)
15 – 19	49 (51.6)	46 (48.4)	95 (12.4)
20 – 24	264 (52.9)	235 (47.1)	499 (65.3)
25 – 29	82 (53.6)	71 (46.4)	153 (20.0)
30 – 34	5 (31.2)	11 (68.8)	16 (0.2)
35 – 39	0 (0.0)	1 (100)	1 (0.1)
40+	0 (0.0)	0 (0.0)	0 (0.0)
Total	400 (52.4)	364 (47.6)	764 (100)

Source: Field data (2022)

Of the 764 respondents who replied to the gender-related questions in Table 2, 400 of them, representing 52.4%, been males, while 364 respondents representing 47.6%, been females. A revelation that majority of the respondents taking part in the study were males. Majority of the respondents, that is 499 (65.3%), were in 20–24 age groups, which can be understood since the majority of pre-service teachers gain admission to colleges of education after their senior high School education. Two hundred and sixty-four of the respondents who form the majority within the 20–24 age groups were males, while two hundred and thirty-five were also females. One female pre-service teacher was the only person in the 35–39 age range. No respondent, that is 0 (0.00%), were found between the age group of 40+. Figure 4 provides a visual representation of this.

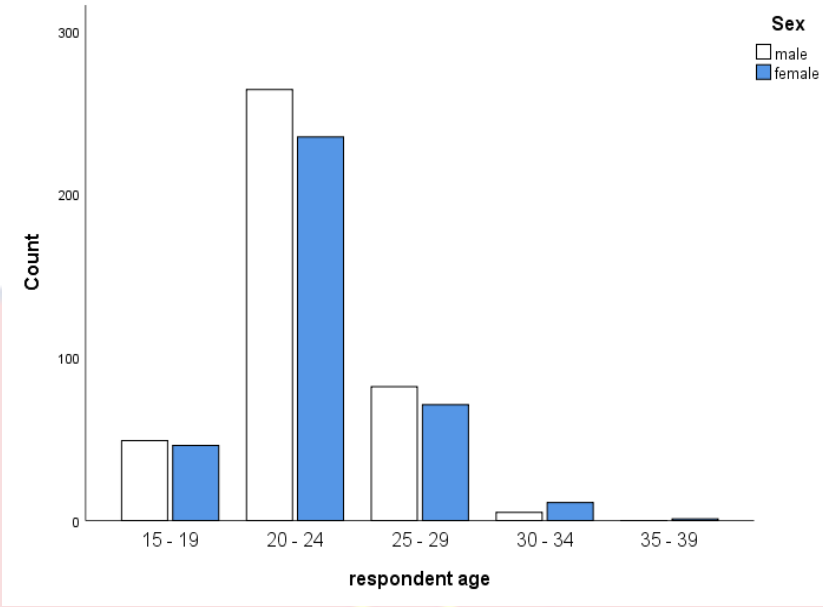

Figure 8: Bar chart of sex distribution by age

With a clear understanding of the demographic features of the data, the next section will look at the presentation of research questions and hypothesis analysis. The results that were analyzed quantitatively based on whether first-years' achievement in mathematics is related to affects (self-concept, self-efficacy, and achievement motivation).

Mathematics Affects Pre-service Teachers Demonstrate

This section of the study used descriptive statistics to analyze the results. A summary of the independent variables that were used in the study was presented. Hence, the researcher was interested in the general nature of affects using descriptive statistics. Mean score and standard deviations values guided the presentation of the statistics. To respond to the research question, self-administered questionnaires as in Appendix A were given to the 764 respondents in the five sampled colleges of education on different days to obtain data for the analysis. Sixty-seven items of the questionnaire were used to explore how pre-service teachers' affective variables differ across gender

and programme of study. Therefore, three constructs were used: self-concept (n = 20, α= .910); self-efficacy (n = 29, α= .926); and achievement motivation (n = 15, α= .863). Details of how these scale were developed as well as their reliability can be found in (Chapter Three).

For all items, a five-point Likert scale was used with responses are interpreted as follows: 1 is the lowest possible score, which denotes a very strong negative attribute, while the 5 is the highest possible response rate which represents a very strong positive attribute. Also, the cut-off scale used to compare with the mean rating was 3.00. A score of 3.00 and below will be considered as below average whereas a score above 3.00 is above average. Any mean value above this cut-off point is considered a good response and vice versa. To characterise the degree of self-concept, self-efficacy, achievement motivation, and mathematical accomplishment in the study, the mean and standard deviation were used. Table 4 displays the findings for the three affect variables' mean and standard deviation.

Table 4: Mean and standard deviation of the affective variables

ITEMS	MEAN	SD
SELF-CONCEPT		
I looked forward to mathematics classes.	3.71	1.26
I hate mathematics.	2.11	1.12
I do badly in mathematics test.	2.41	1.25
I never want to take another mathematics course.	2.48	1.41
I get good marks in mathematics.	3.49	1.20
I have always done well in mathematics.	3.37	1.19
I often need help in mathematics	3.62	1.13
Mathematics is one of my best subjects.	3.21	1.38
I have trouble understanding anything with mathematics in it.	2.49	1.23
I enjoy studying for mathematics.	3.53	1.25
It is important to me to do well in mathematics classes.	4.15	1.04
I think I am one of the best students in mathematics.	3.06	1.27
I think most of my classmates are smarter than I do.	2.61	1.23
I participate more than my classmates during mathematics class.	3.05	1.13
I feel that I am among the bottom 5% of my class.	2.09	1.22
I can solve more mathematics problems than my classmates.	2.95	1.16
I ask for help with my mathematics assignments more than any of my classmates.	2.57	1.21
I contribute more than my colleagues during discussions in math class.	2.99	1.11
I find mathematics easier than many of my classmates.	2.90	1.28
I feel my classmates are doing better than I do in mathematics.	2.59	1.27
SELF-EFFICACY		
I have always been successful with mathematics.	3.25	1.18
I make excellent grades on mathematics tests.	3.14	1.16
I got good grades in mathematics on my last report card.	3.47	1.15
Even when I study very hard, I do poorly in mathematics.	2.22	1.25
I do well on even the most difficult mathematics assignments.”	3.05	1.16
I do well on mathematics assignments.	3.66	1.10
Seeing adults do well in mathematics pushes me to do better.	3.84	1.14
When I see how my mathematics teacher solves a problem, I can picture myself solving the problem.	3.81	1.16

Table 4 Cont.

Seeing kids do better than me in mathematics pushes me to do better.	**3.71**	**1.23**
I imagine myself working through challenging mathematics problems successfully.	3.69	1.13
When I see how another student solves a mathematics problem, I can see myself solving the problem in the same way.	3.62	1.14
I compete with myself in mathematics.	3.67	1.14
My math teachers have told me that I am good at learning mathematics.	3.26	1.25
People have told me that I have a talent for mathematics."	3.20	1.29
Adults in my family have told me what a good mathematics student I am.	3.10	1.27
I have been praised for my ability in mathematics.	3.35	1.27
Other students have told me that I'm good at learning mathematics.	3.24	1.31
My classmates like to work with me in mathematics because they think I'm good at it.	3.29	1.29
I feel stressed when I am in a mathematics class.	2.39	1.25
I feel nervous when I am in a mathematics class.	2.62	1.22
I feel relaxed when taking mathematics test.	2.89	1.33
I start to feel stressed-out as soon as I begin my mathematics work.	2.60	1.14
I have usually been at ease in mathematics courses.	3.06	1.24
I usually don't worry about my ability to solve mathematics problems.	3.02	1.32
My whole body becomes tense when I have to do mathematics.	2.59	1.29
I get depressed when I think about learning mathematics.	2.43	1.28
It wouldn't bother me at all to take more mathematics courses.	2.95	1.40
Doing mathematics work takes all of my energy.	2.49	1.23
I am unable to think clearly when working mathematics.	2.37	1.28
ACHIEVEMENT MOTIVATION		
I am most motivated in mathematics when I see my work improving.	4.03	1.13
I am most motivated in mathematics when I am becoming better at my work.	3.97	1.10
I am most motivated in mathematics when I am good at something.	3.93	1.10
I am most motivated in mathematics when I solve a problem.	4.08	1.02

Table 4 Cont.

I am most motivated when I am confident that I can do my schoolwork.	4.09	1.03
I am most motivated when I am doing better than others in mathematics.	3.95	1.15
I am most motivated when I receive good marks in mathematics.	4.21	1.01
I am most motivated when get a reward.	4.13	1.07
I am most motivated when I become a leader in mathematics.	3.71	1.32
I am most motivated when I am praised in mathematics."	3.92	1.12
I am most motivated when I am noticed by others in mathematics.	3.82	1.14
I am most motivated when I am in charge of a group in mathematics.	3.79	1.14
I am most motivated in mathematics when I am competing with others.	3.67	1.26
I am most motivated when I work with others in mathematics.	3.96	1.06
I am most motivated in mathematics when I am in a group.	3.84	1.10
I am most motivated when I work mathematics with friends at school.	3.98	1.08
I am most motivated when I am helping others in mathematics.	4.04	1.07
I am most motivated in mathematics when I am showing concern for others in mathematics.	3.80	1.22
GRAND MEAN	3.29	1.18

Self-concept (M = 3.00, SD = 0.66), self-efficacy (M = 3.10, SD = 0.70), achievement motivation (M = 3.94, SD = 0.82)

Source: Field Data (2022)

The mean and standard deviation values of the self-concept items are in a range from 2.09 to 4.15 and 1.13 to 1.11 respectively as shown in Table 4. The mean on pre-service teachers' mathematics self-concept was 3.00. This mean corresponds to code 3 on the five-point Likert scale which stands for undecided. This means that the pre-service teachers were neutral on their mathematics self-concept. In other words, they were uncertain on

understanding of their strengths and weakness within themselves and in comparison to their colleagues in mathematics on the whole.

The self-concept items recorded high standard deviation values, indicating the pre-service teachers' have different opinions about their knowledge levels in self-concept. The results from Table 4 also show the pre-service teachers reported they disagree with the statement "I feel that I am among the bottom 5% of my class (M: 2.09, SD: 1.22). Also, the respondents agreed with the statement "It is important to me to do well in mathematics classes" (M: 4.15, SD: 1.04) as reported in Table 4. The value 4.15 is above the midpoint (M=3.0), thus an indication that the pre-service teachers' attached importance to the study of mathematics.

The results of the respondents' self-efficacy statements show that the mean and standard deviation values of the self-efficacy statements are in a range from 2.22 to 3.84 and 1.10 to 1.29 respectively as shown in Table 4. The mean on pre-service teachers' mathematics self-efficacy was 3.10. This mean corresponds to code 3 on the five-point Likert scale which stands for undecided. This means that the pre-service teachers were neutral on their mathematics self-efficacy. The self-efficacy items recorded high standard deviation values, indicating that the pre-service teachers' have different opinions about their knowledge levels in self-efficacy. The results from Table 4 also show the pre-service teachers reported they agree with the statement "I am unable to think clearly when working mathematics" (M: 2.37, SD: 1.28). Also, the respondents agreed with the statement "Seeing adults do well in mathematics pushes me to do better" (M: 3.84, SD: 1.14) as reported in Table 4. The value 3.84 is above the midpoint (M=3.0), thus an indication that the

pre-service teachers' attached importance to self-efficacy in the study of mathematics.

The results of the respondents' achievement motivation statements show that the mean and standard deviation values of the achievement motivation statements are in a range from 3.67 to 4.12 and 1.6 to 1.01 respectively as shown in Table 4. The mean on students' mathematics achievement motivation was 3.94 ≈ 4. This mean corresponds to code 4 on the five-point Likert scale which stands for agree. This means that the students agreed to have mathematics achievement motivation. The results in this table also reveal that the students were generally desirous to attain high standards in their mathematics achievement motivation. The achievement motivation items recorded high standard deviation values, indicating the pre-service teachers' have different opinions about their knowledge levels in achievement motivation. The results from Table 4 also show the pre-service teachers reported they agree with the statement "I am most motivated in mathematics when I am competing with others" (M: 3.67, SD: 1.26). Also, the respondents agreed with the statement "*I am most motivated when I receive good marks in mathematics"* (M= 4.21, SD=1.01) as reported in Table 4. The value 4.21 is above the midpoint (M=3.0), thus an indication that the pre-service teachers' attached importance to the study of mathematics.

Finally, Table 4 displays the overall mathematics affects mean score (M = 3.29, SD = 1.18) is above average, which suggests that the three mathematics affects (self-concept, self-efficacy and achievement motivation) truly exist among pre-service teachers in mathematics at the selected colleges of education. Specifically, pre-service teachers' achievement motivation was

the most rated factor on the part of the respondents (M = 3.94, SD = 0.82). This seems to suggest that pre-service teachers consider achievement motivation in mathematics as an important factor that affects performance. Pre-service teachers' self-efficacy was rated second (M = 3.10, SD = 0.70), while pre-service teachers' self-concept (M = 3.00, SD = 0.66) was rated third. It was also revealed from Table 4 that self-concept recorded highest reliable response of 0.66 when compared with the other standard deviations of 0.70 and 0.82 for self-efficacy and achievement motivation, respectively. The least data spread was from achievement motivation, though it recorded the highest score among the variables. Further, the response to the item "*I feel that I am among the bottom 5% of my class"* (M = 2.09, SD = 1.22) was rated the least, while the response to the item "*I am most motivated when I receive good marks in mathematics"* (M= 4.21, SD=1.01) was rated the highest.

In conclusion, the overall/ grand mean on pre-service teachers' affect was 3.28. This mean corresponds to code 3 on the five-point Likert scale which stands for undecided. This means that the pre-service teachers were undecided to have the three mathematics affects on the whole. The results might suggest that sometimes pre-service teachers were generally emotional about their attitude and believed in mathematics, yet at other times not. Particularly, almost all students were undecided to have self-efficacy and self-concept. Although this was the case, the results in this study reveal that the students agreed to have mathematics achievement motivation.

Pre-Service Teachers' Academic Achievement in Mathematics

I also presented a summary of the dependent variable that was used in the study. As mentioned earlier, the study used achievement tests scores (Learning and Applying Number and Algebra) as the dependent variable. Learning and Applying Number and Algebra was used because it is a foundation course and, as such, compulsory for all level 100 pre-service teachers. The achievement test contained 20 multiply choice questions. The test was marked out of 100%, and a score of 50% or higher is considered a pass (based on the colleges affiliated universities grading system). The descriptive statistics of achievement test score of the various colleges of education by their programme of study are shown in Table 5.

Table 5: Statistics of Pre-service Teachers' Achievement Test Score of all Five Colleges in the first year of their training

Name of College	Programme of study	N	Mean	Std. Deviation
College A	JHS Education	72	69.31	14.47
	Primary Education	46	63.04	17.40
	Early Grade Education	41	66.71	14.52
	College A Mean/SD	159	66.82	15.51
College B	JHS Education	136	68.90	16.03
	Primary Education	40	70.63	14.99
	Early Grade Education	15	59.67	17.06
	College B Mean/SD	191	68.53	16.04
College C	JHS Education	116	68.71	15.69
	Primary Education	34	62.94	15.53
	College C Mean/SD	150	67.40	15.79
College D	JHS Education	61	64.10	14.90
	Primary Education	38	55.92	13.55
	Early Grade Education	18	56.67	17.32
	College D Mean/SD	117	60.30	15.28
College E	Primary Education	92	55.54	14.31
	Early Grade Education	55	57.82	15.27
	College E Mean/SD	147	56.39	14.66
Overall mean	JHS Education	385	68.16	15.51
	Primary Education	250	60.40	15.96
	Early Grade Education	129	60.70	15.92
	OVERALL COLLEGE MEAN/SD	764	64.36	16.17

Source: Field data (2022)

Table 5 displays scores and standard deviation of the sampled colleges and their achievement test score. From the table, it is clear that College A had a mean and standard deviation value of 66.82 and 15.51, respectively. Also, respondents from College B mean scores (M= 68.53, SD = 16.04) revealed an

above average mathematics achievement. College B recorded the highest mean score and standard deviation among the sample colleges for the study. It is revealed that College C had a mean and standard deviation values of 67.40 and 15.79, respectively. College E, with the lowest mean score of 56.39 among the colleges, also recorded the lowest standard deviation of 14.66. Respondents from College D's mean score (M= 60.30, SD = 15.27) revealed an above average mathematics achievement.

Another interesting finding of the result was that the JHS programme of College A recorded the highest mean (M= 69.31, SD = 14.47) among all the other programmes of study. Also, the results revealed was that primary education programme of College D recorded the lowest mean (M=55.54, SD= 14.31) in comparison to the other programmes of the other four colleges.

In conclusion, the table indicates that pre-service teachers' overall mean of 64.36 is above the midpoint (M = 50), indicating that the mean rating of mathematics is high in terms of achievement. The small overall standard deviation of 16.17 indicates that the respondents have a similar strength of mathematics achievement.

Pre-Service Teachers' Mathematics Affects in Terms of Gender and Programme of Study

The goal of this research topic was to determine how gender and programme of study affected the self-concept, self-efficacy, and achievement motivation of pre-service mathematics teachers from different institutions utilizing their questionnaire responses scores in the test.

Finding out whether pre-service teachers' gender and program of study genuinely affected how mathematics affected their self-concept, self-efficacy,

and success motivation was the study's third research question. This research question was therefore answered in two subsections.

In responding to the RQ3, I was interested in finding out whether first-year pre-service teachers mathematics affects varied with their gender. The study's goal was to determine whether male and female respondents' mathematics affect (self-concept, self-efficacy, and achievement motivation) scores varied. Male and female distinctions were used to categorize gender as it has been defined. Based on the responses from 764 prospective teachers, I conducted an independent t-test to that effect. A t-test was used to quantitatively analyze the information gathered in response to this query. The t-test was chosen because this section of the question compared the mean score of one continuous variable (one affective variable at a time) for two different categories of subjects (male and female difference). Table 6 shows the t-test results of the differences between male and female pre-services teachers on their mathematics self-concept, self-efficacy, and achievement motivation are shown.

Table 6: The Results of the effect of gender on mathematics affects (self-concept, self-efficacy, and achievement motivation)

Variable	Group	N	Pre-service Teachers rating		t-value	Mean diff.	Sig.	Effect size
			Mean	Std. D				
Self-concept	Male	400	3.43	.64	4.376	.21	.000*	.024
	Female	364	3.22	.66				
Self-efficacy	Male	400	3.46	.69	2.412	.12	.016*	.008
	Female	364	3.33	.70				
Achievement motivation	Male	400	4.00	.75	2.17	.12	.030*	.006
	Female	675	3.87	.88				

*Statistically significant at $p < a = 0.05$

Scale: strongly disagree=1, disagree=2, neutral, 4 = agree, 5 = strongly agree; $p < a = .05$

Table 6 compares male and female self-concepts on mathematical achievement using an independent t-test. The results revealed a significant difference [t (762) = 4.376, p = 0.000] in the scores, with the mean score for male self-concept (M = 3.43, SD = 0.64) higher than female self-concept (M = 3.22, SD = 0.66). The magnitude of the difference in the means (mean difference = 0.21) was significant but very small (eta squared = 0.0113). The small effect size suggests that the extent of the difference was minimal (Field, 2018). The results suggest that there is a significant difference in the mean self-concept scores of male and female pre-service teachers in favour of the males.

Also, the mathematics achievement for male and female self-efficacy was compared. The results from Table 6 indicate that there was a significant difference (t (762) = 2.412, p=0.016 < 0.05) in the scores, with the mean score for male self-efficacy (M=3.46, SD=0.69) higher than female self-efficacy (M=3.33, SD=0.70). The size of the mean difference (mean difference = -8.44) was noteworthy but very small (eta squared= 0.007). The effect size of 0.007 indicated that about 0.7% of the variance in the male and female mean scores of the first-year prospective teachers in sampled colleges can be attributed to their self-efficacy (Pallant, 2016; Field, 2018). The results suggest that there is a significant difference in self-efficacy scores of male and female respondents in favour of the males.

Finally, to compare the mathematics achievement for male and female achievement motivation, an independent sample t-test was used (as shown in Table 6). The results revealed statistically significant differences [t (762) = 2.17, p=0.030] in the scores, with the mean score for male achievement motivation (M=4.00, SD=0.75) being higher than female achievement motivation (M = 3.87, SD = 0.88). The magnitude of the difference (mean difference = 0.13) was significant but very small (eta squared = 0.0061). The effect size of 0.006 indicated that about 0.6 percent of the variance in the male and female mean scores of the pre-service teachers was attributed to their achievement motivation. The results suggested that there is a significant difference in pre-service teachers' mean achievement motivation scores of male and female respondents. The result favours the male respondents. The significant difference in favour of the male respondents might be due to favourable motivational strategies towards them in the five selected colleges

for the study. It is therefore suggested that a well-organised conventional teaching procedure/strategy that has the potential to improve gender responsiveness should be used by tutors to include all pre-service teachers.

In relation to Research Question 3, I was also interested in finding out whether first-year pre-service teachers' mathematics affects varied with their programme of study, and I conducted a one-way ANOVA to establish this. Table 7 showed the results.

Table 7: The Results of the effect of Programme of Study on Respondents Mathematics affects

Variable	Programme	Pre-service Teachers		F	Sig.	Effect size
		Mean	Std. D			
Self-concept	JHS education	3.39	.68	3.821	.022*	.010
	Primary education	3.25	.64			
	Early grade	3.31	.61			
Self-efficacy	JHS education	3.45	.69	2.382	.093*	.006
	Primary education	3.32	.72			
	Early grade	3.41	.67			
Achievement motivation	JHS education	4.04	.71	7.523	.001*	.019
	Primary education	3.78	.94			
	Early grade	3.95	.82			

*Statistically significant at $p < a = 0.05$

Scale: strongly disagree=1, disagree=2, neutral, 4= agree, 5 = strongly agree; $p < a = .05$

It can be observed from Table 7 that there was a significant effect of the programme of study on mean self-concept scores. To put it another way, the programme of study had a significant main effect on mean self-concept scores [F (2, 761) = 3.821, p = 0.022]. The self-concept scores of JHS education (M = 3.39, SD = 0.68) were rated as the highest, followed by early grade (M = 3.31, SD = 0.61) and primary education (M = 3.25, SD = 0.64) as the least rated programmes of study on self-concept. Moreover, the effect size for self-concept by programme of study (eta square) was calculated as 0.010. From Cohen's criterion, the effect size of programme of study for the present study was relatively small (Pallant, 2016; Field, 2018).

However, the results obtained for the pre-service teachers' programme of study (*JHS education* M = 3.45, SD = 0.69; *early grade education* M = 3.41, SD = 0.67 and *primary education* M = 3.32, SD = 0.72), seem to suggest that the mean self-efficacy scores for all the three programmes were all equal. The reason for this is that the t-test [F (2, 761) = 2.382, p = 0.093] results revealed that programme of study had no significant main effect on self-efficacy scores. The implication is that at least two of the mean scores on pre-service teachers' mathematics self-efficacy for the three groups of programme of study did not differ. The effect size for self-efficacy by programme of study was calculated as 0.006. That is, the actual differences in the values were small, which means that the differences between JHS, primary and early grade education seemed to be of little practical significance.

Moreover, from the mean and standard deviation of mathematics achievement motivation, JHS education response (M = 4.04, SD = 0.71) was relatively higher than that of early grade (M = 3.95, SD = 0.82) and primary

education (M = 3.78, SD = 0.94). The one-way ANOVA findings revealed that this difference is statistically significant [F (2, 761) = 7.523, p = 0.001]. That means the achievement motivation scores of JHS education were significantly higher than the mean achievement motivation scores of early grade and primary education. The effect size for achievement motivation by programme of study was calculated as 0.019, a small effect size (Pallant, 2016; Field, 2018).

On the whole, pre-service teachers' programme of study had a significant effect on self- concept and achievement motivation scores, meanwhile programme of study had no significant main effect on self-efficacy scores.

Pre-Service Teachers Mathematics Achievement in Terms of Low and High Affects, Gender, and Programme of Study

This research hypothesis sought to find out whether mathematics related affects, gender and programme of study on pre-service teachers' mathematics achievement is significant. To find the impact on pre-service teachers' mathematics achievement, a relationship between each predictor variable (affects, gender and programme of study) and mathematics achievement was proposed, hence, three research hypotheses were postulated. The first part explores whether significant differences exist across mathematics achievement test scores for high and low self-concept, self-efficacy and achievement motivation. The research hypothesis was answered using pre-service teachers' mathematics achievement test scores obtained in number and algebra and their level of affects using an independent sample t-test. On the five-point Likert scale, pre-service teachers' responses of 3.0 and

below were classified as low self-concept, self-efficacy and achievement motivation whiles responses above 3.0 were considered as high. An independent samples t-test was conducted. The reason the independent sample t-test was chosen was because this section of the question compared the mean score of one continuous independent variable (mathematics achievement) for two different categories (high and low) of subjects. The second part explores whether significant differences exist between mathematics achievement test scores with gender (male and female) using an independent t-test. Part three of the research hypothesis explores whether significant differences exist across mathematics achievement test scores by the programme of study (JHS, primary and early grade education), using one-way ANOVA.

To respond to the research hypothesis, questionnaire and achievement tests as in Appendices A and B, respectively, were administered to the 764 respondents in the five sampled colleges of education on different days to obtain data for the analysis.

As already mentioned, the research hypothesis sought to use ANOVA with post-hoc test to find if there is a notable change in first-years' mathematics achievement scores across their programme of study (specialisations). ANOVA was conducted to explore the impact of programmes of study on mathematics achievement scores. The results presented in Tables 8 and 9 were obtained from pre-service teachers' mathematics achievement test scores and their programme of study information from Part A of the research questionnaire. The independent variable is the programme of study (specialisations) with early grade

education, primary education and JHS education groups. The dependent variable is mathematics achievement, measured with tutor made achievement test. All pre-service teachers in the sample colleges take approximately the same lessons and exams on mathematics. One of the only differences between them is their programme of study. Normality checks and Levine's test for homogeneity of variance (where p > 0.05) were carried out and the assumptions were met. The descriptive statistics of pre-service teachers' mathematics achievement scores and their programmes of study are presented in Table 5.

The results of Table 5 showed that the highest average achievement test score was obtained by pre-service teachers was in JHS education (68.16), followed by early grade education and then pre-service teachers who study primary education. The overall mean and standard deviation of 64.36 and 16.17, respectively indicated that these programmes may have a notable impact on mathematics achievement. The respondents in all the programmes are performing above average (> 50) in mathematics which lead to the grand mean of 64.36 with a standard deviation of 16.17.

The ANOVA *F* statistics were used to ascertain whether the differences between these means are statistically significant. Respondents per their chosen programme of study from the sample colleges were divided into three groups (JHS Education, Primary Education and Early Grade Education). At the p 0.05 level, Table 8 demonstrated a statistically significant difference in the results of the accomplishment tests: [F (2, 761) = 22.635, p =.000]. As a result, the null hypothesis was rejected, indicating that there are differences in the means of the research programme. The sum of squares between

groups/total sum of squares used to compute the effect size (eta squared) was 0.056, meaning that the programmes explained 6% of the variance in math achievement. Although statistical significance was reached, the actual mean score difference across the three research programs was quite modest (Pallant, 2016; Field, 2020). This means that roughly 94% of the results were due to external factors.

Aside from the determination of the statistical significance and effect size of the programme of study on mathematics achievement, there was a need to also determine where the differences occur. The post-hoc analysis was conducted to determine the programme of study that is significantly different or otherwise. The Tukey post-hoc test was used because of its ability to compute the average of each group and that of every other group and test their individual significant difference. Table 8 displays the multiple comparison of the programmes.

Table 8: Multiple Comparisons of the Programme of Study

		Mean		F-test		
(I) Programme	(J) Programme	Difference (I-J)	Sig.	F	Sig.	Effect size
JHS Education	Primary Education	7.756*	.000	22.635	.000	.056
	Early Grade Education	7.458*	.000			
Primary Education	JHS Education	-7.756*	.000			
	Early Grade Education	-0.298	.983			
Early Grade Education	JHS Education	-7.458*	.000			
	Primary Education	.298	.983			

*Statistically significant at $p < a = 0.05$

Source: Field data (2022)

The post-hoc comparison calculated using Tukey HSD test in Table 8 revealed that the mean response for JHS education (*Mean*= 68.16, *SD*= 15.51)

was significantly different statistically at $p < .05$ from early grade education (*Mean*= 60.70, *SD* = 15.91) and primary education (*Mean* = 60.40, *SD* = 15.96). But, primary education did not differ significantly from early grade education when compared. It was observed that when primary education is represented by (I), the mean difference is negative but not statistically significant with early grade education (MD= –0.298, $p = 0.983$) and significantly negative with JHS education (*MD* = – 7 .756, $p = 0.000$).

As part of response to the research hypothesis, the study also explored pre-service teachers' low and high mathematics affects on their mathematics achievement.

On a five-point Likert scale, pre-service teachers' responses of 3.0 and below were classified as low self-concept, self-efficacy and achievement motivation, while responses above 3.0 were considered high. The difference between pre-service teachers with low and high mathematics affects on their mathematics achievement is shown in Table 9.

Table 9: Group Statistics of Low and High Self-Concept, Self-Efficacy, and Achievement Motivation on Mathematics Achievement

Variable	Group	N	Achievement test score		F	t-value	Mean diff.	Sig.	Effect size
			Mean	SD					
Self-concept	Low	239	58.56	16.32	2.131	-6.894	-8.44	.000*	.058
	High	525	67.00	15.41					
Self-efficacy	Low	217	56.91	17.06	10.911	-7.881	-10.40	.000*	.075
	High	547	67.31	14.81					
Achievement	Low	93	54.10	15.89	.066	-6.540	-11.61	.000*	.053
motivation	High	675	65.71	15.72					

*Statistically significant at $p < a = 0.05$

An independent samples t-test was conducted to compare the mathematics achievement of high and low self-concept (as shown in Table 9). The results showed a statistically significant differences (t (762) = -6.894, p=0.000) in the scores. The mean score for low self-concept (M=58.56, SD=16.318) was lower than that for high self-concept (M=67.00, SD=15.41). The magnitude (mean difference = -8.44) was remarkable, hence H_0 was rejected. The significant difference was very moderate (eta squared=0.0587), an indication that the impact was average. The results suggest that low pre-service teachers' self-concept will lead to low mathematics achievement. Also, when pre-service teachers' self-concept is high, the same high mathematics achievement will also be recorded by them. According to the literature, teachers should always give good feedback to students to boost their self-concept (Burnett, 1999 as cited in Awan et al., 2011).

The mathematics proficiency of pre-service teachers with high and low self-efficacy was compared using another t-test. Table 9 indicates a statistically significant differences (t(762) = -7.881, p=0.000) in the scores. The mean score for low self-efficacy (M=56.91, SD=17.01) was lower than that for high self-efficacy (M=67.31, SD=14.81). The mean difference of -10.40 was significant. The impact of self-efficacy revealed a statistic of 0.075 which is a moderate effect size between the low and high mean scores (Pallant, 2016; Field, 2018). This meant that the difference in self-efficacy between the low and high mean scores of the students was average. Hence, H_0 was rejected. The results suggest that low pre-service teachers' self-efficacy will lead to low mathematics achievement. Similarly, when pre-service

teachers' self-efficacy is high, it leads to same corresponding high mathematics achievement.

Table 9 finally showed an independent t-test used to compare mathematics achievement for high and low achievement motivation. There were significant differences (t (764) = -6.540, p=0.000) in the scores. The score for low achievement motivation (M = 54.10, SD = 15.89) was lower than that for high achievement motivation (M = 65.71, SD = 15.72). The mean difference = -11.61 was significant. Hence, H_0 was rejected. The impact of achievement motivation revealed a statistic of 0.053 which is a moderate effect size between the low and high mean scores (Pallant, 2016; Field, 2018). This meant that the difference in achievement motivation between the low and high mean scores of the students was average. The results suggest that low pre-service teachers' achievement motivation will lead to low mathematics achievement. Similarly, when pre-service teachers' achievement motivation is high, their mathematics achievement will also be high.

To respond to the third part of the research hypothesis, another independent samples t-test was conducted to compare the mean score of male and female pre-service teachers, which appear to influence their mathematics achievement. To address the differences, if any, between the male and female mean score on mathematics achievement from the two perspectives, a hypothesis was tested between the responses of 400 male pre-service teachers and 364 female pre-service teachers. As mentioned earlier, the male and female responses are independent from each other. The details from the independent-samples t-test are presented in Table 10 below.

Table 10: Differences in Mathematics Achievement between Male and Female Pre-service Teachers

Sex	N	Achievement test score		F	T-value	Mean diff.	Sig.	Effect size
		Mean	Std. D					
Male	400	65.43	16.01	.000	1.914	2.24	.056*	.005
Female	364	63.19	16.28					

*Statistically significant at $p < a = 0.05$

Source: Field data (2022)

An independent sample t-test was conducted to compare the mathematics achievement for male and female affects (as shown in Table 10). The results showed no statistically significant differences ($t(762)= 1.914$, $p=0.056$) between the two groups. The mean score for male (M=65.43, SD=16.01) was higher than the female mean score (M=63.19, SD=16.28). The magnitude of the difference in the means (mean difference = 2.24) was not significant. The significance of the difference was very small (eta squared=0.005), an indication that the impact was minimal. It seems to suggest that both male and females value mathematics achievement equally. The reason is that the t-test (sig. = 0.056) results showed no significant difference between the two groups with a very low effect size (d = 0.005).

In conclusion, the results suggest that first-year pre-service teachers programmes of study in all the five colleges recorded high mathematics achievement. The results also affirm that low self-concept, self-efficacy and achievement motivation have a corresponding impact on mathematics achievement and vice versa. It is therefore important for tutors of the various colleges of education to always design their teaching and learning activities to

raise first-years' self-concept, self-efficacy and achievement motivation. Finally, it was revealed in this hypothesis that no statistically significant differences were found between the male and female respondents.

Influence of Pre-Service Teachers Mathematics Affects on their Mathematics Achievement

The quantitative data generated from the responses on each part of the questionnaire and pre-service teachers' mathematics achievement was analysed using Pearson correlation coefficient. These analyses were performed in three parts. The first part of this research question sought to determine the relationship between pre-service teachers' mathematics self-concept and their mathematical accomplishment using self-concept questionnaire in Part B and their achievement in mathematics. At the second part, the question sought to ascertain the relationship between respondents' mathematics self-efficacy and their mathematical achievement using self-efficacy questionnaire in Part C and their achievement in mathematics. Finally, the third part of the question sought to ascertain the relationship first-years mathematics achievement motivation and their mathematical achievement using achievement motivation questionnaire in Part D and their success in mathematics.

This research question intended to ascertain the extent first-year students' mathematics self-concept, self-efficacy and achievement motivation influence their mathematics achievement using Part B to C of the questionnaire in Appendix A.

In analysing this research question, multiple regression was used to find out the extent to which self-concept, self-efficacy, and achievement motivation of pre-service teachers influence their mathematics achievement.

As mentioned earlier, the study used tutor made achievement test scores (Number and Algebra) as the dependent variable. The college results were graded based on the five colleges grading system. The dependent variable was represented by the achievement in mathematics because the researcher wanted to explore if the college results were affected by mathematics affects and to what extent if they did. Before the regression analysis, the researcher first of all tried finding if a statistically significant link existed between the affects and mathematics achievement test scores. Correlational analysis between the independent variables and mathematics achievement was ascertained by calculating the correlation coefficient. The correlation coefficient was carried out to measure the strength of a linear relationship between the variables. To better understand the nature of the association between the independent variables (self-concept, self-efficacy, achievement motivation) and mathematics achievement, a scatterplot was used to obtain an idea about the direction of the relationship, as shown in Figure 9.

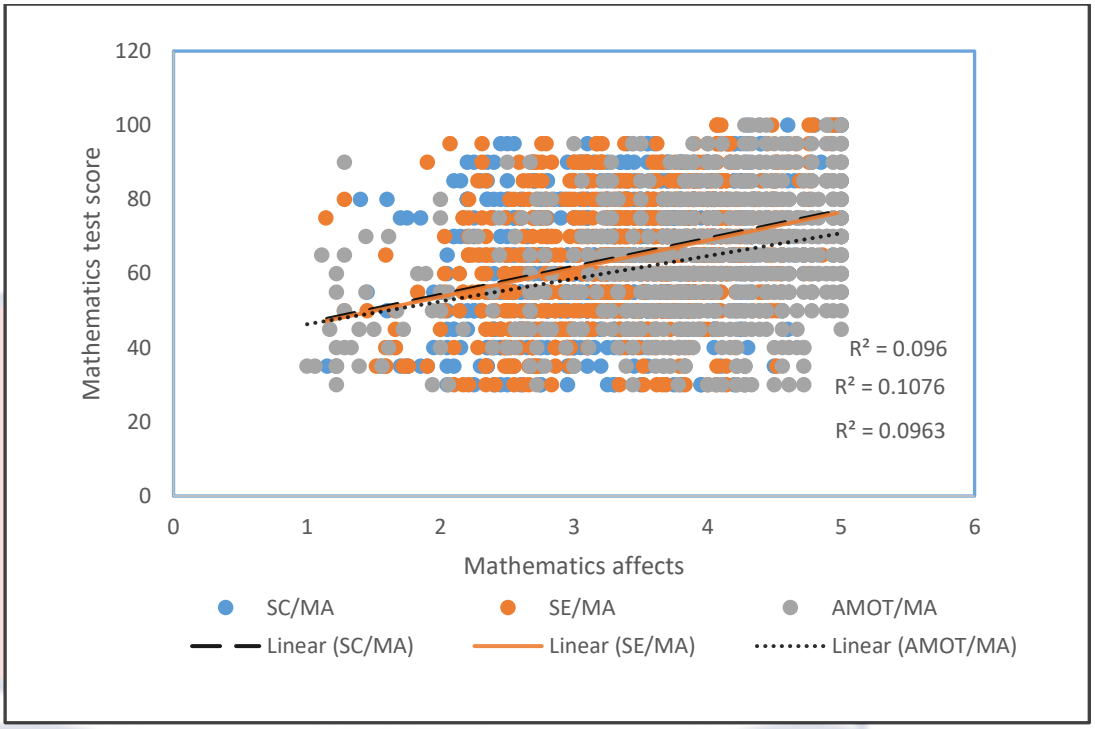

Figure 9: Scatter plot showing self-concept, self-efficacy, achievement motivation, and their mathematics achievement

Graphically, Figure 9 seems to indicate a moderate increase in the lines of best fit. These lines of best fit are relatively surrounded by the data points for first-years' self-concept (SC), self-efficacy (SE), and achievement motivation (AMOT) on their mathematics achievement (MA). As such, all the scatter plots displayed a positive relationship with mathematics achievement (MA) and the three affects (SC, SE, and AMOT). The scatter plot also showed the lines of best fit equations as 0.096, 0.11, and 0.09 for self-concept (SC), self-efficacy (SE), and achievement motivation (AMOT), respectively.

The major of correlational analysis is to provide a description of the strength and direction of the linear relationship between two variables. A correlational matrix indicating the correlation coefficients and their significant values was calculated to further explain whether the positive relationships

displayed from the scatterplot in Figure 9 will be high, moderate or low. The correlation matrix is described in Table 11.

Table 11: Correlation Matrix between Self-concept, Self-efficacy, Achievement Motivation and Mathematics Achievement

		Achievement Test Scores	Self-Efficacy	Self-Concept	Achievement Motivation
Achievement Test Scores	Pearson Correlation	1	.328**	.310**	.310**
	Sig. (2-tailed)		.000	.000	.000

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

From Table 11, respondents' self-concept and mathematics achievement was moderate, positive and significantly correlated, with Pearson's r (764) = 0.310 and p = 0.000. This indicates a significant connection between the respondents' self-concept and mathematics achievement because the p-value is less than the 0.05 level of significance.

Also, the results in Table 11 indicates there is a significant moderate positive linear correlation between pre-service teachers' self-efficacy and their mathematics achievement: Pearson's r (764) = .328, p = 0.000.

Finally, Table 11 revealed that respondents' achievement motivation and mathematics accomplishment were moderate, positive and significantly correlated; Pearson's r (764) =0.310, p= 0.000. This indicates a significant connection between pre-service teacher's achievement motivation and mathematics achievement because the p-value is less than the 0.05 level of significance.

The above results and the diagnostic analysis seem to suggest that all the independent variables should be considered when predicting or studying the influence of mathematics achievement. From the above, it means that increment in pre-service teachers' affects will have a corresponding increase in their mathematics achievement. The implication is that if pre-service teachers have high desire to achieve and their self-concept and self-efficacy are boosted, they will have a substantial improvement in their mathematics achievement at the five selected colleges of education.

All the independent variables should be considered in this study because, as indicated in Table 11, all independent variables seem to potentially predict achievement. Though three of the independent variables showed a significant relationship with the dependent variable, the relationship was observed to be moderate at an alpha level of 0.05 but not at 0.01 which is the normal alpha level for correlational analysis (Pallant, 2016). Hence, the three variables being significant at 0.05 suggest a moderate relationship with the performance. Table 12 shows results of the investigation conducted with the aid of a regression model.

Table 12 provides analysis of regression on self-concept, self-efficacy, and achievement motivation as indicators of mathematical accomplishment.

Table 12: Regression Analysis of Affects on Achievement Test Scores

	Unstandardized Coefficients	Standardized Coefficients		F-test	
Mathematics Affects	B	Beta	Sig.	F	Sig.
(Constant)	28.369		.000	42.365	.000
Self-Concept	3.123	.127	.017		
Self-Efficacy	3.125	.135	.016		
Achievement Motivation	3.798	.192	.000		

Dependent Variable: mathematics achievement Test Scores

Predictors: (Constant), achievement motivation, self-concept, self-efficacy

Significant at P < 0.05, R Squared =0 .143, Adjusted R Squared =0 .140

Source: Field data (2022)

The model accounts for 14.3 percent of variance of mathematics achievement. The coefficients table indicated the contribution of the variables in the model in predicting mathematics achievement. It revealed that achievement motivation has the highest beta value of 0.192, as such, making the strongest unique significant contribution on mathematics achievement after all the other concepts are controlled. Self-efficacy having a beta value of 0.135, makes the second largest contribution, while self-concept made the least unique significant contribution of 0.127. The p-value is significant for all the independent variables (p=0.000); hence, the individual variables, *self-concept* (p = 0. 017), *achievement motivation* (p = 0.000), and *self-efficacy* (p = 0.016) had statistically significant contributions and can be used as predictors of mathematics achievement. The regression F-test result [F (3, 764) = 42.365, R^2=0.143, p=0.00] showed that the result was significant,

meaning self-concept, self-efficacy, and achievement motivation collectively contributed significantly to mathematics achievement.

The regression model is shown as follows:

Mathematics Achievement (MA) = 28.369 + 3.123(self-concept) + 3.125(self-efficacy) + 3.798 (achievement motivation).

The regression equation model indicated that for every unit increase in respondents' self-concept, self-efficacy, and achievement motivation, their mathematics achievement score increases by 3.123, 3.125, and 3.798, respectively. It was concluded that achievement motivation had the greatest influence on mathematics achievement. The regression analysis mathematically indicates that tutors at the selected colleges should provide the necessary support in the areas of achievement motivation, self-efficacy and self-concept to improve on pre-service teachers' mathematics achievement. The constant value of 28.369 from the model is the mean of mathematics achievement when self-concept, self-efficacy, and achievement motivation are zero, meaning that without these predictors, mathematics achievement would be approximately 28 percent.

In conclusion, this research question revealed a moderately positive correlation between self-concept, self-efficacy, achievement motivation, and their mathematics performance. It was also identified that pre-service teachers' self-concept, self-efficacy and achievement motivation are all significant predictors of success in mathematics.

Discussion of Results

The study looked at how self-concept, self-efficacy, achievement motivation, and mathematical accomplishment are related, using an adapted questionnaire and mathematics achievement test scores. The discussion of the results from the analyses is presented based on the proposed research questions and hypotheses as well as the literature review in Chapter 2 of this study.

Description of pre-service teachers on the following mathematics affects (self-concept, self-efficacy and achievement motivation)

The research question one which is "How would you describe pre-service teachers on the following mathematics affects (self-concept, self-efficacy and achievement motivation)?" is discussed. The findings of the descriptive statistics showed that pre-service teachers' overall mean score (M = 3.29, SD = 2.18) is average high, which suggests that the three mathematics affects (self-concept, self-efficacy and achievement motivation) truly exist among pre-service teachers in mathematics at the selected colleges of education. Basing on the five-point Likert scale on which the students rated themselves on math self-efficacy items, this value corresponded to code 3 which was undecided. This means that the students having uncertain to possess math affects, they believed in their abilities to study mathematics. In terms of levels, we can say that they had average level of mathematics affects. This assertion was also supported by Agbornu (2018) who reported the existence of mathematics affects (self-concept, self-efficacy and anxiety) among senior high school students. Also this association is particularly true

basing on Jameson and Fusco (2014) who found that adult learners self-reported lower levels of mathematics self-efficacy.

Differences of pre-service teachers' mathematics affects (self-concept, self-efficacy and achievement motivation) based on gender and programme of study

The research question two which is "To what extend do pre-service teachers' affective variables (self-concept, self-efficacy and achievement motivation) differ in terms of gender and programme of study?" is discussed. Before the discussion of this research question, it is important to state that the findings of the descriptive statistics showed that pre-service teachers' mean rating of mathematics was high in terms of their self-concept, self-efficacy, and achievement motivation. This research question was addressed in two ways: based on gender using t-test and based on programme of study using an ANOVA to investigate how they differ in terms of the three affect variables. The next section looks at pre-service teachers' affects based on gender.

First-year Pre-service Teachers' Mathematics Affects by Gender

The first subsection of research question one investigated the significant difference in female and male pre-service teachers' mathematics affect (self-concept, self-efficacy and Achievement Motivation). The results in Table 8 showed that the self-concept scores of female and male were significantly different and in favour of males. The magnitude of the differences in self-concept as explained by male and female pre-service teachers was very small. This means that pre-service female and male teachers differ in their understanding of their strengths and weaknesses within themselves and in comparison to their colleagues (self-concept). This may be

due to inadequate teaching resources, teaching strategies that reduce social-emotional learning, or psychological assistance by stakeholders. Gender Equality and Social Inclusion (GESI) issues may not also be tailored well by tutors for the females to hold stronger views about their capabilities and competence. In line with this study are some previous findings that showed difference in male and female self-concept (Erdogan & Sengul, 2014; Lawrence & Vimala, 2013). Erdogan and Sengul (2014) reported difference in elementary school students' mathematics self-concept by gender. Their result was in favour of male learners, which is in consistence with this study. This might be due to the fact that, just as in this study, they also used the Self-Description Questionnaire proposed by Marsh (1992). Awan et. al, (2011) discovered significant gender difference in favour of girls in their study. The reason for such results might be due to the small sample size use. This was not the case in this study, as male pre-service teachers have high confidence and self-perception than female colleagues. The findings here again, as far as determining the significance of the data is concern, go contrary to Dramanu and Balarabe (2013) revelation that there was no statistically significant difference between the self-concept of male and female JHS students in Ghana. Again, both Haciomeroglu and Bilgen (2013) and Ayodele (2011) showed in their studies that gender made no significant difference in mathematics self-concept. The reason for lack of gender influence from the above studies seems to be due to enabling environment provided to solve mathematical problems cooperatively.

The self-efficacy scores from Table 8 revealed a substantial gender difference. The mean score for male self-efficacy was higher than female self-

efficacy. The magnitude for the difference in the means was significant but very small. The effect size of 0.007 of pre-service teachers, indicated that about 0.7% of the variance in the male and female mean scores was attributable to their self-efficacy. The results showed that the self-efficacy of male and female pre-service teachers differ significantly. The difference was in favour of males. This means that pre-service teachers' gender differs from their belief in and ability to succeed in mathematics. A study in consonance with this study was conducted by Naz, Shah and Rehman, (2016), which revealed that males had significant higher mathematics self-efficacy than females. Another study supporting such finding was by Peters (2013), who opined that boys attained higher mathematics self-efficacy than girls. Contrary to this study were the findings of Ayotola and Adedeji (2009), and Ampofo (2019), who found no significant difference in boys' and girls' mathematics self-efficacy in the studies they individually conducted in Nigeria and Ghana, respectively.

Achievement motivation plays important role in explaining gender differences in school and college attainment. This was supported by the outcome of the findings in this study. From Table 8, the results indicated statistically significant differences in the scores, with the mean score for male achievement motivation higher than female achievement motivation. The magnitude of the difference in the means was significant but very small. The effect size of 0.006 indicated that about 0.6% of the variance in the male and female scores of the students was attributable to their achievement motivation. The results suggested that a significant difference existed in pre-service teachers' achievement motivation of male and female respondents. The results

favours pre-service males in the colleges. The significant difference in favour of the males might be due to the male favourable motivational strategies that are used in our colleges and schools. Gender responsive strategies should use by tutors to include all pre-service teachers (Liu & Zhu, 2009). Thus, this study concluded that there is significant difference between the sex differences of the respondents with regard to their achievement motivation. The study revealed that male pre-service teachers perceived better achievement motivation than the females. This result was supported by other studies in other circles of education. For example, significant difference was found in achievement motivation of male and female students when Liu and Zhu (2009) studied senior high school students. Liu and Zhu (2009), results concluded that male students have higher achievement motivations than female students. Also, a significant gender difference with respect to mathematics self-concept was revealed by Lee and Kung (2018), who concluded that males had a significantly higher mathematics self-concept than females. A similar and significant difference between 250 boys' and girls' achievement motivation was revealed by Lawrence and Vimala (2013) in favour of the boys.

There are other studies that also reported on the results being statistically significant but favouring the opposite sex (Devakumar, 2018; Maheswari & Aruna, 2016). For example, Devakumar (2018) study revealed that there was a significant difference in achievement motivation scores where the girls scored higher than the boys. Devakumar (2018) recommended that, people should avoid resistance to girls' education or preconceived ideas about the quantity and quality of education because such biases reduce the

motivation for achievement in students. Also, Maheswari and Aruna (2016) inferred that there is a significant difference between gender differences of the respondents with regard to achievement motivation. The researchers used census method to select 128 (36 males and 92 female) students from N.N. Ramanathan Iyyer high school, Nangavaram, Karur district. Maheswari and Aruna (2016) concluded that female students perceived better achievement motivation than their male colleagues. This could be as a result of the females in the current global community being aware and have their aspirations in place. The current study confirms Devakumar (2018) and Maheswari and Aruna (2016) findings of a significant difference, but only that the mean response for achievement motivation in this study favoured male pre-service teachers.

However, previous literature has established no significant differences in male and female achievement motivation (Oladipo & Ojufo 2013; Nagarathanamma & Rao, 2007; Kaushik & Rani, 2005; Akindipe, 2015). Akindipe (2015) conducted a study on mathematics achievement motivation in a collective culture among 178 boys and 168 girls in southwestern Nigeria. The result revealed no significant difference in boys' and girls' mathematics achievement motivation. Oladipo and Ojufo's (2013) investigation into the factors that predict need achievement among undergraduate students in Nigeria universities found no significant difference in need achievement of male and female students.

First-year Pre-service Teachers' Mathematics Affects by their Programme of Study

The second subsection of research question one, as part of discussions research question results as indicated in Table 7, revealed varied findings about pre-service teachers' affects from their programme of study. The present research findings showed a significant effect of programme of study on achievement motivation, with JHS education having the highest as compared to primary education and early grade education. Similar significant findings have been reported by Shekhar and Devi (2012), in which science stream students reported significantly higher achievement motivation compared to arts stream students.

Similarly, self-concept was found to have a statistically significant effect on programme of study, with JHS education having the highest as compared to primary education and early grade education. The findings of the current study, which found a statistically significant difference in the self-concept of students enrolled in various programs of study and courses of study, were also corroborated by work by Trautwein et al. (2006) and Matuvo (2012). When Ajmal and Rafique (2018) investigated the connection between academic self-concept and academic accomplishment among distance learners, their findings concurred with those of Trautwein et al. (2006) and Matuvo (2012). Ajmal and Rafique (2018) supported the results of this study that there is a significant difference in the academic self-concept of distance learners in the M.Ed. and B.Ed. programmes. Findings revealed that M.Ed. students have a higher academic self-concept than B.Ed. students.

In this study, the JHS education mean self-efficacy scores were higher than primary education and early grade education. However, the results also revealed that the programme of study did not have a significant main effect on mean self-efficacy scores. These results are similar to the findings of Abd-Elmotaleb and Saha (2013), who found that there was no statistically significant difference on learners' self-efficacy in their field of study. This was in sharp contracts to the study by Filippou (2019), which found that the social self-efficacy of students' field of study was statistically significant.

It is important to emphasis in the discussion that this is a new finding that has been revealed in this current study, and no literature seems to be available to support the effect of affective variables on the three programmes of study (early grade education, primary education and JHS education).

Low and high mathematics affects of pre-service teachers on achievement test scores

The first part of the research hypothesis looked at the difference between achievement test scores of pre-service teachers with high self-concept, self-efficacy, and achievement motivation and that of their colleagues with low self-concept, self-efficacy and achievement motivation. This study revealed that the level of pre-service to succeed (self-efficacy) is connected with their levels of mathematics achievement. This finding is in line with Siriparp (2015), who stated that students with high self-efficacy perform better academically. The findings of this study are also echoed by the results of Agbornu and Edekor (2020). Agbornu and Edekor (2020) also stated in support of the finding that students' mathematics performance will decline if they have low levels of self-efficacy, and vice versa. Lent and Brown (2006)

stated that failure brought on by low levels of self-efficacy will negatively impact students' lives.

Another finding of this study was that significant difference exist in the mean score of pre-service teachers with high and low self-concept. This means that higher levels of self-concept are likely to lead to higher levels of mathematics achievement, and pre-service teachers who have minimum levels of self-concept are also likely to perform poorly in mathematics. The current study also revealed that the magnitude of the differences in means of pre-service teachers' low and high self-concept as explained by the means, was moderate. The result of this study is similar to that of Crawford (2013), who found that an increase in students' self-concept will yield a corresponding increase in their academic performance. The reason for the similarity in the results of this study and that of Crawford (2013) may be due to the fact that the respondents were all from colleges of education and both studies also used correlational design.

Again, the result of this study provide evidence that, the mean score of students with high achievement motivation and students with low achievement motivation differs significantly. An indication that a significant difference actually exists in the mathematics performance of pre-service teachers based on their level of achievement motivation.

Students who are extremely motivated outperform motivated students in the classroom (Tella, 2007). Teachers should be provided with refresher programs, workshop training, and in service training courses to help them with necessary skills and competencies to enhance learner's achievement motivation. This finding is also consistent with Broussard (cited in Awan et al.

2011), who reveals that higher levels of mastery goals (a sub-construct of achievement motivation) are found to be related to high achievement and lower levels of mastery goals are also found to be related to low achievement. This is an indication that the high mean score of self-concept, self-efficacy, and achievement motivation had a positive impact on their performance in the mathematic test. Meaning the overall performance of pre-service teachers in all the colleges is above average. This is an endorsement of the assertion that the high similarity expressed in pre-service teachers' affects has affected their performance positively.

The reason could be that the mathematics achievement test questions are within the same knowledge level of respondents' mathematics related affects. This corroborated the findings of Awan et al. (2011), which indicates that the high mean and low standard deviation between mathematics and English self-concept has a corresponding effect on their achievement.

Difference in programme of study on achievement test scores

The result of this section of the research question sought to provide evidence of a notable variation in mathematics achievement score on programme of study. As indicated earlier, the programme of study is categorised into primary education, early grade education and JHS education. Table 8 showed there was a statistically significant difference in achievement test scores for the three programmes of study. It was found that when ANOVA is used to compare the means of mathematics achievement with each of the three programmes of study, differences exist across the programme of study. This is an indication that the means of programme of study are not all equal, that is, at least one is different from the rest. The result from Table 8 also

revealed that primary education did not differ significantly from early-grade education when compared. One probable reason for this outcome was that first-years of the colleges of education have an unequal level of understanding of mathematics, especially in Number and Algebra, which is a foundation course in their various programme of study. Moreover, because the pre-service teachers come to offer different programme of study, they might not all be provided with the same content materials and teaching resources, as such, they were unable to have equal competition with one another. Additionally, the negative mean difference is an indication that tutors should not be targeting pre-service teachers' in the primary programme on subjects that involve mathematics as their main reason for teaching. Below are few studies that have similarity with this study, though in reviewing related literature, no studies were found that directly compared mean differences among pre-service teachers' mathematics achievement score across their programme of study in the colleges of education.

Ajmal and Rafique (2018) supported the study's outcome this study that there is a significant difference in the achievement of distance learners of the M.Ed. and B.Ed. programme. According to them, distance learners of the B.Ed. programme showed higher achievement than distance learners of the M.Ed. programme. Other researchers also supported the findings (Kyoshaba, 2009; Amasuomo, 2014). The result was corroborated by the findings of Kyoshaba (2009), whose study established difference in the academic performance of students admitted to a faculty of study, and Amasuomo (2014), who also found significant differences in the level of performance between students admitted with different certificates, that is, a secondary

school certificate and City and Guilds certificate. However, the finding was different from that of Adedapo (2020), who found that no significant difference was established in distance learners across science, social science, and humanities programme. The similarities between this study and those by Amasuomo (2014) and Kyoshaba (2009) may be due to the fact that the same research design was used. The correlational research design was used in all the three studies. Thus, college tutors should include content that are mathematics related to self-concept, self-efficacy, and achievement motivation when planning their teaching strategies. The content of the teaching should not also be delivered in favour of any programme of study.

Gender Differences in Pre-service Teachers' Mathematics Achievement

The discussion on the differences in mathematics achievement also took gender into consideration. The results showed did not show statistically significant differences between first-year pre-service male and female teachers. It seems to imply that both genders of pre-service teachers' value mathematics achievement equally and that pre-service teachers' achievement in mathematics does not depend on gender. The size of the mean difference was not significant statistically, hence H_0 was accepted. The significant difference was very small, an indication that the impact was minimal. This finding is similar to Njoki, King-White, Kinai, and Kigen (2019) study, which showed that male and female students were not significantly different in mathematics achievement. The findings also sit well with Ayotola and Adedeji (2009), who found no significant difference between secondary school male and female students mean achievement scores in mathematics. However, Muchera, Dixon, & Hartley (2010) disagreed with this, as he found the sex

difference in mathematics performance to be highly significant in favour of female students. The differences in the results of the Muchera et al. (2010) study and the current one could be due to the study level of students involved. Also one of the study was done among secondary school students in Kenya while the other was among first-years in the colleges of education in Ghana.

Influence of self-concept, self-efficacy and achievement motivation on mathematics achievement

In Table 11, the result indicated a moderate and significant positive correlation between self-concept and mathematics achievement. This means that a pre-service teacher whose self-concept characteristics is moderately high will likely display moderate achievement in mathematics, and vice versa. So, self-concept explains roughly 9% of the variation in mathematical achievement. Although the result sharply contradicts the findings of Agbornu and Edekor (2020) results that students' mathematics achievement and self-concept were unrelated, nevertheless, this study agrees with Timmerman et al. (2017) and Adegoke (2015), who both found a positive relationship between self-concept and mathematics achievement. Similar to this, according to Yara (2010), there is a connection between academic self-concept and mathematics proficiency in some secondary schools in south-western Nigeria. Furthermore, the results of a study by Ayodele (2011) indicated that self-concept moderately correlated with performance in mathematics. Their findings are similar and consistent with the findings of this study that there is a moderately positive correlation between pre-service teachers' self-concept and their mathematics achievement. The reasons this study has similar findings as Timmerman et al. (2017), Adegoke (2015), Yara (2010) and Ayodele (2011)

may be associated with sample size and design. These studies used large sample size and the researchers adopted correlational design.

This shows that pre-service teachers' intra-individual and social comparison correlate moderately with their mathematics achievement. Hence, when pre-service teachers compare their perceptions with their own performances in mathematics or with the performances of other pre-service teachers in mathematics, a moderate relationship will be seen. A moderate relationship will also be revealed any time pre-service teachers compare their own performance in mathematics with their own performances in mathematics. Pre-service teachers understanding of their strengths and weaknesses within themselves and in comparison with their colleagues need to be enhanced.

Also, the results in Table 11 indicated a moderate and positive linear correlation between students' self-efficacy and mathematics achievement. Despite the conflicting studies on self-efficacy and mathematics accomplishment, the results of the study support Agbornu and Edekor (2020) finding that students' mathematics self-efficacy sronger correlated with their mathematics achievement. Ampofo (2019) indicated that a strong positive correlation exists between the pre-service teachers' mathematics self-efficacy and their mathematics achievement. It is a revelation that stronger arithmetic performance correlates with higher Self-efficacy levels, and vice versa.

Finally, the result shows that achievement motivation and their mathematics achievement were moderate, positive and significantly correlated. This result suggests that first-years' in the colleges of education desire to attain high standards and accomplish unique objectives in

mathematics (achievement motivation) is likely to moderately influence their achievement in mathematics. This shows that a pre-service teacher considered a moderate performer in mathematics is more likely possess a moderate achievement motivation. As such, pre-service teachers' achievement motivation correlates moderately and positively with their mathematics achievement. The study is in consonance with Awan et al. (2011), who found that there was a significantly positive correlation between achievement motivation and academic achievement in mathematics. This result is similar to Ajogbeje et al. (2013) study, where a positive and significant correlation coefficient was found between achievement motivation and mathematics achievement.

However, the result contradicts the findings of Obiero (2018), which reported a positive but weak (0.12) none significant (0.188) relationship between achievement motivation and mathematics performance. Therefore, the study has shown that all three constructs correlates positively but moderately with pre-service teachers' mathematics achievement. Hence, regression analysis was perform using all the variables.

The R squared in the model summary (Table 12), shows how much of the variation in test scores can be explained by mathematics affects. The p-value is significant for all the independent variables. Hence, the individual variables, self-concept, self-efficacy, and achievement motivation, had statistically significant impact and are reliable predictors of academic accomplishment. The regression F-calculated result from Table 12 showed that the result was significant, thus these three factors–self-concept, self-efficacy, and achievement motivation collectively contributed significantly to

mathematics achievement. The regression equation model indicated that for every unit increase in self-concept, self-efficacy and achievement motivation, their mathematics achievement score increases by 3.123, 3.125 and 3.798, respectively. Each of the affective variables made a unique statistical contribution to the equation. It was concluded that achievement motivation has the greatest influence on mathematics achievement. This means that achievement motivation marks the strongest unique contribution to explaining mathematics achievement when the variances of self-concept and self-efficacy in the model are controlled.

A lot of studies have shown the predictive value of self-concept (Adegoke, 2015; Njoki, King-White, Kinai & Kigen, 2019); self-efficacy (Agbornu & Edekor, 2020; Azar, 2013); and achievement motivation on mathematics achievement. For instance, Agbornu and Edekor (2020) and Bandura (2006) concluded that self-efficacy is a good predictor of mathematical achievement. Agbornu and Edekor (2020) study also share similar findings, because self-efficacy was not the best predictor in both scenarios. The result also corroborates the reported findings of Awan et. al (2011), who revealed in their study how self-concept and achievement motivation collectively contributed significantly to academic achievement of mathematics. These researchers recommended to stakeholders that they design programs such as positive self-talk in the basic and second circle schools that will build students' self-efficacy.

The model, which includes self-concept, self-efficacy, and achievement motivation, explains 14.3 percent of the variance of mathematics achievement. It therefore means that besides self-concept, self-efficacy, and

achievement motivation identified, other factors not yet identified in the colleges of education have a chance of contributing to or predicting about 86.7 percent of pre-service teachers' mathematics performance. The results suggest that pre-service teachers' self-concept, self-efficacy and achievement motivation alone do not contribute significantly to their mathematics achievement in college but do so when other variables are considered. This called for different research studies to further explore the other factors in the field of education and most specifically in the colleges of education. This finding lent credence to the results of Laryea et al. (2014) and Crawford (2013), who both found out that, though self-concept significantly influences academic performance, effort in learning by students directly contributed significantly to self-concept, leading to an increase in academic performance. Also, Causapin (2012) opined that self-efficacy effects are mediated by previously acquired mathematical skill (ability), without which performance will still be poor. The findings of this research and those of Laryea et al. (2014), Crawford (2013), and Causapin (2012) have paved the way for other researchers to extend the scope of this topic to include other affective factors

Considering the performance of each predictor, it revealed that achievement motivation has the highest/strongest unique significant contribution on mathematics achievement after all the other variables are controlled for. This was in line with Asiedu (2020), who also proposed that the strongest predictor of pre-service teachers' achievement in college algebra is pre-service teachers' motivation, attitude and lesson presentation. Self-efficacy makes the second largest contribution. As indicated by Agbornu and Edekor (2020), self-efficacy also predicted acceptable mathematics

performance and was considered the best predictor in a study conducted by Azar (2013) when compared with academic procrastination and achievement motivation. Self-concept made the least unique significant contribution. This is an implication that increasing pre-service teachers' achievement motivation will have a great influence on their self-concept and self-efficacy. As such, tutors should find means of improving pre-service teachers' achievement for motivation for better results in mathematics.

Also, the findings of Azar (2013) and the current study revealing the strongest predictor varying from study to study supports the assertion of Sawyerr and Agyei (2022) that "finding the strongest predictor is dependent on the context in which the study was conducted".

Chapter Summary

The study investigated the association between first-year pre-service teachers' affects (self-concept, self-efficacy, achievement motivation) and their mathematics achievement. The significant difference of gender and programme of study was also explored. A comprehensive analysis of correlation showed that mathematic achievement had a significant, moderately positive relationship with self-concept, self-efficacy, and achievement motivation. Also, with a sample size of 764 first-year pre-service, the ANOVA revealed that all the predictor variables individually or collectively contributed to achievement in mathematics. It was found that self-concept, self-efficacy, and achievement motivation explained 14.3% of the variance in mathematics achievement, and achievement motivation is the highest predictor of mathematics achievement. The study also indicated significant difference

between gender and programmes of study on the independent variables and mathematics achievement, respectively.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

The final chapter provides a summary of the key study outcomes, summary, conclusions, and suggestions that came from the analyses of the available data.

Summary

To shed additional insight on the relationships between students' self-concept, self-efficacy, achievement motivation, and mathematics accomplishment, the correlational study design was employed. The significant difference of gender and programme of study was explored. The gender differences were grouped into male and female, while the programme of study was categorised into early grade education, primary education, and JHS education.

The study's respondents were selected using a multi-stage sampling technique. Per the recommendation by Krejcie and Morgan, 764 pre-service teachers from 5 colleges in the northern part of the country were selected, where College A had a sample of 160 pre-service teachers, College B had a sample of 191 pre-service teachers, College C had a sample of 150 pre-service teachers, College D had sample of 118, and College E had a sample of 148 pre-service teachers.

Two different instruments were used for the data collection: a pre-service teachers' questionnaire and teacher-made achievement tests. Inferential and descriptive statistics were used to analysed the data that were obtained from the questionnaire and the teacher made achievement test. The

achievement test scores were subjected to sample size testing, normality testing (using Kolmogorov-Smirnov and Shapiro-Wilk significant values and regression standardized residual plot) assumptions, and multi collinearity (using scatter plot, correlation test, Variance Inflation Factor and Tolerance) assumptions. Some known inferential statistics measures employed in this study were Pearson product-moment correlation, multiple regression, ANOVA, and the independent sample t-test.

Key Findings

The key research findings of the study that were revealed from the analyses are based on the proposed research questions and hypotheses.

The first research question sought to describe pre-service teachers on the following mathematics affects (self-concept, self-efficacy and achievement motivation). Descriptive analysis revealed that pre-service teachers were generally emotional about their attitude and believed in mathematics, yet at other times not. All pre-service teachers were also undecided to have self-efficacy and self-concept. Although this was the case, the results in this study revealed that the students agreed to have mathematics achievement motivation.

Research question 2 sought to determine pre-service teachers' academic achievement in mathematics in the first year of their training. A close examination of the test scores revealed that pre-service teachers' in the first year of their training overall mean of 64.36 is above the midpoint (M = 50), indicating that their performance in mathematics is high.

The third research question sought to find out how well pre-service teachers affective variables (self-concept, self-efficacy, and achievement

motivation) differ in terms of gender and programme of study. The following results were revealed;

1. The result showed that pre-service male and female teachers mathematics affects (self-concept, self-efficacy and achievement motivation) score were all significantly different and in favour of males. The effect sizes of self-concept, self-efficacy and achievement motivation were 0.024, 0.008, and 0.006, respectively.
2. The study also observed that two of the mathematics affects (self-efficacy and achievement motivation) showed a significant effect on programme of study, while self-concept revealed no statistically significant effect on programme of study.

The research hypothesis of the study focused on whether there was any significant difference between pre-service teachers having low and high mathematics affects (self-concept, self-efficacy, and achievement motivation), gender and programme of study on their mathematics achievement. The following results were revealed:

1. The study also identified that higher levels of self-concept, self-efficacy, and achievement motivation lead to higher levels of mathematics achievement, and that pre-service teachers who have lower levels of self-concept, self-efficacy, and achievement motivation are also likely to underperform in mathematics.
2. The study identified a significant difference in first-years' mathematics achievement score for their programme of study.
3. The study found no significant difference in male and females' mathematics related affects on their mathematics achievement scores.

Finally, research question four examined the extent the three affective variables of pre-service teachers influence their mathematics achievement. The following results were made known:

1. A moderate positive correlation between teachers' self-concept, self-efficacy, achievement motivation, and their mathematics achievement.
2. The study found that pre-service teachers' self-concept, self-efficacy and achievement motivation are all significant predictors of mathematics achievement. This, therefore, shows that, for first-year pre-service teachers in this context to improve in their mathematics achievement, there is a need to pay attention to these three affective variables. The regression model showed that first-year pre-service teachers' achievement motivation was the best predictor of mathematics achievement, followed by self-efficacy, and then self-concept.

Conclusion

The following conclusions were drawn from the findings of the study.

1. First year pre-service mathematics teachers' show generally an average level of their affects. Though the overall affects were average, a low level of self-efficacy and self-concept shown while achievement motivation show a high level.
2. First year pre-service teachers' knowledge, skills and practices is above average level in mathematics.
3. It is clear that gender difference in pre-service teachers' mathematics affects existed. Though the magnitude of all three variables was very

small, it revealed that male pre-service teachers perceived better mathematics related affects than the female pre-service teachers.

4. The study concludes that students' self-concept and achievement motivation were identified to have influence on the three programme of study while self-efficacy was identified to have no influence on the three programme of study
5. The study concludes that the existence or lack of self-concept, self-efficacy, and achievement motivation are likely to have a significant relationship with pre-service teachers' mathematics achievement.
6. The study further concludes that differences exist across the three programmes of study (Early grade, upper grade and JHS education) in mathematics achievement. According to the study, the three programmes of study taken by pre-service teachers (Early grade, upper grade and JHS education) have an unequal level of impact on mathematics achievement.
7. The male and female pre-service teachers having high mathematics affects do not have higher mathematics achievement, and the male and female pre-service teachers with low mathematics affects do not have lower mathematics achievement.
8. An improvement in mathematics achievement is positively related with self-concept, self-efficacy, and achievement motivation.
9. Self-concept, self-efficacy, and achievement motivation were all predictors of accomplishment in mathematics. An indication that an increase in pre-service teachers' mathematics affects will have a positive impact on their mathematics achievement. The findings of this

study have therefore revealed the need to pay attention to the contribution of first-years' self-concept, self-efficacy, and achievement motivation to improve on their mathematics achievement.

Recommendations

The suggested recommendations may not apply to all colleges but only to those with similar features. Based on the main conclusions of this study researchers, curriculum reviewers and developers, policymakers, the Ghana Tertiary Education Commission (GTEC), and other stakeholders are given the following recommendations for use.

1. The principals and professional development coordinators (PDCs) of the various colleges of education may be tasked with using the weekly professional development sessions (PDS) for tutors as fertile ground for refresher training of mathematics affects (self-concept, self-efficacy, and achievement motivation) to improve their knowledge on identifying and handling pre-service teachers with such related variables.
2. Tutors should help first-years to develop their mathematics affects. Pre-service teachers should be educated and counselled on the benefits of self-concept, self-efficacy, and achievement motivation in learning mathematics. An increase mathematics related affects could help pre-service teachers improve on their mathematics achievement.
3. College tutors should strategize their teaching methods to gear towards developing pre-service teachers' self-concept, self-efficacy, and achievement motivation. Strategies such as paying of compliments, encouraging positive self-talk, and identity development will all

improve their knowledge about their affects and their competencies in mathematics.

4. This study therefore recommends stakeholders to pay equal attention and avoid biased practices in helping both male and female pre-service teachers through Gender Equality and Social Inclusion (GESI) responsive issues to improve their performance in mathematics.
5. College tutors should design mathematics teaching activities that will enable all learners, irrespective of their programme of study, gender, and age to have the ability to execute them successfully without difficulties.

Suggestions for Further Research

Based on the study's focus, the following recommendations for additional research are given.

1. This study revealed the small amount of variance explained by self-concept, self-efficacy, and achievement motivation in achievement. This is an indication that other variable(s) also contribute to pre-service teachers' mathematics achievement. More extensive research should be conducted on other variables that are responsible for increasing mathematics achievement to enable stakeholders focus on those variables.
2. To reveal the true relationship between first-years' self-concept, self-efficacy, and achievement motivation on mathematics achievement in the country other colleges in the southern part of the Ghana should be considered.

3. Another area of research in the future is conducting a longitudinal study to find out the stability of the effects of the three affective variables on achievement of pre-service teachers in mathematics
4. Finally, future researchers can also consider collecting qualitative data through interview as part of the method of data collection. This will reveal more of pre-service teachers' personal views on their mathematics related affects.

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APPENDICES

APPENDIX A

RESEARCH INSTRUMENT (QUESTIONNAIRE)

RELATIONSHIP BETWEEN FIRST YEAR PRE-SERVICE TEACHERS' MATHEMATICS AFFECTS AND MATHEMATICS ACHIEVEMENT

Dear Pre- service teacher,

This questionnaire is meant to enable the researcher to learn about your self-concept, self-efficacy and achievement motivation and their relations on your achievement in mathematics. Please be assured that your response for this survey will be treated confidential and for the purpose of this study. Kindly provide genuine response to each question.

PART A (Demographics of respondents)

1. Age (years): 15 – 19 [ ] 20 – 24 [ ] 25 – 29 [ ] 30 – 34 [ ] 35-39 [ ] 39 + [ ]

2. Sex: Male [ ] Female [ ]

3. Name of College: ……

4. Program of Specialisation: Junior High School Education [ ] Primary Education [ ] Early Grade Education [ ]

PART B: SELF-CONCEPT

For each of the statement, select only one option (Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree) that best describes your affect by placing a check mark (√) in the appropriate box.

Internal comparison	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I looked forward to mathematics classes.					
2. I hate mathematics.					
3. I do badly in mathematics test.					
4. I never want to take another mathematics course.					
5. I get good marks in mathematics.					
6. I have always done well in mathematics.					
7. I often need help in mathematics.					
8. Mathematics is one of my best subjects.					
9. I have trouble understanding anything with mathematics in it.					
10. I enjoy studying for mathematics.					
11. It is important to me to do well in mathematics classes.					
Social comparison	**Strongly**	**Strongly**	**Neutral**	**Agree**	**Strongly**

	Disagree	Disagree			Agree
12. I think I am one of the best students in mathematics.					
13. I think most of my classmates are smarter than I do.					
14. I participate more than my classmates during mathematics class.					
15. I feel that I am among the bottom 5% of my class.					
16. I can solve more mathematics problems than my classmates.					
17. I ask for help with my mathematics assignments more than any of my classmates.					
18. I contribute more than my colleagues during discussions in math class.					
19. I find mathematics easier than many of my classmates.					
20. I feel my classmates are doing better than I do in mathematics.					

PART C: SELF-EFFICACY

Mastery Experiences	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I have always been successful with mathematics.					
2. I make excellent grades on mathematics tests.					
3. I got good grades in mathematics on my last report card.					
4. Even when I study very hard, I do poorly in mathematics.					
5. I do well on even the most difficult mathematics assignments.					
6. I do well on mathematics assignments.					
Vicarious Experiences					
7. Seeing adults do well in mathematics pushes me to do better.					
8. When I see how my mathematics teacher solves a problem, I can picture myself solving the problem.					
9. Seeing kids do better than me in mathematics pushes me to do better.					
10. I imagine myself working through					

challenging mathematics problems successfully.					
11. When I see how another student solves a mathematics problem, I can see myself solving the problem in the same way.					
12. I compete with myself in mathematics.					
Verbal Persuasion					
13. My math teachers have told me that I am good at learning mathematics.					
14. People have told me that I have a talent for mathematics.					
15. Adults in my family have told me what a good mathematics student I am.					
16. I have been praised for my ability in mathematics.					
17. Other students have told me that I'm good at learning mathematics.					
18. My classmates like to work with me in mathematics because they think I'm good at it.					
Emotional Reactions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
19. I feel stressed when I am in a mathematics class.					
20. I feel nervous when I am in a mathematics class.					
21. I feel relaxed when					

taking mathematics test.					
22. I start to feel stressed-out as soon as I begin my mathematics work.					
23. I have usually been at ease in mathematics courses.					
24. I usually don't worry about my ability to solve mathematics problems.					
Physiological reactions					
25. My whole body becomes tense when I have to do mathematics.					
26. I get depressed when I think about learning mathematics.					
27. It wouldn't bother me at all to take more mathematics courses.					
28. Doing mathematics work takes all of my energy.					
29. I am unable to think clearly when working mathematics.					

PART D: ACHIEVEMENT MOTIVATION

Mastery goals	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I am most motivated in mathematics when I see my work improving.					
2. I am most motivated in mathematics when I am becoming better at my work.					
3. I am most motivated in mathematics when I am good at something.					
4. I am most motivated in mathematics when I solve a problem.					
5. I am most motivated when I am confident that I can do my schoolwork.					
Performance goals	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
6. I am most motivated when I am doing better than others in mathematics.					
7. I am most motivated when I receive good marks in mathematics.					
8. I am most motivated					

when get a reward.					
9. I am most motivated when I become a leader in mathematics.					
10. I am most motivated when I am praised in mathematics.					
11. I am most motivated when I am noticed by others in mathematics.					
12. I am most motivated when I am in charge of a group in mathematics.					
13. I am most motivated in mathematics when I am competing with others.					
Social goals					
14. I am most motivated when I work with others in mathematics.					
15. I am most motivated in mathematics when I am in a group.					
16. I am most motivated when I work mathematics with friends at school.					
17. I am most motivated					

when I am helping others in mathematics.					
18. I am most motivated in mathematics when I am showing concern for others in mathematics.					

APPENDIX B

ACHIEVEMENT TEST

This paper consists of twenty (20) multiple-choice questions. Each question consists of four alternatives lettered A – D. Circle the alternative that best answers each question.

1. Evaluate $2\frac{1}{3} + (2\frac{5}{8} \div \frac{7}{12})$.

   A. $6\frac{5}{6}$

   B. 4

   C. $\frac{1}{4}$

   D. $\frac{5}{6}$

2. Evaluate $101^2 - 1$.

   A. 102

   B. 1020

   C. 10200

   D. 102000

3. Write 3560 in standard form.

   A. 3.65×10^{-4}

   B. 3.65×10^{-3}

   C. 3.65×10^{3}

   D. 3.65×10^{4}

4. Simplify $\frac{x^2+2x-3}{x-1}$.

   A. x + 1

   B. x – 1

   C. x + 3

D. x – 3

5. What is the value of 7 in the number 832713?

   A. Seven thousand

   B. Seven hundred

   C. Seventy

   D. Seven

6. Which of the following statements is not true?

   A. An integer is a rational number

   B. The square root of any natural number is an irrational number

   C. A rational number is always of the form $\frac{x}{y}, where\ y \neq 0$

   D. An irrational number when expressed as a decimal has a non-terminating part.

7. Round the number 49356 to the nearest 100.

   A. 49300

   B. 49400

   C. 49000

   D. 49360

8. Write 37_{ten} as a number in base five.

   A. 221_{five}

   B. 212_{five}

   C. 122_{five}

   D. 111_{five}

9. If $f(x) = -x^2 - 7x - 4$, evaluate $f(-3)$.

   A. – 21

B. – 16

C. 8

D. 26

10. The sum of two numbers is 72. The difference between them is 26. Find the smaller number.

A. 23

B. 28

C. 36

D. 49

11. Which property of operation on whole numbers is shown in the mathematical statement $2(x + 6) = 2x + 12$?

A. Commutative property

B. Associative property

C. Distributive property

D. Additive property

12. Express 0.625 as a fraction in its lowest term.

A. $\frac{5}{8}$

B. $\frac{3}{4}$

C. $\frac{1}{2}$

D. $\frac{1}{4}$

13. Arrange $\frac{2}{5}, \frac{3}{4}, \frac{1}{2}$ in descending order.

A. $\frac{3}{4}, \frac{2}{5}, \frac{1}{2}$

B. $\frac{2}{5}, \frac{1}{2}, \frac{3}{4}$

C. $\frac{1}{2}, \frac{2}{5}, \frac{3}{4}$

D. $\frac{3}{4}, \frac{1}{2}, \frac{2}{5}$

14. If n(A) = 25, n(B) = 35 and then n($A \cap B$) = 5. Find n ($A \cup B$).

    A. 60

    B. 50

    C. 55

    D. 45

15. If $K = \{3, 6, 9, 12, 15, 18\}, S = \{4, 8, 12, 16, 20\}$ and $T = \{2, 4, 6, 8, 10, 12, 14\}$. Find n($K \cap S \cap T$).

    A. 0

    B. 10

    C. 10

    D. 12

16. In class 4, a pupil wrote down the following as properties of odd numbers. Which of these is true. All odd numbers…….

    A. have only two factors 1 and the number itself.

    B. are not multiples of two.

    C. are divisible by whole numbers.

    D. are prime numbers.

17. There are 357 SHS 1 students at Wa Senior High School. The ratio of boy to girls is 7: 10. How many boys are in the class?

    A. 210

    B. 117

    C. 147

D. 107

18. Find the value of x if $3^{x-1} = 81$

A. 3

B. 4

C. 5

D. 6

19. If $x = y$ *and* $z > y$, which of the following must be **true**?

I. $x < z$ II. $x = z$ III. $x > z$

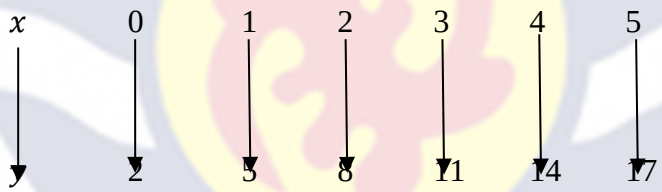
A. I only

B. II only

C. III only

D. I and II only

20. What is the rule of the mapping below?



A. $y = 2x + 2$

B. $y = 3x + 2$

C. $y = 2^x + 2$

D. $y = 3^x + 2$

APPENDIX C

RESEARCHER'S LETTER FOR DATA COLLECTION

UNIVERSITY OF CAPE COAST
INSTITUTIONAL REVIEW BOARD SECRETARIAT
TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/1214
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

17TH JANUARY, 2022

Mr. Francis Mwinlaanaa
Department of Mathematics and ICT Education
University of Cape Coast

Dear Mr. Mwinlaanaa,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2021/60)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research titled **Relationship between First Year Pre-Service Teachers' Self-Concept, Self-Efficacy, Achievement Motivation amd Mathematics Achievement.** This approval is valid from 17th January, 2022 to 16th January, 2023. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

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

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

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

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

APPENDIX D

ETHICAL CLEARANCE LETTER FROM UCC-IRB

McCoy College of Education,

Post office Box ND 12,

Nadowli-Upper West Region.

12th February, 2022.

The Principal,

College of Education A, B, C, D, and E

Dear Sir/Madam,

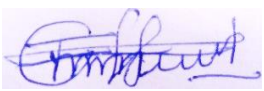
APPLICATION FOR PERMISSION TO INVOLVE LEVEL 100 STUDENTS IN A STUDY

I am Francis Mwinlaanaa, an MPhil Mathematics Education student (Level 850) with the UCC. I write to request for permission to involve first year student teachers of your noble institution to enable me conduct a study on the topic: "RELATIONSHIP BETWEEN FIRST YEAR PRE-SERVICE TEACHERS' SELF-CONCEPT, SELF-EFFICACY, ACHIEVEMENT MOTIVATION AND MATHEMATICS ACHIEVEMENT".

My research instruments have been approved by the university and I will also wish to comply with your institutional directives when granted permission to collect the data. Attached are other supporting documents for your perusal.

Thanks for your usual support.

Yours faithfully,



Francis Mwinlaanaa

Investigator

APPENDIX E

INTRODUCTORY LETTER FROM DEPARTMENT

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF MATHEMATICS AND I.C.T EDUCATION

Telephone: 0332096951
Telex: 2552, UCC, GH
Telegrams & Cables: University, Cape Coast
Email: dmicte@ucc.edu.gh

University Post Office
Cape Coast, Ghana

Your Ref:

Our Ref: DMICTE/P.3/V.3/043

Date: 8th November, 2021

TO WHOM IT MAY CONCERN:

Dear Sir/Madam,

RESEARCH VISIT

The bearer of this letter, **Mr Francis Mwinlaanaa,** with registration number ET/MDP/19/0007 is an MPhil. (Mathematics Education) student of the Department of Mathematics and ICT Education, College of Education Studies, University of Cape Coast.

As part of the requirements for the award of a master's degree, he is required to undertake a research visit at your outfit with the purpose of collecting data on the topic "**RELATIONSHIP BETWEEN FIRST YEAR PRE-SERVICE TEACHERS' SELF-CONCEPT, SELF-EFFICACY, ACHIEVEMENT MOTIVATION AND MATHEMATICS ACHIEVEMENT**".

I would be grateful if you could give him the necessary assistance he may need.

Thank you for your usual support.

Yours faithfully,

Dr (Mrs) Christina Boateng
HEAD