UNIVERSITY OF CAPE COAST

# RELATIONSHIP BETWEEN FIRST YEAR STUDENTS' SELF-CONCEPT, INTRINSIC MOTIVATION AND MATHEMATICS ACHIEVEMENT

MOHAMMED NURUDEEN ALHASSAN

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BY

MOHAMMED NURUDEEN ALHASSAN

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## DECLARATION

### Candidate's Declaration

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

Candidate's Signature…………......................... Date……………….......

Name: Mohammed Nurudeen Alhassan

### Supervisors' Declaration

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

Principal Supervisor' Signature……………….......... Date…………………….....

Name: Dr. Jonathan A. Fletcher

Co-Supervisor's Signature…………………............. Date ……………………

Name: Mr. Alexander Asare-Inkoom

## ABSTRACT

The relatively low achievement of students in mathematics has been of concern to many parents and educators for some time now. Most research concentrated more on the cognitive factors, while the affective factors are ignored. Regrettably in Ghana, little attention is paid to the effect that students' self-concept and intrinsic motivation have on mathematics achievement. Questionnaires were administered to a convenience sample of 89 students together with the end of first semester results were used for the study. The correlation study design was used to study the relationship between first year students' self-concept, intrinsic motivation and mathematics achievement and further sought to determine the extent to which students' mathematics achievement could be predicted from their self-concept and intrinsic motivation

The study identified a strong positive correlation between self-concept and intrinsic motivation; a moderate positive relationship between students' mathematics achievement and self-concept; as well as a moderate positive correlation between mathematics achievement and intrinsic motivation. Although, both self-concept and intrinsic motivation are related to mathematics achievement, it is only intrinsic motivation which is able to predict mathematics achievement. This research has therefore highlighted the need to pay attention to the impact that self-concept and intrinsic motivation have on students' mathematics achievement. Lectures concerned in teaching Algebra and Trigonometry should make every effort to design and implement teaching strategies that foster the development of students' self-concept and intrinsic motivation.

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# DEDICATION

To My Family

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# CHAPTER ONE

## INTRODUCTION

This chapter introduces the thesis and it contains statement of the problem, its purpose, research questions, significance of the study, delimitations and limitations. It also defines key concepts used in the study.

### Background to the Study

Governments have emphasised mathematics education as the basis for modern scientific and technological developments and an important means of communication (Cockcroft, 1982). The language of modern science and technology development is through the usage of mathematics. The concept of communicating signals to various destinations hinges on coding the signals using mathematics.

The world of work depends heavily on calculation and precision, the success in mathematics provides the possibility of success in life (Ministry of Education, Science and Sports [MoESS], 2003). An average understanding of mathematics is considered basic to daily life and is applied in business, engineering, the physical, computer and social sciences and fine arts. This might be the reason why the Ministry of Education, Science and Sports and the Ghana Education Service put a great deal of premium on students to succeed in life by making mathematics compulsory. Mathematics is one of the basic requirements for progression from the basic level to senior high schools and from the latter to the University.

Despite its importance, students continue to perform poorly in the subject in national and international examinations. The West African Examination Council (2006) showed that 15.53% of 18,673 passed with aggregate A1-C4. Similarly, for elective mathematics, 30.29% of the 9,776 students who sat for the examination passed with grades A1-C4. Ghana participated in Trends in International Mathematics and Science Study (TIMSS) and placed second to last in both instances. Out of the 44 countries that participated in 2003, Ghana's eighth graders were placed 43rd beating only South Africa (TIMSS, 2003). Also in 2007, Ghanaian eighth graders were 46th out of 47 countries (TIMSS, 2007). The reasons for the poor performance are attributed to poorly-resourced schools; large classes; a curriculum hardly relevant to the daily lives of students; lack of qualified teachers; inadequate teacher education programmes; no grips of content knowledge and inability to apply basic mathematical principles by students, (Ottevanger, Akker, & de Feiter , 2007; TIMSS, 2003 & 2007). Other reasons are inadequate knowledge of subject matter, non-adherence to rubrics, misinterpretation of questions, unfavourable conditions of service of the teacher which affect teacher preparation, teacher quality and its accompanied impact on students, ineffective supervision of instruction (WAEC, 2006; Etsey, 2005, Agyeman, 1993; Neagley, & Evans, 1970).

Although these reasons are valid, one cannot be certain whether other equally important variables are not responsible for this state of affairs. Research indicates that self-concept and intrinsic motivation can contribute to students' achievement or under achievement (Hamachek, 1995), but this is not mention in the above reasons attributable to the students' poor performance in mathematics.

Self-concept in mathematics, which is the accumulation of knowledge about the self in mathematics, such as beliefs regarding interests, abilities, values and goals becomes more abstract and complex, and hierarchically organized into cognitive representations which direct the processing of information in mathematics (Byrne, 1996a). If the majority of the students are failing, is it a reflection of their low self-concept in mathematics?

Motivated students tend to engage in school, initiate action when given the opportunity and exert effort when implementing learning task. Motivated students appear to be propelled by an increased curiosity, driven by a need to explore, interact with environment and to make sense of it. Motivation is in two forms: extrinsic and intrinsic motivation. Extrinsic motivation is seen to be driven by external forces such as rewards, praises and approval by peers, which can end in the absence of a reward or a gift. Intrinsic motivation that internally drives a person to engage in an activity for the sake of enjoyment or its value can last in a person for life. Intrinsically motivated students take on tasks because they find it interesting and enjoyable. They can generate their own activities and construct their own knowledge.

Dambudzo (2009) states that over the past couple of decades society has placed infinitely more emphasis on the academic achievement of its citizens, especially in mathematics. Students' academic achievement is an important indicator of academic success at university level. Students with higher levels of achievement at university are more likely to secure good employment and salaries. Academic achievement is important because it promotes success later in life (Areepattamannil & Freeman 2008). Mathematics achievement is about what a person has attained in mathematics over a period. Several factors are responsible for success in mathematics. Teachers' mastery of the subject matter, use of appropriate pedagogy, readiness of students to learn, motivation and self-concept among several others could associate with mathematics achievement. Sikhwari (2004) advocated for affective factors to receive attention in academic investigation and endeavours. Variance in academic achievement can be related to affective variables, of which self-concept and intrinsic motivation are the most important (Van der Lith, 1991). Areepattamannil and Freeman (2008) concur with Van der Lith when they stated that academic self-concept and academic motivation have the most potential of being directly influence by classroom teachers, and should be of primary concern. In view of this, the current research looked at self-concept and intrinsic motivation in a survey to investigate whether the mathematics achievement could be attributed to these two factors. From the foregoing, provides enough justification to investigate whether self-concept and intrinsic motivation could be responsible for students' poor mathematics achievement.

## Statement of the Problem

The relatively low achievement of students in mathematics has been of concern to many parents and educators for some time now. Educators have attributed this largely to inadequate knowledge of subject matter, misinterpretation of questions, teacher quality and ineffective supervision of instruction and the abstract nature a section of teachers teach the subject to the students. Most research that has been done on factors that influence academic achievement concentrate more on the cognitive factors, while the affective factors are ignored (Sikhwari, 2004). Again, the reasons attributed to this failure, failed to consider the possibility that, students' perceptions and the motives that engage them can influence positively or negatively on mathematics achievement and education in general.

Regrettably, in Ghana, little or no attention is given to the possibility that student self-concept of herself or himself in mathematics and intrinsic motivation to study mathematics can affect her or his performance. A vacuum therefore exist in our understanding of the possible role of the human attributes (self-concept and intrinsic motivation) on students' mathematics achievement.

A paper presented at the Vice Chancellors' conference in 2004 by Anamuah-Mensah and Mereku, suggested the need to carry out research to identify the dimensions of the low performance by Ghanaian students. This research studied the relationships among First Year University of Cape Coast B.ED (Mathematics) students' self-concept, intrinsic motivation and mathematics achievement, which provided one of such dimensions.

## Purpose of the Study

The research examined the relationship that exists between students' self-concept (SC), intrinsic motivation (IMOT) and mathematics achievement (MA) of first year B. Ed (Mathematics) students at the University of Cape Coast and whether students' mathematics achievement could be predicted from their self-concept and intrinsic motivation.

## Research Questions

Research questions that guided the investigation were:

1. Does students' self-concept correlate with their intrinsic motivation towards the study of mathematics?
2. Does students' self-concept correlate with their mathematics achievement?
3. Does students' intrinsic motivation correlate with their mathematics achievement?
4. To what extent is, first year students' self-concept and intrinsic motivation affect their mathematics achievement?

## Significance of the Study

Research has tended to focus on how to establish a causal relationship or ordering of the three constructs in mathematics, but there has been little research on the extent to which students' self-concept and intrinsic motivation affect their mathematics achievement. The present study examined such an issue with the aim of providing a sense of direction and to open up new opportunities for teachers of mathematics to plan towards the enhancement of students' self-concept and intrinsic motivation alongside the planning, delivery and teaching of mathematics lessons.

## Delimitation of the Study

For the purpose of this research, only first year B.ED (Mathematics) students are used. The multidimensional nature of self-concept and intrinsic motivation would not permit me to use all the dimensions due to constraints placed by resources, materials and the need to make the questionnaire handy, and easy to answer. In this regard, Marsh's intra-individual and social comparison dimensions measured self-concept. Interest, perceived competence, effort, pressure, and usefulness of the Intrinsic Motivation Inventory were used to measure intrinsic motivation.

## Limitations of the Study

There were many advantages of using different locations for conducting research. One limitation of the study was that, the data was collected from the University of Cape Coast, hence the findings was limited to first year students majoring mathematics in the Department of Science and Mathematics Education. The second limitation was that, the respondents were conveniently selected and it is to this group to which generalisation could be made. Another limitation of the study was that only first year B. Ed. (Mathematics Education) students in Department of Science and Mathematics Education were used for the study. The final limitation was that, during the administering of the questionnaire the lecturer started to dictate tutorial questions to students, which interrupted the last 10 minutes of administering the questionnaire, and may have contributed to some students inability to complete the questionnaire.

## Definition of Terms

### Self-concept

In this study, it is referred to students' mathematics self-concept (i.e. self-concept for short) and operationally defined, as students' self-perceived disposition of her or his ability, within the person and in comparison with her or his peers in pursuit of excellence in the study of mathematics.

### Intrinsic Motivation

In recent studies, some researchers have defined intrinsic motivation in different ways. Ryan and Deci (2000) defined it as the performance of a task for the inherent satisfaction it brings to an individual rather than for some separate consequence. It is operationally define as students' readiness to engage in an activity for the share joy and satisfaction she or he gets, rather than any external influence or gain.

**Mathematics Achievement**

Academic achievement is defined as that which is accomplished by the actual execution of class work in the school setting. It is typically assess by the use of teacher ratings, tests, and exams. In this research mathematics achievement is a person's end of first semester examination score in Algebra and Trigonometry course in the first year for the 2010/2011 academic year.

## Organisation of the Rest of the Study

The rest of the study was organised as follows. Chapter 2 outlined a review of related literature on self-concept, intrinsic motivation and students' Mathematics achievement. Chapter 3 described the methodology of the study. This included research design, population, sample and sampling procedure and the instrument used in the study. The results and discussion of the research are presented in Chapter 4. Chapter 5 looked at the summary, conclusions and recommendations of the study.

# CHAPTER TWO

## REVIEW OF RELATED LITERATURE

This chapter presents a review of related literature in the areas related to the three constructs, namely self concept, intrinsic motivation and mathematics achievement. The first section discusses the literature on students' self-concept in mathematics. The second section reviews literature on intrinsic motivation of students in the study of mathematics. The final section looks at the related literature on students' mathematics achievement.

### Theoretical Framework for the Research

The theoretical framework clarifies the important concepts in this study. A theoretical framework suggests my assumptions and beliefs about possible variables and paths to conduct the research. Sekaran (as cited in Radhakrishna, Yoder & Ewing, 2007) mentioned that a theoretical framework is a conceptual model of how one theorizes or makes logical sense of the relationships among several factors that have been identified as important to the problem. It determines which questions and statements are to be answered by the research, and how empirical procedures are to be used as tools to answer these questions or verify the statements (De Vos, Strydom, Fouche & Delport 2005). Radhakrishna, Yoder and Ewing further indicated that, a theoretical framework integrates key pieces of information, especially variables, in a logical manner, and to conceptualize a problem that can be tested.

The three concepts that will be discussed and placed into context in this study are self-concept, intrinsic motivation and mathematics achievement.

Psychologists in education have long been interested in relationships, especially causal relationships, between psychological variables and academic achievement. Because of this interest, explicit linkages between important psychological variables such as attributions, expectancies, self-perceptions, motivational orientations and academic achievement has being identified, through a variety of research designs in a wide range of educational contexts. Several important theories have arisen from investigations of these linkages and relationships. These include Attribution Theory (Weiner, 1986), Expectancy Value Theory (Eccles, 1983), Self-Efficacy Theory (Bandura, 1997), Self-Concept Theory (Marsh, 1993), and Goal Theory (Ames, 1992). As these theories are formulated aspects of each have been researched into, including their explanatory ability with respect to academic achievement (Schunk, 1981; Bandura, 1986; and Zimmerman, 1989).

Notwithstanding these important advances, no single possibility within educational psychology appears to provide a definitively better account for academic achievement than other theories. Academic achievement remains difficult to explain, and even more arduous to predict, no matter the theoretical position one adopts (Dowson, Barker & McInerney, 2004).

For these reasons, there still appear to be substantial scope for the refinement of theoretical approaches to academic achievement from a psychological perspective. Three all-encompassing possibilities are implicated: (a) to continue to digest and fine-tune existing theories, (b) to propose and explore new theories, (c) to explore potential combinations of old and new theories (Dowson, Barker & McInerney, 2004). In this study, I explored the third option.

Cross-theoretical studies in educational psychology are becoming increasingly common, and there is some evidence from these studies that cross-theoretical approaches may provide additional insight explanations of academic achievement (Schell, Bruning & Colvin, as cited in Dowson, Barker & McInerney, 2004). For the purpose of this research a combination of the variables (self-concept and intrinsic motivation) were adopted to explore their effect on mathematics achievement.

A conceptual framework of the relationship between self-concept and intrinsic motivation on mathematics achievement (Figure 1) was proposed and used to examine the data in the study.

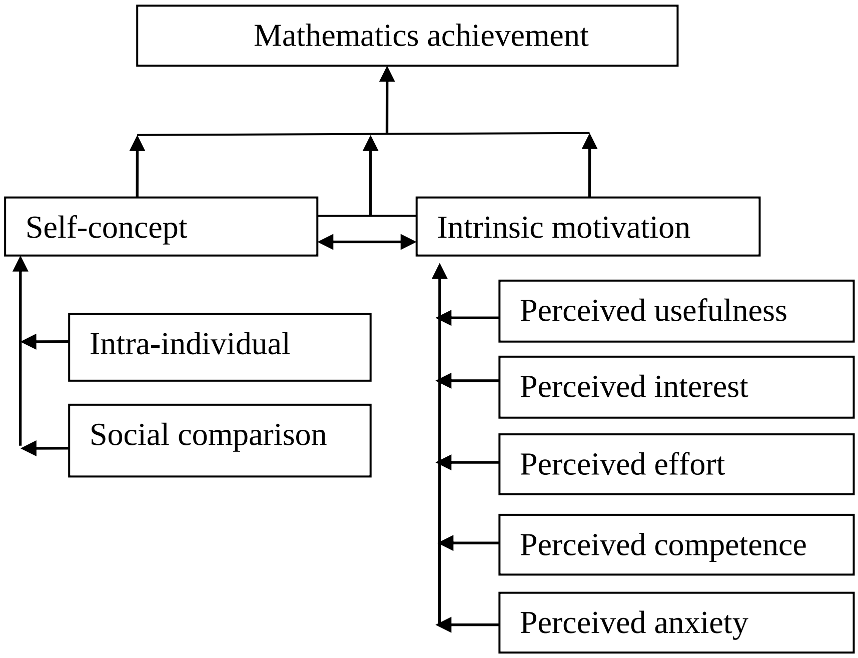


**Figure 1.** A conceptual framework for the research.

The top of the model is mathematics achievement with two main proposed branches, namely self-concept and intrinsic motivation. The first sub-category: Self-concept was further divided into two sub-categories, which consisted of intra- individual comparison and social comparison. The second sub-category: Intrinsic motivation was theoretically anticipated to have five sub-categories stated as perceived usefulness, interest, competence, effort and anxiety. It can be seen in (Figure 1) that, it a broad base and narrowed upwards to determine the relationships and to the extent to which mathematics achievement can be predicted from students' self-concept and intrinsic motivation.

## Self-concept

Olatunde (2010) stated that ‘‘Self-concept has long been a theme in education indicating that a student needs a good academic self-concept in order to be successful academically’’ (p. 129). A review of the literature shows no clear and all embracing definition of the term self-concept. However, Marsh (1990) defined self-concept as the learner's beliefs about her or his personal skills, ability, reasoning ability, enjoyment and interest in a subject.

According to Bong and Skaalvik (2003), self-concept is what people think of themselves based on their experiences and abilities. It is one's self-image. Self-concept is a complex view of oneself. Academic self-concept refers to individuals' knowledge and perceptions about themselves in achievement situations. A study by Guay, Marsh, and Boivin (2003) stated that as children become older, the rating of academic self-concept becomes more reliable and more stable. This claim is base on developmental and psychological theory suggesting that, as children become older, they have an increased awareness of themselves and the world around them. Consequently, the views shared by first year students mathematics self-concept and intrinsic motivation would reliably be measured in this study.

Academic self-concept is considered an important component of academic motivation research (Cokley, 2003, 2007). Klobal and Musek (as cited in Baadjies, 2008) described self-concept as ‘‘an individual’s perceptions of herself or himself; it is a psychological entity and includes one’s feelings, evaluations and attitudes, as well as descriptive categories’’ (p. 2). Thus, self-concept is a cognitive generalization about the ‘self’, which mostly includes self-descriptions of neutral values. Self-concept, according to Cokley (2000), also encompassed a comparative component in which students assessed their academic attitudes and skills in comparison with other students. Academic self-concept has been linked strongly to academic achievement (Marsh, 1990). Recently, Cokley (2007) in the context of education has considered academic self-concept as an important psychological construct because it is able to bring about changes in academic achievement. This notion is of particular interest to this research to determine the extent to which self-concept affects mathematics achievement.

Reyes (1984) refers to the terms mathematics confidence and mathematics self-concept synonymously. Felson (1984) used academic self-concept as self-perceptions of ability, suggesting that the reason why self-percept affected performance was because of its effect on students' effort, persistence, and anxiety. Another view was self-concept of ability, defined as individuals' ratings of her or his ability in academic areas, usually referred to as generalized academic self-efficacy (Bachman & O'Malley, 1986; Feather, 1988).

Mwamwenda (1995) regards self-concept as “a person’s way of perceiving himself, which may be either positive or negative” (p.365). How a person perceives herself or himself is a function of her or his perception of herself or himself independently of others and the interpretation of how a person is perceived by others. According to Very (1979), the self-concept refers to “a configuration of convictions concerning oneself and attitudes toward oneself that is dynamic and of which one is normally aware or may become aware” (p. 47). Gouws and Kruger (1994) regard the self-concept as “the concept or image a person has of herself or himself and is unique, personal and highly meaningful to the person concerned” (p. 6).

The development of self-concept starts from childhood through to adulthood. As a result of a person’s interaction with her or his environment, which includes her or his peers, parents, teachers and the various tasks and responsibilities she or he is assigned and the way in which the person copes with them (Mwamwenda, 1995). Whether a person develops, a positive or negative self-concept depends on how he is treated and how he perceives such treatment.

According to Shavelson (as cited in Bracken, 1996), “self-concept is not an entity within the person, but a hypothetical construct that is potentially useful in explaining and predicting how a person acts” (p. 58). A reciprocal relationship exists between a person’s self-perception and the way that person acts (Bracken, 1996).

Research findings consistently show that mathematics self-concept is related to mathematics performance (Marsh, Walker & Debus, 1991). Marsh, Walker, and Debus compared the direct effect of achievement on the mathematics self-concept and self-efficacy of fifth graders and reported a stronger direct effect on self-concept than on self-efficacy. Relich, (as cited in Marsh, 1990) assessed mathematics self-concept, mathematics achievement, performance on a division task, and self-efficacy for the division task. Achievement correlated equally strongly with self-efficacy (globally assessed) and self-concept. Specific performance on the division task was, more strongly correlated with specifically assessed self-efficacy than with mathematics self-concept. These results provide support for the task-specific nature of self-efficacy measurement. However, the effect of subject specific self-concept on mathematics achievement remains scarce. Other findings are contradictory.

Norwich (1987) found that self-concept did not relate to self-efficacy when students were either familiar or unfamiliar with a task. Marsh, Walker and Debus (1991) compared the mathematics self-concept and self-efficacy of elementary school students and reported correlations as low as .18.

Unfortunately, self-concept has not received a significant amount of attention in the study of First Year University of Cape Coast (UCC) students' academic outcomes. Therefore, research on the self-concept of First Year UCC students' remains scarce.

**Dimensions of Self-concept**

The mathematics and verbal self-concepts have been virtually uncorrelated within a multidimensional framework of academic self-concept (Marsh, 1986). An adolescent's mathematics self-concept can differ significantly from his or her verbal self-concept; therefore, a high mathematics academic self-concept does not necessarily predict a high verbal academic self-concept. This finding was in contrast to the Shavelson model. As a better alternative, Marsh (1986, 1990) developed the Internal (I) and External (E) frames of reference model (I/E model) to explain the difference between virtually uncorrelated mathematics and verbal academic self-concept scores. The two frames of reference work in opposition to each other and this explains why mathematics and English self-concept are often uncorrelated with each other.

When describing self, one may use the words "I'' and "me." Naturally, the "I" and "me" perspectives of self have played important roles in self-concept identification (Mead, 1913). While the "I" perspective portrays the self as a doer and the "me" standpoint is needed to gain an understanding of self as object (James, 1890). Martin and Debus (1998) stated that, "Individuals are capable of forming biased (optimistic or pessimistic) appraisals of their competence" (p. 518). To avoid this, people should aspire to have accurate description of their self-concept and realistic views of her or his competence level; as such, persons with accurate self-concepts have realistic views of their competence levels (Sze & Valentin, 2007). The indicators of self-concept from the doer and object aspects can help measure out the information from different viewpoints, and thus, avoid potential mistakes using a single indicator from one perspective (Bennett & Sani, 2004; Breckler & Greenwald, 1986; Greenwald, 1982).

Marsh (1990) suggested a two-point framework to guide the analyses of self-concept: First, the intra-individual comparisons (internal frame of reference), in which students compare their own achievements in one subject with their achievements in other subjects; and second, the social comparisons (external frame of reference), in which students compare their own achievements with those of their classmates. The internal and external frames align with the identification of self-concept from the doer and object aspects in this investigation.

**Intra-individual comparison.** With the internal frame of reference, students evaluate their own performance in any particular school subject in relation to their performance in other subjects. The individual, in reference to her or his ability in all other school subjects, creates a hierarchy of self-concept. The doer concept of intra-individual comparison postulates that, students assess how good they are at a subject. Wilkins (2004) employed ‘I usually do well in mathematics’ (p. 9), taken from TIMSS (2003) to indicate self-concept. Based on the operative definition of mathematics self-concept, the statement *I usually do well in mathematics* represents a reasonable measure (Wilkins, 2004).

**Social comparison.** The external frame of reference on the other hand, allows students to compare their self-perceived performance in any particular school subject with the perceived performance of other students in the same school. This external reference serves as a basis for students' mathematics and verbal self-concepts. For example, if a student's verbal achievement is higher than her or his classmates' achievement, then her or his verbal self-concept tends to be higher as well. Because achievements in mathematics and verbal school subjects are positively correlated, social comparisons lead to the expectation that domain-specific mathematics and verbal self-concepts are positively correlated as well (Leondari & Gialamas, 2002; Li, Lee, & Solmon, 2005; Marsh, 1990).

The external frame of reference enriches the self-concept configuration by giving the students the opportunity to compare her or his achievement with others. As Walshaw (2007) has pointed out, identity is socially constructed. An individual impression of self-strength could develop her or his academic self-concept externally through a comparison with their classmates. In the present study, students had a chance to rank their acceptance of statements like, *my friends are not better than me in mathematics*. This external comparison can portray self-concept from an object perspective, reflecting the relative difficulty students endure from mathematics learning. However, Marsh (1984); and Marsh and Parker (1984) added a slight dimension to this model known as the "Big-Fish-Little-Pond-Effect" (BFLPE) to encapsulate frame-of-reference effects posited in social comparison theory (Diener & Fujita, 1997; Festinger, 1954).

This BFLPE model derives its theoretical basis from research in psychophysical judgment, social judgment, sociology, social comparison theory, and the theory of relative deprivation. Marsh (1984) hypothesized that individuals compare their abilities with those of their classmates and use this social comparison impression as one basis for forming their own self-concept. Marsh however said the BFLPE occurs when equally good students have lower self-concepts when they compare themselves to much better students and higher self-concepts when they compare themselves with less able students. To make things clearer for example, Mash stated that if an average-ability student is in a class of highly able students, his or her academic abilities would be lower than the average of the other students in this class, and this discrepancy would lead to an academic self-concept that is below average.

Conversely, Mash said if the student is in a class of less able students, then her or his academic ability would be above the average of the other students in the class, and that difference would lead to an academic self-concept that is above average.

In accordance with the BFLPE model, Marsh (1984) posited that academic self-concept correlated positively with individual achievement (i.e. more able students had a higher self-concept), but negatively related to class-average achievement (i.e. the same student had a lower academic self-concept when class-average ability is high).

The BFLPE is domain specific, supporting the multidimensional perspective of self-concept rather than a one-dimensional approach that focuses exclusively on global self-concept or self-esteem. The BFLPE in traditional academic settings — the negative effect of school-average or class-average achievement measures — was specific to academic self-concept. Marsh and Parker (1984) showed that there were large negative BFLPEs for academic self-concept, but little or no BFLPEs on general self-concept or self-esteem. Marsh, Chessor, Craven, and Roche (1995) reported two studies of the effects of participation in gifted and talented academic programmes on different components of self-concept over time and in relation to a matched comparison group. There was clear evidence for negative BFLPEs in that academic self-concept in the gifted and talented programmes declined over time and in relation to control groups, but effects were small or no significant for non-academic components of self-concept and global self-esteem.

Marsh, Koller, and Baumert (2001) compared the size of the negative BFLPE on the academic self-concepts of East and West German students after the fall of the Berlin Wall. Prior to the reunification, West German students had attended segregated schools largely based on their academic ability whereas East German students attended unsegregated schools in which there were mixed ability levels. When selective schooling was first, introduced, the BFLPE for East German students at the start of the school year was not nearly as large as it was for West German students (who had already been in ability-grouped schools for the two previous years). The size of the BFLPE was larger for East German students by the middle of the school year, and did not differ from the West German schools by the end of the first school year following the reunification. This suggests that the BFLPE does not occur immediately but takes some time to take effect.

Other researchers: Marsh, Hau and Craven (2004) presented results from a large cross-cultural study (conducted by the Organisation for Economic Cooperation and Development) consisting of nationally representative samples of approximately 4,000 fifteen-year olds from 26 countries (total N = 103,558), who completed the same self-concept instrument and achievement tests. The effects of school-average achievement on academic self-concept were negative in all 26 countries and, consistent with previous research, the size of the BFLPE did not vary with the students' initial ability levels. Taken together, the research evidence suggested that the BFLPE is very robust, which could generalised across educational settings.

In summary, self-as-doer and self-as-object are 2 interrelated components that surface in the historical literature (James, 1890) and Marsh's (1990) internal and external framework. The doer indicator is based on past analyses of research data and the object indicator further incorporates an external social comparison to facilitate the self-appraisal in this study. The BFLPE occurs when able students have low self-concept when they begin to compare themselves with less able students in the social comparison model.

## Motivation

Spinath and Steinmayr (2007) declared that perhaps more than anything else, to be well equipped for life-long learning, individuals needed a high, sustained motivation to learn. This is an admission of how important motivation is to learning. Students, who arrived at university for the first time, exhibited newfound freedom. It is at this time that the students' academic motivations largely dictated the choices that they made, and whether or not they met the different standards and expectations that is required of them (Clark & Schroth 2010). Schick and Phillipson (2009) stated that there exists a consensus that motivation promotes academic performance in students. It seemed therefore, that motivation contributed to the variance in academic achievement**.**

Motivation refers to "a student's willingness, need, desire and compulsion to participate in, and be successful in the learning process" (Bomia, Beluzo, Demeester, Elander, Johnson, & Sheldon, 1997, p. 1). Middleton and Spanias (1999) viewed motivation as reasons individuals have for behaving in a given situation.  Mwamwenda (1995) defines motivation as "an energiser or a driven force, a desire or an urge that causes an individual to engage in certain behaviours" (p. 259). Comprehensively defined by Ames (1992) as part of one's goal structures, one's beliefs about what is important and determines whether one will engage in a given pursuit. Motivation is the attribute that moves us to do or not to do something (Gredler, 2001). Skinner and Belmont (1991) explained that students who are motivated to engage in school "select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest" (p. 3).

Motivation, described as a process through which individuals whip up and sustain interest in an activity. Other researchers viewed motivation as a process through which an individual's needs and desires are set in motion (Alexander & Murphy, 1998; Pintrich, Marx & Boyle, 1993). Academic motivation reflects students' levels of persistence, interest in the subject matter, and academic effort (DiPerna & Elliot, 1999); it plays a major role in academic success (Alexander, 2006; Ames & Ames, 1985; Dweck & Legget, 1988; Wylie, 1989). While motivation is critically important to student learning (Pintrich & Schunk, 2002), lack of motivation is a frequent problem with students at all levels. To be actively involved in an activity requires something to hook you onto it, motivation has that magnet that can attract and maintain the interest of an individual in the activity. This attraction can be internal or external, depending on the underlining factor(s).

People take up things or do some things simply because it interests them or because they think it is good or enjoyable. Their concern is not about what they will get out of it, but because of sheer satisfaction and joy experienced in the activity. If learners are motivated to attain a given goal, this goal directed their activities in the direction of achieving the goal. They experienced pleasure in doing the activity. They tend to develop inner satisfaction, confidence and are successful. For instance, a person interested in dance, rehearses for hours not because she or he wants to win some competition, but just for the pure joy of dancing. A student could be studying hard not to get excellent grades, but because she or he is interested in the subject. In such a case, even if the student fails or gets less mark she or he continues to study that subject and takes failures as learning lessons. On the other hand, if a student had studied in order to gain recognition among her or his peers, then the underlining factor is an external force.

The literature on motivation in education and social situations in general has focused on intrinsic and extrinsic motivation with a great deal of debate (Sansone "& Harackiewicz, 2000). Extrinsic motivation, such as rewards, can have an undermining effect and decrease intrinsic motivation. Yet both intrinsic and extrinsic motivations are key features of students' participation in mathematics classrooms. Both have also appeared to be mutually perpendicular field of inquiry to the development and instruction of content, with motivation hesitantly intersecting with education in the form of students' incentives to learn mathematics because it is fun, applicable and useful to their life, through relevant contexts, e.g. sports or vocations. Students can become motivated because they want to participate more fully in what is offered in their classrooms at any point in time.

One specific aspect of motivation is intrinsic motivation. Intrinsic motivation appears to combine elements of Weiner's (1974; 1980; 1986) attribution theory, Bandura's (1977; 1993) work on self-efficacy, and other studies related to goal orientation (Pintrich, 2001). Important to the present study is the fact that intrinsic motivation can be influenced within the educational context (Deci & Ryan, 2004).

Intrinsic motivation increases when individuals attribute educational results to internal factors they can control (attribution theory) (Weiner, 1980). Intrinsic motivation is believed to increase when individuals believe they are capable of reaching desired goals (self-efficacy) (Bandura, 1977; Lent, Brown & Larkin, 1986; Marsh, Walker, & Debus, 1991). Intrinsic motivation is also said to increase when individuals are interested in mastering a subject, rather than simply earning good grades (goal orientation) (Dweck, 1986; Nicholls, 1984). Research has also shown that when these factors converge can result in high levels of intrinsic motivation and subsequently result in successful learning (Alexander, 2006).

**Theoretical Framework of Motivation**

Some researchers have used motivational approaches, such as expectancy-value theory (Berndt & Miller, 1990), goal theory (Meece & Holt, 1993), and self-efficacy theory (e.g., Zimmerman, Bandura, & Martinez-Pons, 1992) to examine the relationship between academic motivation and academic achievement. Another perspective that appears promising and pertinent for the study of academic achievement is Deci and Ryan's (1985, 1991 & 2000) motivational approach: the Self-Determination Theory (SDT). This theoretical perspective has generated a considerable amount of research in the field of education (Deci, Vallerand, Pelletier & Ryan, 1991). For this reason, the SDT is adopted in my research.

**Self-determination theory perspective**. According to Ryan, Kuhl and Deci (as cited in Areepattamannil and Freeman 2008), the self-determination theory is an approach to human motivation that highlights the importance of the psychological need for autonomy. Autonomy implies that individuals experience choice in the initiation, maintenance, and regulation of their behaviours (Deci & Ryan, 1985, 2000). Central to the theory is the distinction between autonomous and controlled motivation. Autonomous motivation involves acting with a full sense of volition and choice, and it encompasses both intrinsic motivation and well-internalized or integrated extrinsic motivation (Deci & Ryan, 1985, 2000). To choose to engage in an activity rather than being required to perform it in order to satisfy the expectations or demands of others, there is an implication that the person would rather be doing this activity, rather than other activities she or he could equally be doing at the time.

Controlled motivation, in contrast, involves acting with a sense of pressure or demand and includes regulation by external contingencies and by contingencies that are partially attributable to success, for example to gain admission to pursue an engineering course, one has to pass with a good grade in mathematics. This could be motivating enough to study mathematics.

**Extrinsic and Intrinsic Motivation**

In this research, two types of motivation are considered. That is the extrinsic and intrinsic motivation.

**Extrinsic motivation.** Extrinsic motivation refers to the inspiration that depends on external reward to initiate actions towards a set goal. A student who is extrinsically motivated, studies because she or he wants good grades, marks, praise or recognition. Here, the joy for studying the subject does not matter. The goal of the student is to get good grades, marks, praise or recognition, and she or he works hard even if she or he hates the subject. People with extrinsic motivation are goal oriented; they hardly pay attention to their happiness and personal development. Achievement of their goal or target might be their only aim, which may give them joy. Extrinsic motivation is subject to change and variation with value of the reward. Such a person is de-motivated easily when the reward is absent. A bigger reward may call for greater engagement than a smaller reward.

**Intrinsic motivation.** Intrinsic motivation reflects the propensity and eagerness of a person to engage in activities that interest her or him. It is also defined as the performance of a task for the inherent satisfaction it brings to an individual rather than for some separate consequence (Ryan & Deci, 2000). Nolen and Nicholls (1993) conceptually defined intrinsic motivation as the internal drive to engage or perform an activity. Intrinsic motivation is a process of arousal and satisfaction in which the rewards come from carrying out an activity rather than from the result of the activity. Development of academic intrinsic motivation in young children is an important goal for educators because of its inherent importance for future motivation, as well as for children's effective school functioning (Gottfried, 1990). This justifies the need to consider intrinsic motivation in this research among adult learners.

Intrinsic motivation in educational psychology literature is described in terms of three interconnected elements among students. These are special drive to tackle more challenging tasks; as learning, driven by curiosity or special interests; as a development of competence; and mastery of learning tasks in which learning is seen as valuable in itself (Eccles, Wigfield, & Schiefele, 1998; Pintrich & Schunk, 1996; Stipek, 1998). Students who demonstrate signs of internal driver towards activities, show signs of competence and place more value on learning activities are more likely to be intrinsically motivated than students who do not show these signs.

***The nature of intrinsically motivated student.*** Intrinsic motivation in respect of university courses would be reflected in the active involvement in the course, the enjoyment of the lectures, the classes, and the readings, and an intrinsic interest in the course material (Harackiewicz, Barron & Elliot, 1998). Harackiewicz, Barron, and Elliot (1998) further declared that intrinsically motivated students love learning, and their questions to their instructors were more likely to concern the material itself, than what is covered in the exam. That means students who are intrinsically motivated study not only to pass their exams, but also gain knowledge for its sake.

Students with a profound cognitive need to obtain knowledge and understand their environment, or with a positive sense of respect for themselves and what they are doing, are intrinsically motivated (Crous, Roets, Dicker and Sonnekus 2000). In a study done by Clark and Schroth (2010), they examined the relationship between personality and academic motivation in 451 first year college students. They found that those students who were intrinsically motivated to attend college tended to be extroverted, agreeable, conscientious, and open to new experiences. Crous, Roets, Dicker and Sonnekus (2000), together with Harter and Connell (as cited in Pintrich & Schunk, 2002) outline the following as characteristics of students who are intrinsically motivated. They showed signs of:

1. Preference to challenging rather than easy task;

2. Working to satisfy their own interest and curiosity, rather than working to please their teacher and obtain good grades;
3. Independence rather than dependence on the teacher;
4. Independent rather reliance on the teacher's judgement;
5. Internal criteria for success and failure rather than external criteria;
6. A desire for inner enrichment;
7. Goal-orientation;
8. Anticipation or expectation that an objective will be met;
9. Concentration on the learning task;
10. Persistence and practice;
11. Interest in the object or theme;
12. Viewing learning as a meaningful activity;
13. Intellectual curiosity or inquisitiveness;
14. Ability not to perceive unsuccessful first attempts as failures, and the will to make repeated attempts.

It can be deduced from the characteristics that, any student who exhibited such characteristics can be said to be highly intrinsically motivated and very likely to succeed in the study of mathematics.

***Predictor variables of intrinsic motivation.*** According to Spinath and Steinmayr (2007), intrinsic task-values denote the degree of positive affective evaluation of an activity that included liking, enjoyment, for reasons that lie within the activity itself, rather than its consequences. They furthermore indicated that intrinsic task-values were not the only reason for learning, task enjoyment can be considered as the most desirable state for learners, because learning comes as a by-product of engaging in a pleasurable activity.

Intrinsically motivated behaviors, which are performed out of interest, satisfy the innate psychological needs for competence and autonomy, and are the prototype of self-determined behavior (Ryan and Deci 2000). Deci and Ryan (as cited in Mnyandu 2001) viewed the need for self-determined behavior as an important motivator inherent in intrinsic motivation that closely intertwined with the need for competence.

Intrinsic motivation in respect of university courses is reflected in the active involvement in the course, the enjoyment of the lectures, the classes, and the readings, and an intrinsic interest in the course material (Harackiewicz, Barron & Elliot, 1998). Also, they declared that intrinsically motivated students love learning, and their questions to their instructors are more likely to concern the material itself, than what will be covered in the exam.

In accordance with IMI as mentioned under instrument in Chapter 1: perceived Interest, perceived competence, perceived anxiety, perceived usefulness and perceived effort were considered as predictor variables of intrinsic motivation.

*Perceived interest.* According to cognitive-evaluation and self-determination theory, two important predictors of intrinsic motivation are the self-selection of activities and the competence that individuals feel while engaging in them. According to the proponents of the theory, when activities are perceived as chosen (i.e., self-determined) rather than required, and when people believe they will be successful in carrying out the activities, there is a high likelihood that intrinsic motivation is experienced in the form of interest. According to Horn (1982), Investment Theory suggests that interest guides the engagement and investment of intellectual resources. This means a student would only invest her time or his time in activities that are interesting and would depart from it when she or he finds it to be boring.

*Perceived competence*. Zimmerman (2000) acknowledged that, students' belief about their academic capabilities play an important role in their achievement motivation. The role that beliefs about perceived competence play in motivating students is the primary focus of several theoretical perspectives (Pajares, 1996). Even though theories of perceived competence have a long history in social science research, these theories have long been plagued by a lack of more clearly differentiated literal meanings and correspondingly differentiated operational definitions of the constructs used (Bong & Clark, 1999).

Perceived competence represents the extent to which a person believes that he or she has performed or is able to perform well at an activity (Bandura, 1982; Harter, 1981). It is noted to affect intrinsic motivation following feedback, either during or at the conclusion of performance on a task (Bandura, 1982; Harackiewicz, 1989). Thus, performance feedback is hypothesized to influence perceptions of competence, which in turn influence intrinsic motivation. Bandura and Schunk (1981) stated that perceived competence is an important process variable in intrinsic motivation research. In this research, perceived competence is defined as the importance one places on accomplishments of tasks in the study of mathematics.

*Perceived anxiety*. In this research anxiety and pressure is used interchangeably. Mathematics learning anxiety is a kind of special anxiety formed in learning and applying mathematics. It targets mathematics activities and influences the efficiency and effect of mathematics activities. Individuals who perceive mathematics as difficult and their ability to do mathematics as poor generally avoid mathematics, if possible (Hilton, 1981; Otten & Kuyper, 1988). Such students are termed mathematics anxious (Middleton, & Spanias, 1999). Hoyles (1981) examined the stories told by students in their mathematics education about how they felt reflected significant influences on their learning. Students tended to derive satisfaction from a task when they were involved in successful work, and they tended to blame their dissatisfaction on the teachers.

Hoyles (1981) study showed that students' anxiety, feelings of inadequacy, and shame were common in interpreting their bad experiences in mathematics and that students generally recall more bad experiences in mathematics than in other subjects. In view of the foregoing, this research considers anxiety as an important affect variable that can have significant impact on students' intrinsic motivation to learn mathematics.

*Perceived usefulness of mathematics.* Fennema and Sherman (1976) incorporated perceived usefulness into their Mathematics Attitude Scales, and researchers have used these and other scales to demonstrate that perceived usefulness is consistently related to mathematics performance. Among early users was Armstrong (1985). As was the case with mathematics confidence, correlations were generally moderate. As expected, students' perceived usefulness of mathematics is also related to the confidence they express in their achievements.

Utility value is the degree to which students, value mathematics for its usefulness in a future endeavour. Eccles and Wigfeild (1995) found that students' choice to participate in a mathematics task related to their valuing of mathematics. This means to choose to study mathematics other than another subject, demonstrate ones way of saying that mathematics is useful. Greene, DeBacker, Ravindran. and Krows (1999) reported that valuing variables significantly predicted effort and mathematics achievementfor both male and female students in an elective mathematics classes. DeBacker and Nelson (1999) reported that valuing variables predicted effort and persistence in science for both boys and girls, and science achievement for boys. In view of this reported value of perceived usefulness, the researcher considers it as a variable to measure intrinsic motivation in this research.

*Perceived effort.* It is important for students to learn how to learn and take control of their efforts (effort regulation). One self-regulatory resource management strategy described by Pintrich, Smith, Garcia, and McKeachie (1991) is effort regulation. Also referred to as volition (Corno, 1993), effort regulation refers to a learner’s ability to control his or her attention and efforts even in situations that presented distractions that may be perceived to be interesting. This is a clear demonstration of intrinsic motivation, as those distractions are not enabling enough to disengage the person’s commitment to complete study goals. A person’s ability to manage her or his effort is important to academic success in mathematics, because it does not only signify goal commitment, but it also regulates the continued use of learning strategies (Pintrich, Smith, Garcia & McKeachie, 1991).

## Mathematics Achievement

According to Baadjies (2008), the main aim of every lecturer is to ‘‘obtain maximum achievement from each student’’ (p. 31). Lecturers therefore strive to obtain and maintain good mathematics achievement at all times. Brennen (as cited in Baadjies) stated that in the academic domain, achievement is regarded as a performance that led to progress of the students at school. Teaching and learning strategies are marshalled in that direction to achieve maximum performance. The American Psychological Association (1999), viewed achievement as the competence a person has in an area of content. Although this competence resulted from many intellectual and non-intellectual variables, this research concentrated exclusively on the former. The experimental level achievement is referred to as acquisition, learning, or knowledge representation. Achievement is preferred in the educational or psychometrics fields, being sometimes characterised by the degree of inference required on the part of the student to give a response, and by the type of reference to a cognitive process made explicit in the measurement tool.

In the 1950's and early 60's usually students had to master the basic facts (Schoenfeld, 1992), meaning the reproduction of declarative knowledge. It is thought that these basic facts were necessary to build further abstract rules, and little reference was made to possible cognitive processes, no matter what complexity of inference was required from the student (Algarabel & Dasí, 2001).

Cognitive psychology produced a shift from the study of behaviour to its unobservable psychological antecedents (Algarabel & Dasí, 2001). The cognitive analysis of achievement looks into the experimental study of memory storage and retrieval. From the cognitive point of view, achievement must be a construct that should refer to the different stages of knowledge acquisition. The product that is, knowledge that characterises the expert, is a highly structured set of mental models built after long sessions of practice.

Achievement is sometimes separated into knowledge components (Ruiz-Primo, 1998), like declarative, procedural and strategic. The declarative knowledge is composed of domain specific content, whereas the procedural and strategic refer to specific production systems (Anderson & Lebiere, 1998) and specific heuristics (Schoenfeld, 1992). The cognitive system has also the ability to monitor the process and use nonspecific strategies that are also a part of our proficiency in achievement. These different components of achievement develop conjointly and cannot be treated separately.

In summary, knowledge acquisition basically, is the expert use of the sensory, short and long-term memories through the adoption of strategies. Thus, mathematics achievement is the competency of a person in relation to mathematical knowledge.

**Relationship between Self-concept and Intrinsic Motivation**

Positive self-perceptions of ability have shown to relate to measures of intrinsic motivation (Meece, Blumenfeld & Hoyle, 1988; Gottfried, 1990; Skaalvik & Rankin, 1996). Mac Iver, Stipek and Daniels (1991) proposed a causal relationship between self-perceived abilities and intrinsic motivation, and demonstrated that self-perceptions of ability predicted directional changes of intrinsic motivation. Research has shown that students with positive self-perceptions persevere when confronted with challenging tasks and eventually succeed (Berry & West, 1993; Bouffard, 2000; Bouffard-Bouchard & Pinard, 1988; Harter, 1992).

Additionally, high self-concepts of ability may be favourably a precondition for initiating and persistence of effort in learning and in achievement situations (Craven & Marsh, 1997; Helmke, 1989, 1991, 1992). Perseverance in the face of challenge or difficulty is also a key feature of a mastery goal; this again suggests that positive self-concept may causally precede the development of mastery goals. On the other hand, students with low self-concepts may avoid challenging learning situations that could further threaten their self-concept (Baumeister, Tice & Hutton, 1989; Thompson, 1994).

A study on 181 Asian and European graduate students, Ahmed and Bruinsma (2006) found that the positive relationship between academic self-concept and autonomous motivation was significant. In view of this, Ahmed and Bruinsma concluded that the more positive students felt about their achievement, the more motivated they are. A recent study by Green, Nelson, Martin and Marsh (2006) stated that more research has been conducted into self-concept and motivation, but little research is known about the relationship between self-concept and intrinsic motivation.

It appears that, the review in this section so far has presented fragmented components of intrinsic motivation, but silent on the relationship between self-concept and intrinsic motivation, hence the need to examine whether such relationship exists, establishing such a relationship is one of the focus areas of this research.

**Relationship between Self-concept and Mathematics Achievement**

Studies on the relationship between self-concept and students' academic achievement in educational settings have been the focus of research for many years (Hamachek, 1995). Majority of these researches have supported the belief that there is a persistent and significant relationship between self-concept and academic achievement and that a change in one seems to be associated with a change in the other (House 1993; Hamachek 1995; Barker, Dowson, McInerney 2005; Damrongpanit 2009; Sikhwari 2004; Kumar, 2001). A major longitudinal study by Brookover, Erikson and Joiner, (as cited in Hamachek, 1995), investigated the relationship between self-concept of ability and academic performance of more than 1000 male and female students from the time of age fifteen to about age eighteen. They found that self-concept was a significant factor in achievement among this age group.

Marsh (1993) found that the relationship between self-concept and academic achievement is very specific. General self-concept and non-academic aspects were not related to academic achievement while academic self-concept was moderately related to academic achievement. Specific achievement in subject-related self-concepts, were highly related to academic success in that content area. Research has also supported the view that academic self-concept and academic achievement are mutually reinforcing to each other to the extent that a positive (or negative) change in one facilitates a commensurate change in the other (Bracken, 1996).

There is evidence to support the assertion that student self-beliefs are related to several types of achievement outcomes. For example, in a longitudinal study of high school students, Vallerand, Fortier, & Guay (1997) indicated that self-perceptions were significant predictors of subsequent school withdrawal. Likewise, academic self-concept and achievement expectancies significantly related to the school withdrawal of adolescent students (House, 1999).

Researchers have also found a significant predictive relationship between academic self-concept and subsequent grade performance (House, 1997; Marsh & Yeung, 1997; Vrugt, 1994), and that these results have suggested higher levels of academic self-concept tend to be associated with higher levels of academic achievement. Several facets of academic self-concept (self-ratings of overall academic ability drive to achieve, mathematical ability) and achievement expectancies (expectations of graduating with honours) positively related to chemistry achievement (House, 1996) whereas elementary school-aged students' reading self-concept was significantly correlated with reading achievement (Chapman & Tunmer, 1995). Other researchers identified academic self-concept to have a multifaceted structure and that students tend to develop self-concepts in specific subject areas, such as reading, science, and mathematics (Marsh & Yeung, 1996; Mui,Yeung, Low, & Jin, 2000). Therefore, it is important to examine specific academic subjects when assessing the relationship between student self-beliefs and achievement outcomes.

To explain student performance in mathematics, Reyes and Stanic (1988) proposed a model to consider the effects of numerous factors, including societal influences, school mathematics curricula, classroom processes, and student attitudes and achievement-related behaviours. Their results indicated that students' comparisons of themselves with others might influence the expectations for success. Several researchers have found that students' attitudes are significantly related to their mathematics achievement. For example, Pajares and Graham (1999) found that mathematics self-efficacy was significantly associated with the achievement of middle school students. In a similar way, House (1993) found that students with higher academic self-concepts tended to earn higher grades in mathematics courses, even after controlling for the effects of previous achievement. Furthermore, Marsh and Yeung (1997) found that academic self-concept exerted significant causal effects on the mathematics achievement of adolescent students. In addition, House (1995) found that several facets of academic self-concept and achievement expectancies (self-ratings of mathematical ability, overall academic ability, expectations of graduating with honours) were significantly associated with grades in mathematics courses of adolescent students.

Researchers have observed the relationship between student beliefs and mathematics achievement in cross-cultural settings. In a longitudinal study of high school students in Hong Kong, Rao, Moely, and Sachs (2000) noted that self-concept of mathematics ability was a significant predictor of subsequent achievement.

A research by Abu-Hilal (2000) found that students' perceptions regarding the importance of mathematics exerted a significant effect on achievement and that mathematics achievement then increased self-concept. Results from a longitudinal study of elementary and middle school students indicated that initial mathematics achievement was significantly related to subsequent mathematics self-concept (Skaalvik & Valas, 1999). The relationship between self-concept and mathematics achievement become stronger as students' grade level increases (Ma & Kishor, 1997).

Yara (2010) stated that, there is a relationship between academic self-concept and academic achievement in secondary and postsecondary students. Yara further stated that there is a quantified relationship between self-concept and scholastic ability, but few have studied population of students in a selected admissions college programme, particularly among first-year B.ED (Mathematics) students.

Recently, Marsh (as cited in Areepattamannil & Freeman 2008) declared that a higher self-concept is associated with greater academic achievement among students. Damrongpanit (2009) found a strong relationship between self-concept and academic achievement on 820 Grade 9 students, The result from this study indicates that the more a student feels positive about her or his ability, the higher would her or his achievement be.

In spite of the support for the relationships, there are also contradictions concerning the relationships between mathematics self-concept and academic outcomes. Although female students' mathematics grades were higher, their self reported mathematics self-concepts and mathematics test scores were lower (National Center for Education Statistics, 1990) than their male counterparts.

According to Trusty, Watts and House (1996) study on 563 African American elementary learners, school-related self-concepts did not account for a significant amount of variability in achievement test scores. In another study by Areepattamannil and Freeman (2008) on 573 Grade 11 and 12 students from two public secondary schools in the Greater Toronto area, they found only small to moderate correlations between academic self-concept and academic achievement variables for both the non-immigrant and immigrant groups. Similarly, in a study done in South Africa by Baadjies (2008) on 44 Grade 9 learners attending St Barnabas College, it was found that there existed no significant correlation between self-concept and academic achievement.

Vialle, Heaven and Ciarrochi (2005) did a study on 65 high-ability secondary school students. The sample was drawn from a longitudinal study of more than 900 students. The research demonstrated that there was no correlation between self-esteem and academic achievement in the gifted group. Although the study by Vialle, Heaven and Ciarrochi focused on self-esteem and not on self-concept, both of these constructs are very closely related and are often used synonymously.

According to Bryne (1996b) and Hattie (1992) there has not been enough research to resolve the issue of whether academic self-concept facilitates achievement or whether instead, academic achievement facilitates academic self-concept. Some self-concept studies have reported positive self-concept to have causal predominance over academic achievement while others however, have argued in the opposite direction in that their investigations supported the view that academic achievement precedes a positive self-concept (Kelly & Jordan, 1990). Marsh (1993) suggested longitudinal and repeated measures and designs to establish the true nature of the causal relationship. Pajares (1996), however, argued that because of the reciprocal nature of human motivation and behaviour, it is unlikely that such a debate can be resolved. Pajares went further to say that it is impossible to develop better understandings of the conditions under which self-efficacy beliefs operate as causal factors through their influence on choice, effort and persistence in human functioning.

Cokley (2000) investigated academic self-concept and its relationship to academic achievement in African American College students found that the best predictor of academic self-concept for students attending predominantly White colleges and universities was grade point average, whereas the best predictor of academic self-concept for students attending historically Black colleges and universities was quality of student-faculty interactions.

Researchers have shown a causal relationship between (academic) self-concept and mathematics achievement (Lau, Yeung, & Jin, 1998). Many of these models are supported by the skill development model; the self-enhancement model and the reciprocal effects model.

The skill development model stated that academic achievement exerts a positive effect on academic self-concepts of students (Jen & Chien, 2008). This model maintained that past achievement, whether successful or unsuccessful, affects the formation of self-concept but that self-concept does not influence achievement (Barker, Dowson & McInerney, 2005). This model implied that academic self-concept emerged principally as a consequence of academic achievement. In a study done by Helmke and Van Aken (as cited in Vialle, Heaven & Ciarrochi, 2005), they found that academic achievement has more of an impact on self-concept than the other way around.

The self-enhancement model proposed that, the improvement of students' academic self-concepts was a prerequisite to enhance their academic performance. The self-enhancement model further posited that the self-concept variables were primary causes of academic achievement (Green, Nelson, Martin & Marsh, 2006). This model maintained that an improvement of self-concept lead to improved academic performance and that achievement does not influence self-concept (Barker, Dowson & McInerney, 2005). This research supported this model. It is the belief of this research that self-concept could have influence on academic achievement.

The reciprocal effects model assumed that self-beliefs predicted increases in academic achievement and conversely, higher levels of academic achievement predicted improvements in self-beliefs (Barker, Dowson & McInerney, 2005). According to Green, Nelson, Martin and Marsh (2006), the reciprocal effects model has had the most support. Green, Nelson, Martin and Marsh stated that the reciprocal effect model has major implications for the importance placed on academic self-concept as a means of facilitating other desirable educational outcomes, as well as being an important outcome variable.

Research has also supported the view that academic self-concept and academic achievement mutually reinforce each other, to the extent that a positive or a negative change in one facilitates a commensurate change in the other (Olatunde, 2010). Green, Nelson, Martin and Marsh, (2006) simplified this assertion by stating that, improved academic self-concepts lead to better academic achievement, and improved achievement lead to better academic self-concepts.

The review above shows that although most educators conclude that correlation exists between academic self-concept and academic achievement, there exists contrasting findings in this respect. There is also causal relationship between academic self-concept and academic achievement. This study therefore looked into the relationship that exists between students' self-concept and mathematics achievement in other to contribute to knowledge our understanding to this relationship.

## Relationship between Mathematics Achievement and Intrinsic Motivation

Gottfried (1985) demonstrated the significance of academic intrinsic motivation for children's education in the results of three studies. The participants of Study 1 were 141 white, middle-class children attending fourth and seventh grades in a suburban-public school district. Participants of Study 2 were 260 black and white middle-class children in grades 4 through 7 of an integrated, public school. One hundred sixty six white, middle-class boys and girls comprised the sample of Study 3. They attended grades 5 through to 8 at a private school. Gottfried hypothesized that academic intrinsic motivation positively related to school achievement.

Gottfried (1985), the results supported the hypothesis that academic intrinsic motivation positively and significantly related to children's school achievement as measured by both standardized achievement tests and teacher grades. Children who reported higher academic intrinsic motivation had significantly higher school achievement (Gottfried, 1985).

Gottfried (1990) further found that intrinsic motivation was a significant construct in children's education. The study examined academic intrinsic motivation in elementary school children presented in two studies. The first was a longitudinal study of 107 middle-class subjects beginning at age 1 and continuing through age 9. The second study was cross-sectional, involving a sample of 98 multiethnic children in first, second, and third grades.

Child development was assessed every 6 months from ages 1 to 3.5 years and yearly from ages 5 through 9 years. At each assessment, a comprehensive battery of standardized measure was administered to examine development across cognitive, social, behavioural and academic domains (Gottfried, Gottfried & Bathurst, 1988). Young Children's Academic Intrinsic Motivation Inventory was the index used to assess intrinsic motivation. It assesses intrinsic motivation in mathematics and reading, and it provides a score for general intrinsic motivation. In that longitudinal study, standardized achievement was assessed at ages 7, 8, and 9 years. Teacher's ratings of children's academic performance in reading and mathematics were obtained through completion of the teacher version of the Child Behaviour Checklist (Achenbach & Edelbrock, 1986) also at ages 7,8, and 9 years.

In the cross-sectional study, Gottfried (1990) found that academic intrinsic motivation is a valid construct for young children. Across both studies, positive correlations between motivation and achievement were recorded. Specifically, young children with higher academic intrinsic motivation had significantly higher achievement and intellectual performance (Gottfried, 1990).

Overall, young children with higher academic intrinsic motivation functioned more effectively in school, also intrinsic motivation correlated with later motivation and achievement; and that later motivation was predictable from early achievement (Gottfried, 1990). At the longitudinal study, Gottfried work was an important contributor to validating the construct of intrinsic motivation in younger children. However, the limitations of the study are the relatively small sample size and the ability of children to be able to describe themselves effectively, in the two instruments. As such self-reported descriptions by adult learners are likely to be reliable and that informed the use of first year students in this research.

Fortier, Vallerand and Guay (1995) found that perceived academic competence positively related to intrinsic motivation. The study comprised of a sample of 263 French-Canadian students in the ninth grade from two Montreal high schools. To measure academic motivation, students completed the French form of the Academic Motivation Scale, which assesses three different types of intrinsic motivation: intrinsic motivation to know, intrinsic motivation to accomplish things, and intrinsic motivation to experience stimulation. Final mathematics, French, geography, and biology grades used to determine school performance. It seems that students who felt competent and self-determined in the school context developed an autonomous motivational profile toward education, which led to higher school grades (Fortier, Vallerand, & Guay, 1995). More specifically, the study found that perceived academic competence and perceived academic self-determination positively influenced autonomous academic motivation, which in turn had a positive impact on school performance. It should be noted that Fortier, Vallerand and Guay did not use an experimental or longitudinal design in their study. The failure to control for prior achievement or ability level is another limitation of this study.

In a research paper comprised of several field studies and laboratory experiments, Boggiano, Shields, Barrett, Kellan, Thompson, Simons and Katz (1992) revealed that academic motivation positively influenced academic performance. Fifth-grade children participated in a field study conducted over a 2-year period and examined whether extrinsic and intrinsic children's achievement in an experimental setting paralleled their achievement in the classroom. Motivation orientation was assessed using Harter's (1980, 1981) scale. The assessment of academic achievement was very detailed. It involved three different sessions over the 2-year period. After training, difficulties were tackled to ensure that all children could solve the problems equally well, children worked on a set of four test problems, which were unsolvable (Boggiano, Shields, Barrett, Kellan, Thompson, Simons & Katz, 1992). Children's verbalizations during the final two failure problems were recorded, as well as their attributions for their performance.

National percentile scores for the mathematics and reading portions of the Iowa Test of Basic Skills were obtained as well. Boggiano, Shields, Barrett, Kellan, Thompson, Simons and Katz (1992) found that motivational orientation predicted children's standardized achievement scores. In addition, Boggiano, Shields, Barrett, Kellan, Thompson, Simons and Katz found that children with an intrinsic motivational orientation had higher reading and mathematics scores and higher overall achievement scores than their extrinsic counterparts. Recently, in a study done by Ahmed and Bruinsma (2006), found that academic motivation was positively related to academic achievement. In the same study ''students who reported higher self-determination or an intrinsic form of motivation also reported higher academic achievement'' (p. 567).

Some studies have found little or no significant relationship between motivation and academic achievement. Niebuhr (1995) completed a study that examined relationships between several variables and student academic achievement. The study included an investigation of the relationship of individual motivation and its effect on academic achievement. A survey questionnaire administered to 241 high school freshmen in a small town in the Southeast United States. The Harter motivation instrument (Harter, Whitesell and Kowalski, 1992) was used to measure independently whether a student's motivation was intrinsically or extrinsically oriented (Niebuhr, 1995). The grade point averages reported by the students in the sample to represent academic achievement. The survey questionnaire consisted of 163 items providing individual and family demographic information and responses to perceptual measures (Niebuhr, 1995).

The findings indicated that student motivation showed no significant effect relationship on academic achievement (Niehbur, 1995). However, Niebuhr's findings concluded that the elements of school climate and family environment have a stronger direct impact on academic achievement. It noted that grade point averages reported by the students and may not be as valid as school records.

Goldberg and Cornell (1998) revealed in a study that intrinsic motivation did not directly influence subsequent achievement. The sample included participants in the Learning Outcomes Project conducted by the National Research Centre of the Gifted and Talented. The sample was 949 second and third graders from 15 school districts spanning 10 states. Goldberg and Cornell administered the study instruments early in the school year and again near the conclusion of the school year. The average time between testing was 25 weeks. Intrinsic motivation was measured with a shortened version of Harter's (1980, 1981) self-report measure of intrinsic versus extrinsic orientation in the classroom. Form J of the Iowa Test of Basic Skills (ITBS) measured academic achievement (Hieronymus, Hoover & Lindquist, 1986). Goldberg and Cornell (1998) found that correlations between variables measured at Time 1 and Time 2 revealed a series of statistically significant correlations among intrinsic motivation and academic achievement, although, the correlations were generally low in magnitude. Instead, it indicated that intrinsic motivation influenced perceived competence and that perceived competence influenced subsequent academic achievement (Goldberg & Cornell, 1998). Specifically, intrinsic motivation as measured by either intrinsic mastery motivation or autonomous judgement did not directly influence subsequent achievement.

Again, a study by Stipek and Ryan (1997) also found a weak relationship between motivation and young children's achievement. The study examined the influences of several motivational variables on scholastic achievement in economically disadvantaged and advantaged 4-6 year-old preschool and kindergarten children (Howse, 1999). To assess motivation, the children responded to questions about their worries, attitudes, abilities, emotions, and expectations related to school. Alphabets and a number recognition task coupled with the short form of the McCarthy Scales of Children's Abilities (McCarthy, 1972) were used to assess children's achievement in the fall and spring of the school year.

Stipek and Ryan (1997) revealed that both disadvantaged and advantaged children entered school with positive motivation profiles; however, the motivation of the more advantaged children showed a tendency to decline over the first year. Overall, little or no relationship was found between young children's motivation and their academic achievement. Moreover, Stipek and Ryan found that children's cognitive skills were far better predictors of end-of-the-year achievement than motivation. More recently**,** in a study by Areepattamannil and Freeman (2008) on 573 Grade 11 and 12 learners in the Greater Toronto area, they found weak correlations between academic achievement and academic motivation variables in both the non-immigrant and immigrant groups.

It is discovered from the discussion so far that, the interaction between mathematics achievement and intrinsic motivation remains inconclusive, studies on university students is scarce to find, and therefore needed further investigation.

**Relationship between Self-concept, Intrinsic Motivation and Mathematics Achievement**

Bong (1996) called for a comprehensive model to explain the dynamic interactions among motivational variables. This statement assumed that some kind of interaction existed among motivational variables, but these interactions have not been explained fully. There appeared to be division between most researchers investigating motivation and those investigating self-concept (Skaalvik, Valas & Sletta, 1994; Skaalvik, 1997). Researchers of goal theory avoid the explicit discussion of self-concept instead refer exclusively to perceptions of ability. Researchers on Self-concept acknowledge the impact of intrinsic motivation but avoid the goal theory framework as an explanation. An attempt is made here to unify self-concept and intrinsic motivation as they are interconnected and when combined can provide valuable insight into student mathematics achievement.

Studies have repeatedly shown strong relationships between students' self-concept and measures of intrinsic motivation (Meece, Blumenfeld & Hoyle, 1988), a variety of motivational indicators (Skaalvik & Rankin, 1995), and teachers' ratings of level of engagement, persistence in classroom activities (Skaalvik & Rankin, 1996). Specific to the limited research on the relations between goal theory and self-perceived abilities, mastery goals and performance goals have been found not to correlate significantly with self-perceived abilities or that the relations are weak (Nicholls, Patashnick & Nolen, 1985; Ames & Archer, 1988; Nicholls, 1989). Of the significant correlations found between mastery goals and self-perceived abilities, most are positive (Meece, Blumenfeld & Hoyle, 1988; Schunk & Swartz, 1993), while inconsistent relations have been found between performance goals and self-perceived abilities. Performance goals were relate negatively in studies conducted by Ames and Archer; and Schunk and Swartz. In contrast, performance goals positively correlated to self-perceived abilities in Nicholls' and Skaalvik's (1997) studies. The finding was consistent with an understanding that performance goals are not always dysfunctional for self-perceptions and achievement, for all students at all of the time (Urdan, 1997; Dowson & McInerney, 2003).

Research by McCoach and Siegle (2003) stated that self-concept predicted academic achievement. They stated that as much as one third of the variance in achievement can be accounted for by academic self-concept. Findings seem to lend support to the theory that consistent success or failure has an effect on self-concept, and that the level of academic achievement is influenced by an individual's self-concept of ability (Dambudzo 2009). Other studies indicated that the effect of academic achievement on motivation mediates through academic self-concept (Norwich, 1987; Skaalvik & Rankin, 1995, 1996). Ames's (1990) experimental research found that after one year, students were found to foster mastery goals, demonstrated stronger and enhanced intrinsic motivation, and higher self-concepts of ability. This finding suggests that manipulating mastery goals may result in more positive self-concepts and academic cognition. In another research among high school aged students, Mac Iver, Stipek and Daniels (1991) found a causal relationship between academic self-concept and intrinsic motivation. This group of researchers showed that self-perceptions of ability predicted directional changes in intrinsic motivation. Skaalvik and Ranking (1996) also identified indirect and direct effects of persistence and engagement in classroom tasks (i.e. mastery goal-type behaviours) on achievement, with the indirect effect of mastery goals mediated through self-concept of ability.

Goldberg and Cornell (1998) observed similar relations using intrinsic motivation, autonomous judgment, and perceived competence (a concept of the same kind to self-concept) as predictors of academic achievement. Specifically, cross-lagged longitudinal analyses indicated that prior self-concept predicted subsequent academic achievement rather than the reverse. However, whereas the association of prior achievement to subsequent self-concept was not significant, prior achievement predicted subsequent intrinsic motivation and autonomous judgment. Goldberg and Cornell revealed that neither intrinsic motivation nor autonomous judgment predicted subsequent academic achievement, although both variables predicted academic self-concept.

Marsh, Trautwein, Lüdtke, Köller, and Baumert, (2005); and Goldberg and Cornell (1998) studies are interesting for several reasons: Although they used different measures (intrinsic motivation vs. interests, perceived competence vs. self-concept) at different levels of specificity (school subject-specific vs. school in general) they concluded in the same fashion that neither intrinsic motivation nor autonomous judgment predicted subsequent academic achievement. This research expects self-concept and intrinsic motivation to predict mathematics achievement.

### Mediation Models of the Relationships between Self-concept, Intrinsic Motivation and Mathematics Achievement

Guay, Ratelle, Roy and Litalien, (2010) developed three models to explain the relationships among the three constructs. The three models were mediation model of intrinsic motivation, mediation model of self-concept and the additive model (as seen in Figure 2a, 2b and 2c) respectively.

2a. Mediation model of Intrinsic Motivation

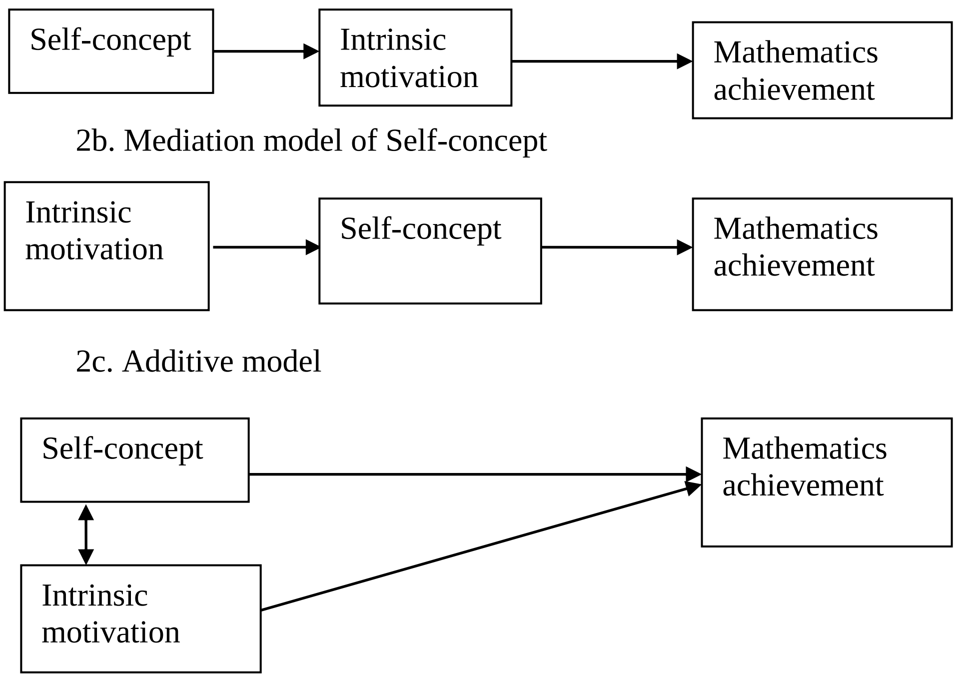


**Figure 2.** Conceptual models of relationships between self-concept, intrinsic motivation and mathematics achievement.

(Adapted from: Guay, Ratelle, Roy & Litalien, 2010)

The first model fits into the SDT (Marsh, 2007). It proposes that intrinsic motivation mediates the contribution of self-concept to mathematics achievement (as seen in Figure 2a). This model presupposes that, students who actively commit themselves to do the social and intra-individual comparisons improved their self-concept. The consequence is that, students feel elated and are more intrinsically motivated to learn mathematics, which subsequently results in an increased mathematics achievement.

A number of cross-sectional and longitudinal studies have provided some support for this model (e.g., Fortier, Vallerand, & Guay, 1995; Guay & Vallerand, 1997). For example, Guay and Vallerand have shown, using a half-longitudinal design and general measures of self-concept, autonomous academic motivation (i.e. not specific to school subjects), and grades, that autonomous academic motivation mediates the academic self-concept–academic achievement relationship. Other studies have tested this meditational model for conceptually- related constructs, namely academic interests and academic intrinsic motivation. Indeed, Guay, Ratelle, and Chanal, (2008) have shown that intrinsic motivation and autonomous academic motivation might have similar patterns of findings when predicting school outcomes.

The second model indicated that self-concept played a mediation role between intrinsic motivation and mathematics achievement (as seen in Figure 2b). That is, students who are intrinsically motivated may be more proactive at school; developed a positive self-concept, and consequently improved on their mathematics achievement. Very few studies have tested this model, although Guay, Boggiano, and Vallerand (2001) showed in a longitudinal study that academic intrinsic motivation predicted subsequent self-concept, whereas prior academic self-concept did not predict subsequent academic intrinsic motivation. However, their study did not access academic achievement. Nevertheless, the argument is that the previously mentioned results of Marsh, Trautwein, Lüdtke, Köller and Baumert (2005); and Goldberg and Cornell (1998) support the mediation model of academic self-concept. These studies found that prior academic interests or intrinsic motivation predicted subsequent self-concept, which itself predicted subsequent achievement. It is interesting to note in those research studies that self-concept equated to academic competence; and interest used to represent intrinsic motivation, which I considered insufficient to represent both constructs. As a result, self-concept and intrinsic motivation were multi-dimensionally covered.

The third model posits that students need to perceive themselves to have positive self-concept and be intrinsically motivated in order to do well in mathematics achievement (as seen in Figure 2c). In a cross-sectional design conducted by Grolnick, Ryan, and Deci (1991) tested this additive model using structural equation model (SEM). Results from the SEM analyses showed that both perceive academic competence (or self-concept) and autonomous academic motivation were associated with academic achievement, as measured by grades and standardized achievement scores. Again, self-concept equated to academic competence and interest used to represent intrinsic motivation.

The literature and empirical investigations mentioned above suggest that there exist some relations among these three constructs. Green, Nelson, Martin and Marsh (2006) indicated that, research has not delved into investigating the relationship between academic self-concept and intrinsic motivation, and their combined effect on mathematics achievement. This view was shared by Ahmed and Bruinsma (2006) when they declared that studies that focus on the relationships between academic self-concept, autonomous motivation (or similar constructs, like intrinsic motivation) and academic performance were largely lacking. From the foregoing, it appears that research that delved into the relationships among these three constructs remains scarce. Our understanding in this area is therefore limited and calls for further investigation, especially among first year university students.

## Summary of Major Findings of the Literature Review

Self-concept is well organised or structured.

1. Self-concept is multifaceted, and the particular facets reflect a self-referent category adopted by an individual and; or shared by a group.
2. Self-concept is hierarchical, with perceptions of personal behaviour in specific situations at the base of the hierarchy; general self-concept – the highest point of the hierarchy is stable, but as one descends the hierarchy, self-concept becomes increasingly situation-specific.
3. Developmentally, self-concept becomes increasingly multifaceted as the individual moves from infancy to adulthood.
4. Self-concept has both a descriptive and an evaluative aspect. Adults can better describe their self-concepts than infants.
5. With respect to the literature reviewed, studies have not compared the effects of self-concept and intrinsic motivation on mathematics achievement, especially among first year university students in Ghana.
6. Intrinsic motivation is driven by self-instinct and does not need any external stimuli to initiate action.

7. Intrinsic motivation increases when individuals attribute educational results to internal factors they can control; when individuals believe they are capable of reaching desired goals; when individuals are interested in mastering a subject, rather than simply earning good grades; and that these factors can converge and result in high levels of intrinsic motivation.
8. There exists contrasting findings in correlations between academic self-concept and academic achievement.
9. There exists causal relationship between academic self-concept and academic achievement.
10. It appears from the discussion so far that, the interaction between academic achievement and motivation remains inconclusive.
11. Literature on the relationship between mathematics achievement and intrinsic motivation is scarce.
12. Many researchers have delved into investigating the relationship between both academic self-concept and motivation, but little is known about the combined effect of self-concept and intrinsic motivation on mathematics achievement.
13. Research that combines self-concept, intrinsic motivation and mathematics achievement remains scarce.
14. There can be three types of interaction between self-concept and intrinsic motivation on mathematics achievement.
15. There can be three types of interaction between self-concept and intrinsic motivation on achievement in mathematics.

# CHAPTER THREE

# METHODOLOGY

This chapter presents the methodology of the research and it contains the research design, population, sample and sampling procedure, instruments, data collection procedure and data analysis.

## Research Design

The correlational study design was used for this research. This design is best suited for studies aimed at finding a number of variables and their relationships (Cohen, Manion & Morrison, 2000). Correlational studies are mainly concerned with achieving a fuller understanding of the complexity of phenomena or, by studying the relationships between the variables which the researcher hypothesizes as being related (Cohen, Manion & Morrison, 2000). When correlations are estimated at a single point in time, a number of variables which are not assessed may be at least partially responsible for the correlation. In cases of correlated changes, however, the likelihood that variables not assessed are responsible for the correlation is greatly decreased because any such variables would have to be changing along with the predictor and subjective experience variables at the same time.

## Population

The target population was all first year Bachelor of Education (Mathematics) students in the Department of Science and Mathematics Education. This group of students (i.e. the target population) are those involve in learning mathematics at the University level and have exhibited some appreciable level of achievement in the study of mathematics at the Senior High School level.

## Sample and Sampling Procedure

The sampling design used was non-probability convenience sampling design. In this type of sampling, each member of the chosen population does not have the same chance of being selected as part of the sample, but because they happen to be present at the place and at the time collecting the data. This design was chosen because it is the most common type of sampling that is employed in educational research (McMillan & Schumacher, 2006).

An initial contact was made through the course representative of first year students to obtain a list of the group and to explain the rationale, purpose of the study and to seek their agreement to participate in the study. All the 96 students gave their consent and these constituted the accessible population. The sampling design used was non-probability convenience sampling on students who were available and were sampled for the study. In all 96 students were sampled, but (as explained below) only 89 submitted their completed questionnaires.

## Instruments

The instruments for the study were a questionnaire (as seen in Appendix A) and end of semester examination in Algebra and Trigonometry. A multi-dimensional two-in-one instrument was used for this study known as the SC-IMOT questionnaire was used. The first part was a three-set statements for demographic survey that was used to described the sample sufficiently, followed by the main instrument to measure students' self-concept with two dimensions. The items were adopted from TIMSS 2003.

The final part was the intrinsic-motivation construct and was measured with a modified 5 dimensions from the Intrinsic Motivation Inventory (IMI), namely perceived interest, perceived competence, perceived anxiety, perceived usefulness and perceived effort. The IMI is an established questionnaire which has been used extensively in studies on intrinsic motivation and self-regulation (e.g., Deci, Eghrari, Patrick, & Leone, 1994; Plant & Ryan, 1985; Ryan, 1982; Ryan, Connell, & Plant, 1990; Ryan, Koestner, & Deci, 1991; Ryan, Mims, & Koestner, 1983). The IMI consists of varied numbers of items from these subscales, all of which have been shown to be factor analytically coherent and stable across a variety of tasks, conditions, and settings. In addition, McAuley, Duncan, and Tammen (1987) have also found strong support for its validity.

Respondents were required to indicate the age; sex; professional qualification and the extent to which they agree or disagree to statements on a five-point Likert scale type instrument ranging from strongly disagree to strongly agree. For the purpose of analysis, strongly disagree was coded 1; disagree was coded 2; undecided 3; agree 4 and strongly agree 5. Negatively worded items attracted reverse coding as well as the items to measure perceived anxiety in solving mathematics problems.

To assess students' achievement the researcher used their first semester examination scores in Algebra and Trigonometry course in the University of Cape Coast 2010/2011 academic year for the first year mathematics education students. The decision to use this course was based on the fact that it was the only course in mathematics that all the students took irrespective of their minor. Secondly, the end of semester grades (total score) are a valid measure of the students’ academic achievement and finally, students’ scores accurately and objectively reflected their mathematics achievement according to the faculty and the university.

## Data Collection for the Pilot Study

A letter obtained from the Department of Science and Mathematics Education ( Appendix I), UCC, was presented to the Head of Department at the University of Education in Winneba (U.E.W) to facilitate the pilot testing of the instrument. A pilot test of the instrument was conducted on 8th November, 2010 at U.E.W among 27 first year students offering B.ED (Mathematics). The result was used and changes made that ensured that an appropriate instrument was carried to the field. I administered the questionnaires to the respondents to indicate the extent to which they disagree or agree with the statements on a 5 -point Likert-type scale, lasting between 15 to 30 minutes, after which the questionnaires were collected.

## Validity

Validity refers to the ability of a survey instrument (questionnaire) to measure what it claims to measure (Ary, Jacobs, & Razavieh, 2002). Dambudzo (2009) stated that, the validity of an instrument is assessed in relation to the extent to which evidence is generated in support of the claim that the instrument measures the attributes targeted in the proposed research. Validity is a concept specific to a given situation: it is dependent on the purpose; the population and the situation where the measurement takes place (McMillan & Schumacher 2006).

De Vos, Strydom, Fouche and Delport (2005) mentioned that the definition of validity included two aspects, namely that the instrument actually measured the concept in question, and that the concept is measured accurately. They further stated that four types of validity exist: namely content validity, face validity, criterion-related validity and construct validity. In this study, the focus has been on content validity, face validity and construct validity.

**Content validity**

The content validity is concerned with the extent to which the content of an instrument are representative or adequate (De Vos, Strydom, Fouche & Delport, 2005). It also means that the items in questionnaire represent the objective of the instrument (Gall, Gall, & Borg 2003). That means a valid measuring device provides an adequate or representative sample of all the constructs being measured.

**Face validity**

The face validity indicates that the questionnaire is pleasing to the eye and applicable for its intended purpose (Ary, Jacobs, & Razavieh, 2002). It shows the degree to which the instrument appears to measure what it is suppose to measure**.** Thus by reading the individual items, it should not be difficult to identify them with their intended measure. The content as well as the face validity of the main instrument (i.e. the questionnaire) were assessed by my supervisors and were found to be satisfactory.

**Construct Validity**

De Vos, Strydom, Fouche and Delport (2005) stated that, construct validity is difficult to validate, as it involves determining the degree to which an instrument successfully measured a theoretical construct. This difficulty arose because of the abstract nature of the theoretical constructs purported to be measured. Again, they stated that construct validity concentrated on the meaning of the instrument and the measuring (i.e. what, how and why it operates the way that it does).

I used factor analysis to assess the construct validity of the SC-IMOT instrument. Field (2005a, 2005b), Ahadzie (2007) and Owusu and Badu (2009), reported that factor analysis is useful for finding clusters of related variables and it is ideal for reducing a large number of variables into a more manageable form. There are two preconditions that sample should meet before conducting factor analysis: first the appropriate sample size and whether sample data is not an identity matrix. These two preconditions should be met to grantee the reliability of the factors analysis (Field, 2005a, 2005b). The data was subjected to the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, which recorded substantial value of .676. The KMO statistic varies between 0 and 1 with a value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion of pattern of the correlations and hence factor analysis is likely to be inappropriate (Gorsuch, 1983; Field, 2005a). A value close to 1.00 indicates that patterns of correlation are relatively compact and so factor analysis should yield distinct and reliable factors (Field, 2005a). However, literature recommends that the KMO value should be greater than .50 if the sample size is adequate (Child, 1990; Field, 2005b). Subsequently, the KMO measure of this study achieved a high value of .68 suggesting the adequacy of the sample size for the factor analysis was met. The Bartlett's test of sphericity was also significant suggesting that the sample was not an identity matrix. The KMO and Bartlett's measure are used to measure sampling adequacy and non identity matrix of the sample in the use of factor analysis (Field, 2005a, 2005b). The KMO and Bartlett's test of sphericity are presented in Table 1.

**Table 1: Kaiser-Meyer-Olkin and Bartlett's Test**

| | |
|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .676 |
| Bartlett's Test of Sphericity Approx. Chi-Square | 608.096 |
| Df | 190 |
| Sig. | .000 |

**Factor Analysis**

Factor analysis seeks to identify fundamental variables, or factors, that explain the pattern of correlations within a set of observed variables (Suhr, 2006). This analysis is often used in data reduction to identify a small number of factors that explain most of the variance that is observed in a much larger number of manifest variables. It is used to generate hypotheses regarding causal mechanisms or to screen variables for subsequent analysis (eg. to identify collinearity, prior to performing a linear regression analysis).

The following steps were used for the factor analysis:

**Confirmatory factor analysis.** Confirmatory factor analysis (CFA) is a statistical technique used to verify the latent constructs in a set of observed variables. CFA allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists (Suhr, 2006).

**Cluster analysis.** Cluster analysis encompasses a number of different algorithms and methods for grouping objects of similar kind into respective categories. A general question facing researchers in many areas of inquiry is how to organize observed data into meaningful structures, that is, to develop taxonomies. In other words cluster analysis is an exploratory data analysis tool which aims at sorting different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. Given the above, cluster analysis is used to discover structures in data without providing an explanation or interpretation. In other words, cluster analysis simply discovers structures in data without explaining why they exist.

a. Main input variables: factors extracted.

b. Result: 6 clusters extracted

**Scree plot**. It is a plot of the variance that is associated with each factor. A scree plot was used to illustrate the factors so identified. It can be seen that several factors were identified, but those that have eiginvalues of more than 1 were retained for the study (as show in figure 3).

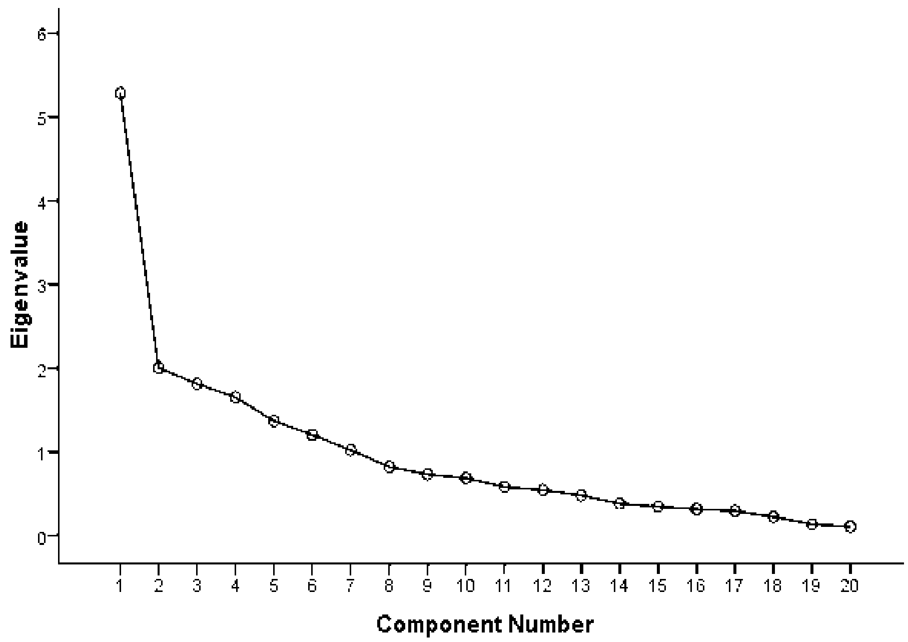


**Figure 3.** A scree plot illustrating factors identified in the study.

Principal component analysis with varimax rotation was performed on the data. The initial factor analysis provided seven factors with eigenvalues greater than one and collectively accounted for 53·9% of variance (as in Appendix D). Appendix C presents the rotated factor matrix for the 7 components. These components were in agreement with the 7 proposed components; however, out of the 7 components, perceived anxiety had only one significant statement loading (i.e. statement 22), as such this was deleted. In addition, two other statements (i.e. statements 15 and 17) were deleted because of their poor factor loadings (< .02). Further, 14 statements (i.e. statements 7, 8, 9, 14, 15, 16, 18, 24, 25, 26, 30, 36, 37 and 38) were deleted because they showed significant factor loadings at components they were not anticipated to measure. A second principal component factor analysis with varimax rotation was performed on the remaining 20 statements. The confirmatory factor analysis was conducted to determine if the results would indicate a better fit after the 17 statements (as in Appendix G) were deleted.

The factor analysis provided six factors with eigenvalues greater than 1 and collectively accounted for 66·6% of variance higher than the previous (Appendix E). Appendix F presents the rotated factor matrix for the six components after those statements were deleted. In all 20 items were used for the study and are listed under the various components (as shown in Appendix H).

**Results of the construct validity analysis.** Based on critical examination of the inherent relationships among the variables under each component, the following interpretations were deduced to represent the underlying dimensions of the components. Component 1 was labelled perceived usefulness; component 2 was labelled perceived interest; component 3 was themed intra-individual comparison; component 4 was themed perceived competence; component 5 was named social comparison; and component 6 was termed perceived effort. These names were derived based on their interrelated characteristics and combination of variables with high factor loadings.

The valid N (Listwise) differs from the number of respondents in the correlation and regression analysis. This is so because one: This default method deleted respondents with missing data on one item or more items even if the missing item or items could not interfere on subsequent analysis; and two the variables in the correlation and regression analysis were computed, as such there are no missing values. Computed variables are transformed variables from sub-groups.

For component I (*perceived usefulness involving 3 items*), coded values ranged from 1 to 5. A coded value of 1 or 2 on factor I indicated that the respondent believes that study of mathematics is not useful. Conversely, a coded value of 4 or 5 on factor I indicated that she or he believes that study of mathematics is useful in her or his life. A coded value 3 means the respondent is undecided on the item in question. The descriptive statistics of students' responses are illustrated in Table 2.

**Table 2: Descriptive Statistics of the Perceived Usefulness Scale**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| I think learning mathematics is useful to me. | 86 | 1 | 5 | 4.65 | .628 |
| I believe studying mathematics is important to me. | 89 | 1 | 5 | 4.65 | .709 |
| I believe learning is beneficial to me. | 83 | 2 | 5 | 4.59 | .681 |
| Valid N (Listwise) | 83 | | | | |

Component II (*Perceived interest, involving 4 items*), students' responses ranged from 1 to 5 with a grand average score of 4.29. A coded value of 1 or 2 on factor I indicated that the respondent believes that study of mathematics is not interesting. Conversely, a coded value of 4 or 5 on factor II indicated that she or he believes that study of mathematics is interesting. A coded value 3 means the respondent is undecided on the item in question. The descriptive statistics are shown in Table 3. It can be seen in Table 3 that the items are generally about love, joy and interest and was not difficult to associate these items with the construct 'perceived interest'.

**Table 3: Descriptive Statistics of Perceived Interest Scale**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| I enjoy doing math. | 87 | 1 | 5 | 4.40 | .994 |
| I do not feel nervous at all when I am taking exams in mathematics. | 88 | 1 | 5 | 3.65 | 1.232 |
| If I have my own way, I will stop learning mathematics. | 87 | 1 | 5 | 4.49 | .987 |
| I love learning mathematics. | 88 | 1 | 5 | 4.60 | .838 |
| Valid N (Listwise) | 84 | | | | |

Scores ranged from 1 to 5 for component III (*perceived competence, involving 3 items*), with grand average score of 3.02. A coded value of 1 or 2 on factor I indicated that the respondent believes that she or he is not competent in the study of mathematics. Conversely, a coded value of 4 or 5 on component III indicated that she or he was competent in the study of mathematics. A coded value 3 means the respondent is undecided on the item in question. The mean, range and standard deviations of students' responses are indicated in Table 4.

**Table 4: Descriptive Statistics of the Perceived Competence Scale**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| I can learn mathematics without difficulty. | 88 | 1 | 5 | 3.32 | 1.327 |
| I am confident that I can handle my problems in mathematics without assistance. | 89 | 1 | 5 | 2.84 | 1.421 |
| I can handle my problems in mathematics without assistance. | 81 | 1 | 5 | 2.89 | 1.378 |
| Valid N (Listwise) | 80 | | | | |

Table 5 shows the range, average, and standard deviation of the responses on each of the four items on component IV. For component IV (*Social comparison, involving 3 items*), a coded value of 1 or 2 indicated that the student believed she or he works hard in mathematics, but does not see the need to compare her or his score to that of their class mates. A coded value of 4 or 5 indicated that the student believed she or he need to work hard, but did see the need to compare her or his score to that of their class mates in order to improve upon their scores and standing among their mates. A coded value 3 means the respondent is undecided on the item in question.

**Table 5: Descriptive Statistics of the Social Comparison Scale**

| Item | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| My friends do better than me in mathematics. | 84 | 1 | 5 | 3.69 | 1.232 |
| My friends are not better than me in mathematics. | 87 | 1 | 5 | 3.44 | 1.353 |
| In class, I see others to be better than me in mathematics. | 88 | 1 | 5 | 2.95 | 1.500 |
| Valid N (Listwise) | 84 | | | | |

On Factor V (*Perceived effort, involving 3 items)*, responses also ranged from 1 to 5. A coded value of 4 or 5 on factor V indicates that students believed that they had to put in a lot of effort in order to do well in mathematics. A coded of 1 or 2 indicated that the students do not believed that they had to put in a lot of effort in order to do well in mathematics. A coded value of 3 means the respondent is undecided on the item in question. The mean, range and standard deviations of students' responses are illustrated in Table 6.

**Table 6: Descriptive Statistics of Perceived Effort Scale**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| I do not try to do well in mathematics. | 84 | 1 | 5 | 4.46 | .963 |
| I do not put a lot of effort in the study of mathematics. | 85 | 1 | 5 | 3.98 | 1.263 |
| I do put a lot of effort in the study of mathematics. | 84 | 1 | 5 | 3.82 | 1.291 |
| Valid N (Listwise) | 82 | | | | |

Finally, on component VI (*intra-individual, involving 4 items*), student responses ranged from 1 to 5. A coded of 4 or 5 on factor VI indicated that students believed that in order to do well in mathematics it is necessary to compare one' score in mathematics with the scores in other subjects. A coded value of 1 or 2 indicated that students believed to do well in mathematics, it is not necessary to compare one' score in mathematics with the scores in other subjects. Table 7 shows the range, average, and standard deviation for the mean coded values of students' responses on each of the four items.

**Table 7: Descriptive Statistics of the items on Intra-individual Comparison Scale**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Learning mathematics is a lot of fun to me. | 82 | 1 | 5 | 4.10 | 1.084 |
| I think I am pretty good in mathematics. | 85 | 2 | 5 | 4.29 | .737 |
| I think I do pretty well in mathematics. | 86 | 1 | 5 | 4.19 | .964 |
| Mathematics is not a difficult subject. | 88 | 1 | 5 | 4.07 | 1.192 |
| Valid N (Listwise) | 80 | | | | |

In general, the average coded value for each factor were all greater than 3 indicating that students appeared to have somewhat positive views on all the items under the various construct extracted.

After determining the six (6) components, two main factors were computed for the correlation and regression analysis. As earlier stated, each student response was assigned a coded value from 1 to 5 on each of the 6 components involving the 20 items. The score was determined using the 5-point Likert scale from the questionnaire. “Strongly disagree” to “Strongly agree” were assigned numerical values of 1 through 5 respectively for each statement. Next, the average of all items in each of the components was calculated for each student, resulting in a mean score for each component ranging from 1 to 5.

With respect to the current study, the items on intra-individual comparison, social comparison, perceived interest, perceived competence, perceived usefulness and perceived effort all had high internal consistencies. Specifically, the internal reliability estimates of the six components were as follows: intra-individual comparison = .51 to .82, social comparison = .74 to .81, perceived interest = .62 to .72, perceived competence = .52 to .90, perceived usefulness = .73 to .85 and perceived effort = .50 to .85. It is concluded from the principal and confirmatory factor analysis that the construct validity was met and as such; the research instrument was valid for the study.

### Reliability

Reliability is the consistency of the measurement - the extent to which the results are similar over different forms of the same instrument or occasions of data collection (McMillan & Schumacher, 2006). Any instrument that showed similarity of results of the same person or a quantity for a number of times irrespective of time and place is reliable. Strydom, Fouche, Poggenpel and Schurink (in Dambudzo 2009) declared that an instrument such as a questionnaire is said to be reliable to the extent that independent administrations of it, or a comparable instrument, consistently yields the same or similar results. Therefore, the more reproducible of the results obtained by the instrument, the more reliable the instrument

McMillan & Schumacher (2006) stated that internal consistency is the most common kind of reliability, since it can be estimated from giving one form of a test only once. There are generally three types of internal consistency measures, namely the split-half-method, the Kuder-Richardsonmethod, and the Cronbach alpha method. This study however focused on the Cronbach alpha method.

The Cronbach alpha method assumes that all statements are equivalent in the determination of internal consistency of the questionnaire. It is a much more general form of internal consistency and is used for statements that are not scored right or wrong (McMillan and Schumacher 2006). In this study the statements in the SC-IMOT questionnaires are not scored right or wrong. The Cronbach alpha is the most appropriate kind of reliability in the case of survey research, as well as for other questionnaires where there is a range of possible answers for each item (McMillan & Schumacher 2006). As was mentioned before, this study is a correlation study research design and there is a range of possible answers for each statement in the questionnaires. Therefore the Cronbach alpha method was considered as the most appropriate measure of reliability for this study.

The internal consistency of the items from the different sub-scales for the SC-IMOT questionnaire was determined. This was determined by calculating the Cronbach alpha's α-coefficients with the help of the SPSS computer software program. Detailed analysis of the reliability of the instrument is summarised in Appendix B. According to McMillan and Schumacher (2006) an acceptable range of reliability coefficients for most instruments is between .70 and .90. The overall Cronbach alpha's α-coefficient of the SC-IMOT instrument was .80.

The scale reliabilities for the two constructs are as follows. The number of items and the internal consistency for each scale are: Self-concept seven items ($\alpha = .70$); intrinsic motivation thirteen items ($\alpha = .73$). The alpha coefficients ranged from .75 to .79, and were satisfactory on the basis of Nunnally's (1978) and McMillan and Schumacher (2006) criterion of a minimum of .70.

The internal consistency was also obtained for the total scores of the self-concept and intrinsic motivation sub-scales. Both sub-scales proved to have high acceptable alpha-coefficients. The information obtained in this study by the research instrument can thus be used with confidence, and can be considered to be reliable.

## Data Collection Procedure for the Main Study

A letter obtained from the Department of Science and Mathematics Education (Appendix I), UCC, was presented to the lecturer for Algebra and Trigonometry who facilitated the administering of the instrument. I administered the questionnaire to 96 respondents on 18$^{th}$ November, 2010 to indicate the extent to which they disagree or agree with the statements on a 5 - point Likert-type scale lasting between 15 to 30 minutes, after which the questionnaire was collected. The respondents were asked to write their last four digits of the registration number on the questionnaire. This was required in order to match the mathematics achievement scores to the appropriate student. The respondents were assured that their identities and the results would be treated confidentially. The total completed and returned questionnaires were 89.

In addition, two letters (Appendix I and Appendix J) were presented to the Head of Students' Records and Management Information Section (SRMIS) requesting for Algebra and Trigonometry first semester results of Level 100

B.ED (Mathematics) students on 29th October, 2010. That request was fulfilled on 17th February, 2011, which made my research data complete.

## Data Analysis

Brink (1999) stated that, the aim of any data analysis was to reduce and to synthesise information in order to make sense out of it, and to allow inference about a population. This assertion was further supported by De Vos, Strydom, Fouche and Delport (2005) when they stated that the purpose is to reduce the raw data to a more manageable and meaningful form, so that the relations of the research problems, questions and hypothesis can be studied, answered and tested, so that conclusions may be drawn.

In furtherance of this idea, Mertens (as cited in Dambudzo 2009) suggested that the statistical procedure chosen for any study depended on the research question, the types of groups one is dealing with, the number of the variables, and the scale of the measurement. Again, De Vos, Strydom, Fouche and Delport (2005) stated that the data analysis does not in itself answer research questions; but provide clues to the answers of the research questions. It is against this background that statistical Techniques be employed to answer research questions.

The responses were coded as follows: 5 = strongly agree; 4 = agree; 3 = undecided; 2 = disagree and 1 = strongly disagree to facilitate the data analysis. In the case of negatively worded statements this scale was reversed for analysis. Also the items to measure perceived anxiety attracted reverse coding.

## Further Statistical Techniques for Answering the Research Questions

In accordance with the stated aims and the research questions of the study, the following statistical analysis techniques were used in this study.

**Pearson Product Moment correlation**

According to Cohen, Manion and Morrison, (2000) correlation techniques are generally intended to answer three questions about two variables or two sets of data. First, ‘Is there a relationship between the two variables?’ If the answer to this question is ‘yes’, then two other questions follow: ‘is the direction of the relationship positive or negative?’ and ‘What is the size?’ Relationship in this context refers to any tendency for the two variables (or sets of data) to vary consistently. Pearson’s product moment coefficient of correlation is one of the best-known measures of association (Cohen, Manion & Morrison, 2000; McMillan & Schumacher 2006). Its statistical value ranges from -1.0 to +1.0 and expresses this relationship in quantitative form. The coefficient is represented by the symbol r.

The co-efficient of correlation, then, tells us something about the relations between two variables. Other measures exist, which allow us to specify relationships when more than two variables are involved. These are known as measures of multiple correlation and partial correlation. Multiple correlation measures indicate the degree of association between three or more variables simultaneously. We may want to know, for example, the degree of association between delinquency, social class background and leisure facilities. Or we may be interested in finding out the relationship between academic achievement, intelligence and neuroticism. Multiple correlation, or ‘regression’ as it is sometimes called, indicates the degree of association between two variables or more than two variables. It is related not only to the correlations of the independent variables with the dependent variables, but also to the inter-correlations between the dependent variables.

**Multiple Regression**

According to Brace, Kemp and Snelgar (2009), 'multiple regression is a statistical technique that is used to predict a person's score on one variable on the basis of her or his scores on several other variables' (p. 206). In this case is to be predicted from students' self-concept and intrinsic motivation. In multiple regression, naturally occurring scores on a number of predictor variables are used and to try to establish which set of the observed variables gave rise to the best prediction of the criterion variable. There are several methods: forward, backward, entry, hierarchical and stepwise selection, but for the purpose of this research the backward regression was used. This was to ensure that only significant predictors are maintained in the final model without causing significant reduction $R^2$.

**Backwards regression**. According to Beal, the dependent variable is regressed on all independent variables. If any variables are statistically insignificant, the one making the smallest contribution is dropped (i.e. the variable with the smallest $R^2$, which will also be the variable with the smallest T value). This process continues until no remaining variables have F statistic p-values above the specified $\alpha$. The end result is that it maintains predictor variables which are statistically significant. Field, (2005a) stated that Leaving non-significant variables in a regression model can 'mask' the significance of related predictors, for that reason the Backwards Regression Method was used in this research to maintain only significant predictors.

In order to examine research questions 1, 2 and 3 the Correlation techniques was employed. SPSS software was used to perform bivariate correlation for research questions 1, 2 and 3.

Research question 4 was investigated using multiple regression. The main purpose of multiple regression is to be able to predict some criterion variable (i.e. mathematics achievement) better from self-concept and intrinsic motivation. It is used to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. The SPSS software package was used to conduct multiple regression to answer research question 4, as that is generally accepted as one of the valid statistical software for use today.

# CHAPTER FOUR

## RESULTS AND DISCUSSION

This chapter presents the results and discussions of the research. It begins with a demographic description of the sample for the study, followed by specific statements of the instrument on self-concept and intrinsic motivation; and finally results and discussion of the research questions.

### Demographic Characteristics of the Students

A cross tabulation analysis was conducted on the characteristics of the sample as shown in Table 8. The age of the participants ranged from 15 to over 39 years. Of the Eighty-nine respondents, Eighty eight participants responded to the statement regarding gender and one failed to indicate the age group.

**Table 8: Respondent Age and Respondent Gender Cross Tabulation**

| | Age group | respondent gender | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| respondent age | 15-18 | 3 | 0 | 3 |
| | 19-22 | 35 | 9 | 44 |
| | 23-26 | 15 | 2 | 17 |
| | 27-30 | 16 | 1 | 17 |
| | 31-34 | 4 | 0 | 4 |
| | 35-38 | 1 | 0 | 1 |
| | 39+ | 2 | 0 | 2 |
| Total | | 76 | 12 | 88 |

A pictorial representation is shown in Figure 4. Eighty-eight out of the 89 respondents who responded to the item on gender, Half of the respondents were in 19-22 age group, 12 (14%) were females consisting of nine (9) between the age of 19-22 and three within the age of 23-30. Males represent 76 (86%) with majority sixty-six (66) of them in the 19-30 age group. There were no females above 30 years but seven (7) of the males were above 30 years.

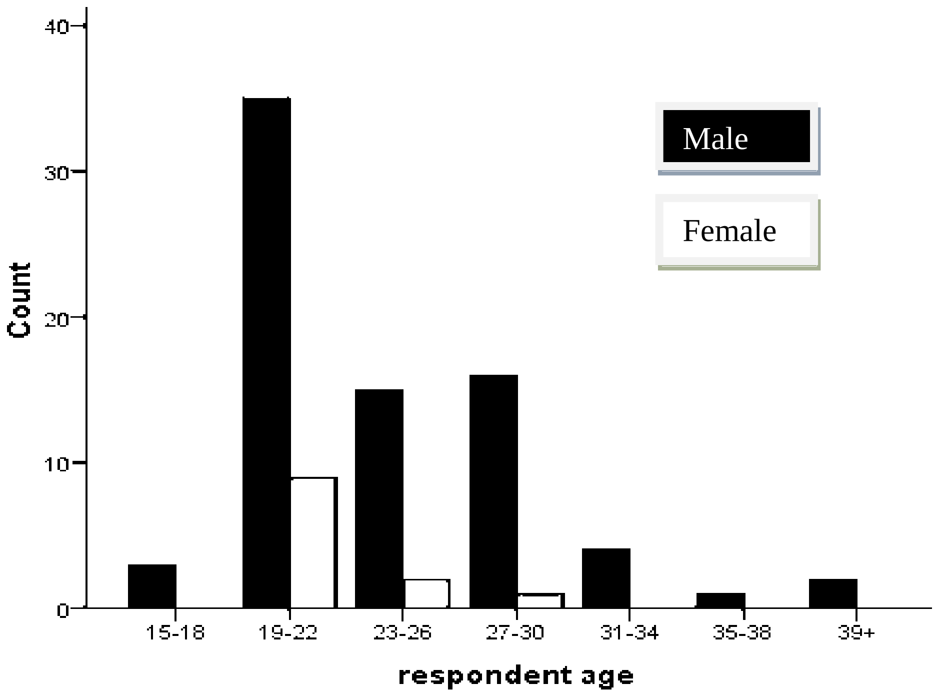


**Figure 4.** A bar graph showing the gender distribution by age groupings.

The respondents with professional teaching certificates were 33 (approximately 38%) and the remaining being Senior High School (SHS) holders as indicated in table 9. One of the respondents failed to indicate her or his professional qualification, resulting in a total of 88. However this would not in any way affect the sample size since the age and professional qualification of respondents is not needed to answer any of the research questions.

**Table 9: Respondent Gender and Respondent Professional Qualification Cross Tabulation**

| | | respondent professional qualification | | |
|---|---|---|---|---|
| | | 3-year post secondary | Neither | Total |
| respondent sex | Male | 29 | 47 | 76 |
| | Female | 4 | 8 | 12 |
| | Total | 33 | 55 | 88 |

The two main constructs computed for the study and their associated statements are listed below:

**Self-concept Statements**

5. In class, I see others to be better than me in mathematics.

12. Mathematics is not a difficult subject.

13. I think I do pretty well in mathematics.

23. I think I am pretty good at mathematics.

27. My friends are not better than me in mathematics.

34. Learning mathematics is a lot of fun to me.

35. My friends do better than me in mathematics.

**Intrinsic Motivation Statements**

4. I love learning mathematics.

6. I can learn mathematics without difficulty.

10. I think I have a mathematical mind.

11. If I have my own way, I will stop learning mathematics.

17 I am confident that I can learn mathematics without difficulty.

20. I belief studying mathematics is important to me.

21. I enjoy doing mathematics.

28. I do not try to do well in mathematics.

29. I do not put a lot of effort in the study of mathematics.

32. I do put a lot of effort in the study of mathematics.

33. I think learning mathematics is useful to me.

39. I belief learning mathematics is beneficial to me.

40. I can handle my problems in mathematics without assistance.

The following section shows how the research questions were answered. It contains tables, figure and diagrams of the analysis in response to the research questions including discussion.

**Relationship between Self-concept (SC) and Intrinsic Motivation (IMOT) in the study of Mathematics**

Research question one was ‘‘does students’ Self-concept correlate with their Intrinsic motivation towards the study of mathematics?’’ and sought to find out if a significant relationship exists between self-concept and intrinsic motivation in the study of mathematics.

The Table 10 shows that, the mean score on each of the constructs was 4, indicating that, students generally responded favourably to the statements on these two constructs. Deviations are approximately 1 standard unit from the mean, which is minimal.

**Table 10: Descriptive Statistics of Self-concept and Intrinsic Motivation**

| | N | Range | Mean | Std. Deviation |
|---|---|---|---|---|
| Self-concept | 89 | 4 | 3.86 | .708 |
| Intrinsic motivation | 89 | 4 | 4.13 | .558 |
| Valid N (Listwise) | 89 | | | |

The valid N (Lisewise) 89 shows that all the respondents had enough data on the variables that were needed to answer this research question and for that reason none of the respondents were dropped in answering research question one.

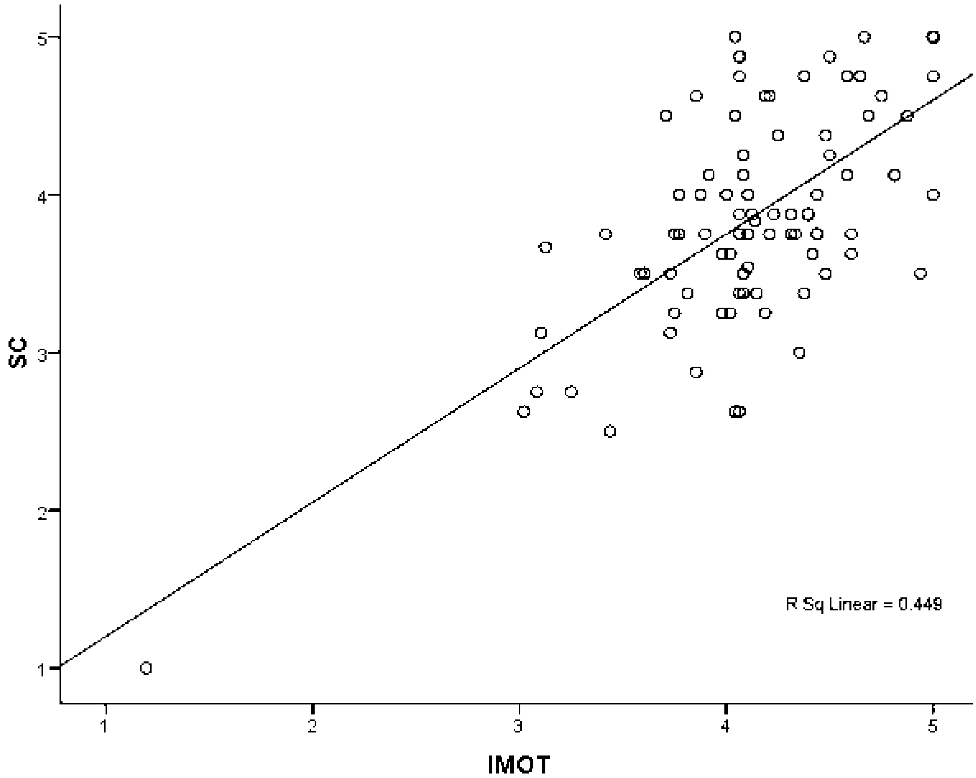


**Figure 5.** A scatter plot of students' self-concept and their intrinsic motivation in the study of mathematics.

A scatter plot summarizes the results in Figure 5. It shows a steep rise from left to right of the line of best fit, the data points are generally clustered around the line of best fit suggesting a strong positive correlation between self-concept and intrinsic motivation.

**Table 11: Correlation between Students' Mathematics Self-concept and Intrinsic Motivation**

| | | SC | IMOT |
|---|---|---|---|
| SC | Pearson Correlation | 1 | .670** |
| | Sig. (2-tailed) | | .000 |
| | N | 89 | 89 |

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

**Findings and Discussion of Research Question One**

A Pearson product-moment correlation coefficient was computed to assess the relationship between students' self-concept and intrinsic motivation in the study of mathematics. There was a strong positive correlation between self-concept and intrinsic motivation, $r = .670$, $n = 89$, $p = .001$ (as shown in Table 10). This result is unique per the literature in this research, because there has not been known research that has sought to establish correlation between these two variables. The variables: intra-individual comparison, social comparison, perceived interest, competence, usefulness and effort are important affect variables. This result gave credence to Deci and Ryan, (2000) conclusion that, intrinsically motivated students engage in behaviours of interest and importance, which is maximize to their advantage. Increases in self-concept are correlated with increases in intrinsic motivation. Alternatively, a decrease in intrinsic motivation correlates with decreases in mathematics self-concept.

Gottfried (1990) stated that, developing academic intrinsic motivation was an important goal for educators because of its inherent importance for future motivation, as well as for students' effective school functioning. This seems to suggest that, intrinsic motivation is relatively an important psychological construct, which plays vital role in learning mathematics. With the strong positive correlation between intrinsic motivation and self-concept, it is arguably possible to state that self-concept is also an important construct in learning mathematics. Students with high self-concept are likely to be highly motivated intrinsically to engage themselves in learning mathematics with a lot of zeal and enthusiasm. Students who are intrinsically motivated to succeed may perceive activities in mathematics to be important to their roles as students in the study of mathematics.

The relationship that exists shows that comparing ones results in mathematics with results in other subjects are likely to be the bases to check the progress of one's' performance. This comparison is identified in this research as a wealthy comparison. In addition, to ensure that a student is in good standing among her or his course mates, the students do comparisons among themselves and use these comparisons to monitor their progress in mathematics. Doing the internal and external comparison is likely to do one of two things: to develop high self-concept or develop low self-concept. A student who consistently sees her or his mark to be lower in mathematics can develop a negative attitude towards mathematics and consequently result in low self-concept. The reverse could also be true where a student who consistently scores higher mark than the course mates is likely to develop positive attitude towards mathematics and can subsequently result in high self-concept.

In this analysis, the factors likely to affect intrinsic motivation are perceived competence, effort, usefulness and interest in the study of mathematics. To do an activity for the sheer joy it brings to the individual, the activity has to be smooth sailing. For a person to smoothly sail through an activity means that the person should be competent in doing the activity. Once competency is assured, the person is willing and ready to carry out the activity with little or no anxiety; and that the usefulness the person attaches to the activity. This means that when a person is able to go through with a great deal of problem solving skills in mathematics, the satisfaction that one gets is likely to keep the person to engage in learning mathematics.

The amount of effort a student puts up in the study of mathematics is likely to predict what score the student might get in a mathematics examination. An intrinsically motivated student is more likely to exert a lot more effort to achieve the desired goal. The more effort that is invested the higher the likelihood of scoring very high marks, which in the end would likely bring to the person some joy and satisfaction, which could be the bases of her or his intrinsic motivation. In this study, students see self-concept and intrinsic motivation as important factors, exhibited in the positive relationship between self-concept and intrinsic motivation in the study of mathematics.

A student is not likely to engage in the study of mathematics, unless the student places some premium in the usefulness of the subject. Perceived usefulness is likely to be the motivation behind students' engagement in the study of mathematics in this research.

Hence, students' Self-concept significantly correlates strongly and positively with their intrinsic motivation towards the study of mathematics.

## Relationship between Students' Self-concept and Mathematics Achievement

Research question two was ''does students' Self-concept correlate with their Mathematics achievement?'' and sought to find if there exists a significant relationship between students' self-concept and mathematics achievement.

**Table 12: Descriptive Statistics of Students' Self-concept and Mathematics Achievement**

| Factor | N | Range | Mean | Std. Deviation |
|---|---|---|---|---|
| Self-concept | 89 | 4 | 3.86 | .708 |
| Mathematics achievement | 89 | 67 | 66.07 | 12.676 |
| Valid N (Listwise) | 89 | | | |

Table 12 shows that all items were responded to by all respondents. It generally shows agreement that Self-concept matters in students' mathematics achievement. The mean mathematics achievement score was satisfactory by UCC Academic Board standards.

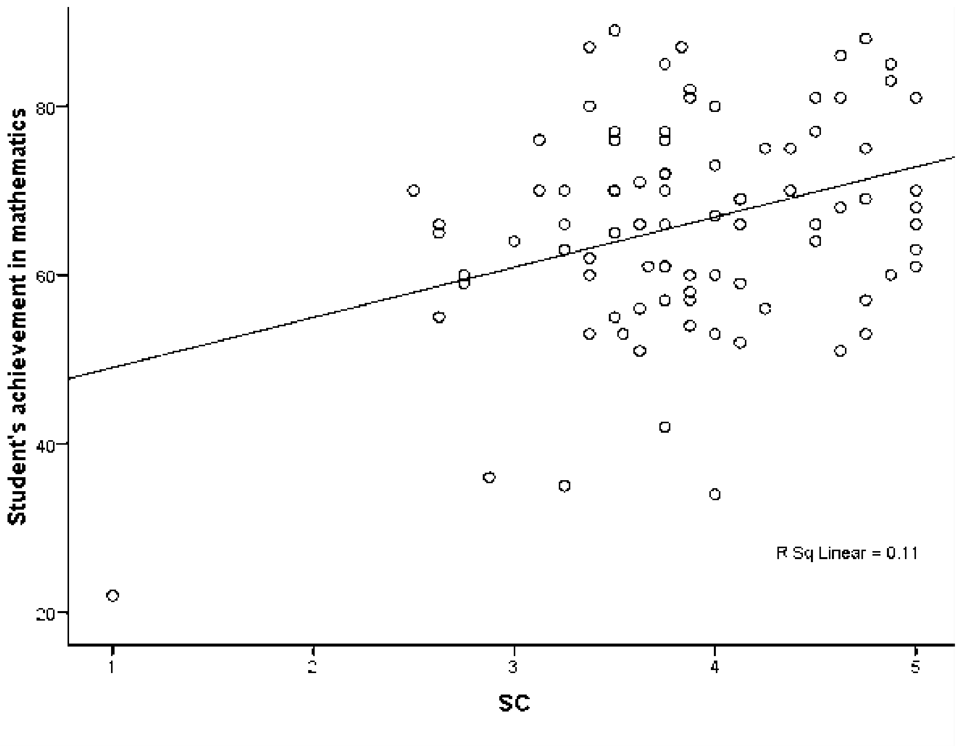


**Figure 6.** A scatter plot showing students' mathematics achievement and their self-concept.

A scatter plot summarizes the results as in Figure 6. It shows a gentle rise from left to right of the line of best fit, the data points are relatively clustered around the line of best fit suggesting a moderate positive correlation between self-concept and mathematics achievement. One student appeared to exhibit an extremely low score in mathematics achievement and low score in self-concept.

**Table 13: Correlation between Self-concept and Mathematics Achievement**

| | | Self-concept | Mathematics achievement |
|---|---|---|---|
| Self-concept | Pearson Correlation | 1 | .332* |
| | Sig. (2-tailed) | | .001 |
| | N | 89 | 89 |

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

**Findings and Discussion of Research Question Two**

A Pearson product-moment correlation coefficient was computed to assess the relationship between students' self-concept and mathematics achievement. There is a moderate and significant positive correlation between the two variables, $r = .332$, $n = 89$, $p = .001$ (as shown in Table 13). Thus about 11% of the variance in mathematics achievement is accounted for by self-concept. Despite the inconclusive reports on self-concept and mathematics achievement, this study agrees with Erikson and Joiner's (as cited in Hamachek, 1995) conclusion that self-concept was a significant factor of mathematics achievement.

The relationship shows that gradual increases in self-concept corresponded with gradual increase in mathematics achievement. It is speculated here that self-concept and mathematics achievement could moderately influence each other. It is possible that self-concept could be influencing mathematics achievement or the vice versa. However, it is significant to state that any influence that could be observed would be more likely to be moderate, because of the moderate positive relationship between the variables. This means that a student who is a moderate achiever in mathematics is more likely to exhibit moderate characteristic in self-concept. This result continues to support the idea of a significant relationship between self-concept and mathematics achievement and that a change in one seems to be associated with a corresponding change in the other.

The internal and external frame of reference plays a moderate role in students' mathematics achievement, though students' do consider comparing their mathematics achievement with their achievement in other subjects or their mathematics achievement with the achievement of their friends, they do these in moderation. This situation is more likely to be attributed to students not doing proper analysis of these comparisons thereby failing to appreciate what these comparisons can do to monitor their mathematics achievement and to use it as bases for adopting corrective measures leading to better performance. It could also be that, students' have not realised the benefits that come with the intra-individual comparison and social comparison that they do. If students had realised the importance of the comparisons and to do proper analysis of these comparisons it could have had much impact than it is observed in this research.

This is so because; higher academic self-concept has been associated with greater academic achievement among students (Marsh, 1990). This indicates that a student who is moderate achiever in mathematics is more likely to be a moderate student with a moderate self-concept. Hence, students' Self-concept significantly correlates moderately and positively with their mathematics achievement.

### Relationship between Mathematics Achievement and Intrinsic Motivation in the Study of Mathematics

Research question three was 'Does students' intrinsic motivation correlate with their mathematics achievement?' and sought to find if there exists any relationship between intrinsic motivation and mathematics achievement.

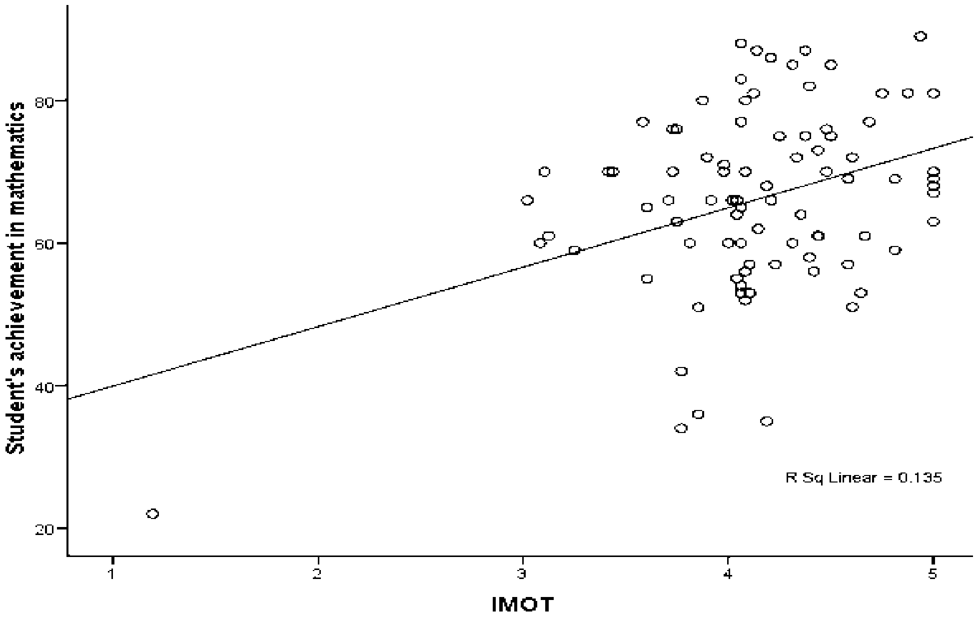


**Figure 7.** A scatter plot showing students' mathematics achievement and their intrinsic motivation.

A scatter plot summarizes the results in Figure 7. It shows a gentle rise from left to right of the line of best fit, the data points cluster around the line of best fit suggesting a strong positive correlation between mathematics achievement and intrinsic motivation. In the same Figure 7, five students exhibit low mathematics achievement but high intrinsic motivation. It also shows that one of the five students obtained both low intrinsic motivation and mathematics achievement.

**Table 14: Correlation between Mathematics Achievement (MA) and Intrinsic Motivation (IMOT)**

| | | MA | IMOT |
|---|---|---|---|
| MA | Pearson Correlation | 1 | .367* |
| | Sig. (2-tailed) | | .000 |
| | N | 89 | 89 |

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

**Findings and Discussions of Research Question Three**

The average mathematics achievement score for the 89 students was 66.07 and the average intrinsic motivation score was 4.13. A Pearson product-moment correlation test was applied to the two variables to measure the relationship between intrinsic motivation and mathematics achievement. The results indicated a moderate positive correlation between the two variables, r = .367, n = 89, p = .001 (as shown in Table 14), meaning that 13% of the variation in Mathematics achievement is accounted for by Intrinsic motivation. This finding contradicts that of Niehbur's (1995) when he concluded that students' motivation showed no significant relationship to academic achievement. In addition, the result disagrees with the finding of Goldberg and Cornell's (1998), when they concluded that intrinsic motivation could not directly influence achievement, but acts as a mediator variable to academic achievement through perceived competence as perceived competence subsequently influences academic achievement. In this research, the opposite is the likely view. Thus, intrinsic motivation is more likely to influence mathematics achievement. The result suggests a significant relationship between mathematics achievement and intrinsic motivation. This shows that an increase in student's intrinsic motivation is likely to result in an increase in her or his mathematics achievement and vice versa.

In an educational setting which values the psychological basis of learning, this study indicates that schools would benefit from focusing more time and energy on increasing student intrinsic motivation. In some respects, intrinsic motivation can be thought of as a precursor to increasing mathematics achievement and likely to play a significant role in our future success in this regard. Finally, this study concludes that students' intrinsic motivation significantly correlates strongly and positively with their Mathematics achievement.

### Effect of Self-concept and Intrinsic Motivation on Mathematics Achievement among First Year Students

Research question four was ‘‘to what extent is first year students' Mathematics achievement affected by their Self-concept and Intrinsic motivation?'' and sought to find out if students' mathematics achievement is significantly predicted by self-concept and intrinsic motivation among first year students. To answer this question, the backward stepwise regression method in multiple-regression was used, to explore whether self-concept or intrinsic motivation could predict mathematics achievement or both.

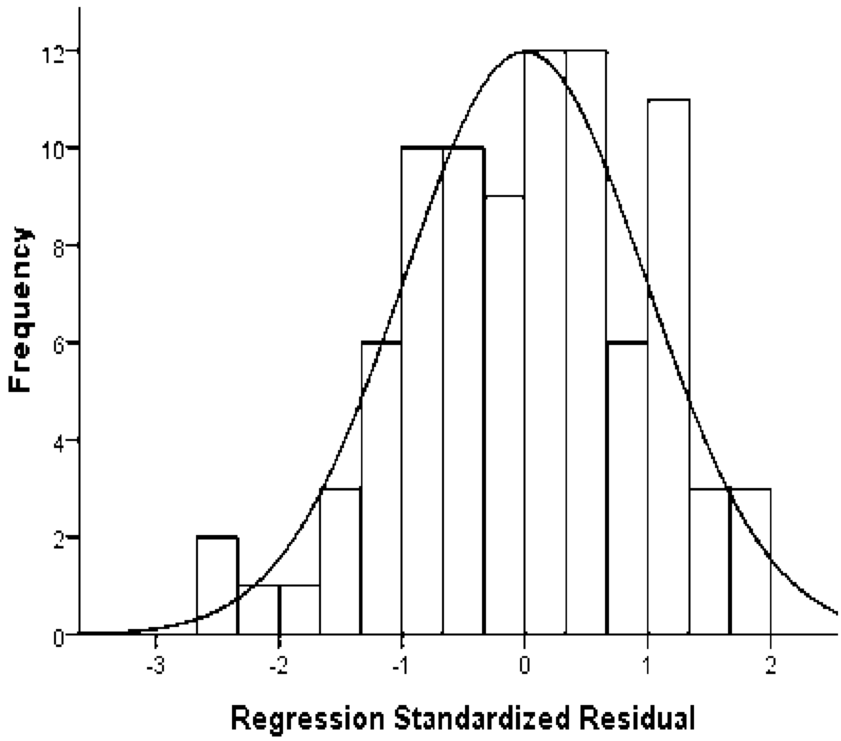


**Figure 8.** A histogram showing regression standard residual of students' self-concept, intrinsic motivation and mathematics achievement.

The assumption for multiple-regression requires that, the residuals (predicted minus observed values) are distributed normally (i.e. follow the normal distribution). To check if the data is normally distributed, a residual plot of a histogram with a line that depicts the shape of the data was compared with the normal distribution curve. The histogram (as shown in Figure 8) shows that the residuals are normally distributed, thereby fulfilling one of the necessary conditions for conducting linear regression.

Another assumption is that the residuals should be independent and measured by the Durbin-Watson test statistic, which test for correlation errors. Specifically it seeks to find out whether adjacent residuals are correlated. The test statistic could vary from 0 to 4 with a value 2 means the residual values are uncorrelated. In this research the Durbin-Watson test statistic is 1.893 which is approximately 2, thereby fulfilling yet another condition for conducting multiple regression analysis.

**Table 15: Multiple Linear Regression Models for the Prediction of Students' Mathematics Achievement (MA) using their Self-concept (SC) and Intrinsic Motivation (IMOT)**

| Model | | B | Std. Error | Beta |
|---|---|---|---|---|
| 1 | (Constant) | 30.607 | 9.470 | |
| | SC | 2.804 | 2.401 | .157 |
| | IMOT | 5.959 | 3.047 | .262* |
| 2 | (Constant) | 31.592 | 9.452 | |
| | IMOT | 8.342 | 2.267 | .367** |

Note.$R^2$ = .148 for step 1: $\Delta R^2$ = -.014 for step 2 (Ps < .246).*p < .05,

**P < .001

Dependent Variable: Student's Mathematics achievement.

**Findings and Discussion of Research Question Four**

In model 1, self-concept and intrinsic motivation were regressed on mathematics achievement. These two predictor variables accounted for 15% (as shown in Table 15), of the variability in mathematics achievement, which is significant, F (2, 86) = 7.482, p = .001 (as shown in Table 16). Intrinsic motivation explains some of the variance that should have been explained by self-concept, thereby preventing the latter from reaching the significant level. This means that self-concept appeared to be an intervening or suppressor variable between mathematics achievement and Intrinsic motivation, which is in line with (Norwich, 1987; Skaalvik and Rankin, 1995, 1996) assertions.  In model 2, a backward stepwise linear regression analysis reveals that self-concept is not a significant predictor of mathematics achievement, which explains why it is dropped. The results obtained in Table 15 show that only students' intrinsic motivation, enters into the regression equation, yielding a coefficient of multiple correlation (R) of .366 and $R^2$ of .134 (meaning that only 13% of the total variance in mathematics is explained by students' intrinsic motivation. Analysis of variance (ANOVA) result for the regression (prediction) produced an F-ratio of 13.544, which is significant at .05 alpha levels as shown in Table 16.

**Table 16: Prediction Models of Mathematics Achievement (MA) by Self- concept (SC) and Intrinsic Motivation (IMOT)**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2095.619 | 2 | 1047.810 | 7.482 | .001[a] |
| | Residual | 12043.976 | 86 | 140.046 | | |
| | Total | 14139.596 | 88 | | | |
| 2 | Regression | 1904.694 | 1 | 1904.694 | 13.544 | .000[b] |
| | Residual | 12234.902 | 87 | 140.631 | | |
| | Total | 14139.596 | 88 | | | |

[a] Predictors: (constants), IMOT, SC, [b] Predictors: IMOT

Dependent Variable: MA

Prediction equation: MA = 31.592 + 8.134IMOT

This result means that students' intrinsic motivation is a significant predictor of students' mathematics achievement as shown by the prediction equation (MA = 31.592 + 8.134IMOT) at the bottom of Table 16. The coefficient 8.134 indicates the unit change in the mean score of mathematics achievement associated with a mean unit change in intrinsic motivation score. Thus for every mean unit change in intrinsic motivation, mathematics achievement is predicted to be about 8 units higher. The finding here, goes contrary to Goldberg and Cornell (1998) revelation that intrinsic motivation did not directly influence subsequent achievement. This result probably implies that, the higher a student's intrinsic motivation, the better her or his mathematics achievement. Thus, the final model (model 2) significantly improves our ability to predict mathematics achievement using intrinsic motivation alone ($\beta = .37$, $p = .001$). This is expected, because the backward stepwise regression begins to drop less or non-significant variables in the subsequent models. This study indicates that the effect of self-concept on mathematics achievement is likely to be mediated through intrinsic motivation.

To investigate the mediating role of the self-concept through intrinsic motivation on mathematics achievement, Guay, Ratelle, Roy and Litalien, (2010) models is considered. The mediation model of intrinsic motivation (i.e. Model 2a) seems to fit what is discovered in this research, but deviates from what was hypothesised in this research. The hypothesised model (i.e. model 2c), anticipated that students' self-concept and intrinsic motivation could both predict mathematics achievement.

The mediation model identified in this research suggests that, students who commit themselves to actively and positively involve in doing the social and intra-individual comparisons (i.e. positive self-concept) are more likely to be intrinsically motivated to learn mathematics, which can subsequently result in positive effect on mathematics achievement. This result is similar to Guay and Vallerand (1997) half-longitudinal design and general measures of self-concept, autonomous academic motivation (i.e., not specific to school subjects), and grades, that autonomous academic motivation mediates the academic self-concept–academic achievement relationship. Although the measurement of the autonomous academic motivation and the academic self-concept are different from what is used in this research. To conclude, intrinsic motivation is the only variable that has a significant and direct likely positive effect on mathematics achievement. As the mean score in intrinsic motivation increases by 1 unit, the corresponding unit increase on the mean score on mathematics achievement is about 8.

To ascertain the power of the model, the Post-hoc Statistical Power for Multiple Regression was computed for the final model using Soper (2011) Free Statistics Calculator. The power of final model is .959, with confident interval $3.836 \leq B \leq 12.848$ (as in Appendix F and G respectively). The final model has a moderate effect size of .2 (as shown in Appendix M).

# CHAPTER FIVE

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Summary of the Research

This study has investigated the relationship between self-concept, intrinsic motivation and mathematics achievement of First-year B. ED (Mathematics education) students in the university of Cape Coast. A convenience sample of 89 students data together with the end of first semester results of Algebra and Trigonometry were used for the study. The correlation study design was used to gain more insight into the relationships between students' self-concept, intrinsic motivation and mathematics achievement. It further sought to determine the extent to which students' mathematics achievement could be predicted by self-concept and intrinsic motivation.

The key research findings are summarized as follows:

1. The study identified a strong positive correlation between self-concept and intrinsic motivation.
2. A moderate positive relationship exists between students' self-concept and their mathematics achievement.
3. The research identified a moderate positive correlation between mathematics achievement and intrinsic motivation. Intrinsically motivated students are more likely to achieve more in mathematics.

4. The study identified intrinsic motivation as the only variable that has a significant and likely positive effect on mathematics achievement.

**Conclusions**

The conclusion of the research is that although both self-concept and intrinsic motivation are related to mathematics achievement, it is intrinsic motivation which is able to predict mathematics achievement. This research has therefore highlighted the need to pay attention to the impact that self-concept and intrinsic motivation have on students' mathematics achievement.

**Recommendations**

Based on the findings of the study, the following recommendations are made:

1. The Department of Science and Mathematics Education in collaboration with the Department of Mathematics and Statistics of the School of Physical Sciences (who are currently teaching Algebra and Trigonometry) should make every effort to design and implement teaching strategies that foster the development of self-concept and intrinsic motivation.
2. Lecturers should adopt strategies that will enhance students' self-concepts by paying students compliments appropriately and as often as required.
3. Lecturers should adopt strategies such as designing challenging activities that convey messages to the learners that they have the skills to successfully engage in those activities.

4. Lecturers concerned in the Departments Mathematics and Statistics as well as those in the Department of Science and Mathematics Education should establish formative assessment strategies that will enhance students' intrinsic motivation with regards to the learning of mathematics.

**Suggestions for Future Research**

An obvious direction for future research is the extent to which the results of this study may be replicated, especially with larger groups of students and possibly in a senior high school where the pass rate in mathematics is very low. Another area for future research is to examine the causal relationships among the variables to understand the variables that are fully responsible for the other, so that lecturers and students can specifically direct their attention towards the enhancement of students' positive attributes in the predictor variables. A longitudinal research could also be conducted to examine the stability of the effects of self-concept and intrinsic motivation on students' mathematics achievement.

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# APPENDICES

## Appendix A

### Instrument for the Study

The purpose of this questionnaire is to enable the researcher to learn how your self-concept (perceived personal mathematical skills, ability, mathematical reasoning ability, enjoyment and interest in mathematics) and intrinsic motivation (refers to motivation that comes from inside an individual rather than from any external or outside rewards, such as money or grades.) influence your study of mathematics. By taking part in this survey, you will be contributing to our knowledge about the relationship between students' mathematics achievement with their self-concept and intrinsic motivation. Please be assured of your anonymity and confidentiality in this study as it is ethically appropriate.

SECTION A

INSTRUCTIONS: Please write the last four digits of your registration number on the top and underline or circle ONLY one where appropriate.

1. Age: [15- 18] [19- 22] [23- 26] [27- 30] [31-34] [35- 38] [39+]

2. Gender: [M] [F]

3. Professional qualification:

[3-year post secondary] [A-4 year post middle] [None]

SECTION B

INSTRUCTIONS: Please rate how strongly you agree or disagree with each of the following statements by placing a check mark (√) in the appropriate box.

**Continuation of Appendix A**

Example

Strongly agree is my preferred choice, so it is checked as shown below.

| Statements | Responses | | | | |
|---|---|---|---|---|---|
| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
| I am a good football player. | | | | | √ |

Please respond to the following items as honestly as you can.

| Statements | Responses | | | | |
|---|---|---|---|---|---|
| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
| 4. I love learning mathematics. | | | | | |
| 5. In class, I see others to be better than me in mathematics. | | | | | |
| 6. I can learn mathematics without difficulty. | | | | | |
| 7. I try my best although I do not like mathematics. | | | | | |
| 8. I am proud of my ability to cope with difficulties in mathematics. | | | | | |
| 9. I get really uptight during mathematics test. | | | | | |
| 10. I think I have a mathematical mind. | | | | | |

**Continuation of Appendix A**

| Statement | Responses | | | | |
|---|---|---|---|---|---|
| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
| 11. If I have my own way, I will stop learning mathematics. | | | | | |
| 12. Mathematics is not a difficult subject. | | | | | |
| 13. I think I do pretty well in mathematics. | | | | | |
| 14. I do not see myself to be good in mathematics. | | | | | |
| 15. I find activities in mathematics very helpful. | | | | | |
| 16. I get really jittery during math tests. | | | | | |
| 17. I am confident that I can handle my problems in mathematics without assistance. | | | | | |
| 18. I do not feel nervous at all when I'm taking exams in mathematics. | | | | | |
| 19. I do not try very hard to score good marks in mathematics. | | | | | |

**Continuation of Appendix A**

| Statement | Responses | | | | |
|---|---|---|---|---|---|
| | strongly disagree | Disagree | Undecided | Agree | Strongly agree |
| 20. I believe studying mathematics is important to me. | | | | | |
| 21. I enjoy doing math. | | | | | |
| 22. I feel I am pressurized to learn mathematics. | | | | | |
| 23. I think I am pretty good in mathematics. | | | | | |
| 24. I put much energy into the study of mathematics. | | | | | |
| 25. I do badly in tests of mathematics as compared to that of my friends. | | | | | |
| 27. My friends are not better than me in mathematics. | | | | | |
| 28. I do not try to do well in mathematics. | | | | | |
| 29. I do not put a lot of effort in the study of mathematics. | | | | | |
| 30. I am not pretty skilled in the study of mathematics. | | | | | |
| 31. I am at ease when learning mathematics. | | | | | |

**Continuation of Appendix A**

| Statement | Responses | | | | |
|---|---|---|---|---|---|
| | strongly disagree | Disagree | Undecided | Agree | Strongly agree |
| 32. I do not put a lot of effort in the study of mathematics. | | | | | |
| 33. I think learning mathematics is useful for me. | | | | | |
| 34. Learning mathematics is a lot of fun to me. | | | | | |
| 35. My friends do better than me in mathematics. | | | | | |
| 36. I was pretty skilled in the study of mathematics. | | | | | |
| 37. I usually get higher marks than my friends in mathematics. | | | | | |
| 38. I am uneasy when taken mathematics exams. | | | | | |
| 39. I believe learning is beneficial to me. | | | | | |
| 40. I can handle my problems in mathematics without assistance. | | | | | |

## Appendix B

**Item-Total Statistics for first Reliability Analysis**

| Statement | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I love learning mathematics. | 145.13 | 279.383 | .461 | .758 | .766 |
| In class, I see others to be better than me in mathematics. | 146.74 | 275.830 | .245 | .781 | .769 |
| I can learn mathematics without difficulty. | 146.41 | 271.813 | .405 | .551 | .763 |
| I try my best although I do not like mathematics. | 145.62 | 276.272 | .334 | .655 | .766 |
| I am proud of my ability to cope with difficulties in mathematics. | 145.59 | 276.013 | .395 | .713 | .765 |
| I get really uptight during mathematics test. | 146.80 | 269.627 | .428 | .645 | .761 |
| I think I have a mathematical mind. | 145.31 | 280.885 | .411 | .800 | .767 |
| If I have my own way, I will stop learning mathematics. | 145.11 | 279.270 | .259 | .512 | .769 |
| Mathematics is not a difficult subject. | 145.69 | 277.485 | .309 | .722 | .767 |

**Continuation of Appendix B**

| Statement | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I think I do pretty well in mathematics. | 145.61 | 276.843 | .410 | .751 | .765 |
| I do not see myself to be good in mathematics. | 145.49 | 281.021 | .217 | .717 | .770 |
| I find activities in mathematics very helpful. | 144.59 | 266.046 | -.006 | .269 | .851 |
| I get really jittery during mathematics tests. | 146.31 | 271.185 | .456 | .660 | .761 |
| I am confident that I can handle my problems in mathematics without assistance. | 146.97 | 271.132 | .369 | .899 | .764 |
| I do not feel nervous at all when I am taking exams in mathematics. | 146.23 | 267.313 | .507 | .845 | .758 |
| I do not try very hard to score good marks in mathematics. | 145.54 | 288.652 | -.013 | .636 | .783 |
| I believe studying mathematics is important to me. | 145.05 | 285.181 | .393 | .743 | .770 |
| I enjoy doing math. | 145.34 | 276.630 | .430 | .844 | .764 |

**Continuation of Appendix B**

| Statement | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I feel I am pressurized to learn mathematics. | 145.46 | 276.519 | .405 | .687 | .765 |
| I think I am pretty good in mathematics. | 145.46 | 278.252 | .537 | .739 | .764 |
| I put much energy into the study of mathematics. | 145.69 | 282.251 | .189 | .587 | .771 |
| I do badly in tests of mathematics as compared to that of my friends. | 145.69 | 270.385 | .497 | .769 | .760 |
| I feel pressured when learning mathematics. | 145.77 | 275.613 | .369 | .737 | .765 |
| My friends are not better than me in mathematics. | 146.16 | 271.739 | .419 | .774 | .762 |
| I do not try to do well in mathematics. | 145.21 | 280.404 | .394 | .566 | .767 |
| I do not put a lot of effort in the study of mathematics. | 145.69 | 283.118 | .167 | .703 | .772 |
| I am not pretty skilled in the study of mathematics. | 145.79 | 272.070 | .515 | .832 | .761 |
| I am at ease when learning mathematics. | 145.90 | 281.923 | .225 | .703 | .770 |

**Continuation of Appendix B**

| Statement | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I do put a lot of effort in the study of mathematics. | 145.79 | 283.437 | .166 | .728 | .772 |
| I think learning mathematics is useful to me. | 145.07 | 285.729 | .345 | .836 | .770 |
| Learning mathematics is a lot of fun to me. | 145.69 | 279.018 | .319 | .717 | .767 |
| My friends do better than me in mathematics. | 145.92 | 274.910 | .399 | .772 | .764 |
| I am pretty skilled in the study of mathematics. | 145.69 | 281.085 | .274 | .699 | .769 |
| I usually get higher marks than my friends in mathematics. | 146.21 | 269.104 | .548 | .830 | .759 |
| I am uneasy when taken mathematics exams. | 146.64 | 285.034 | .086 | .587 | .776 |
| I believe learning is beneficial to me. | 145.16 | 285.239 | .279 | .834 | .770 |
| I can handle my problems in mathematics without assistance. | 146.98 | 269.950 | .401 | .849 | .762 |

## Appendix C

## Confirmatory Analysis of Components at the first stage

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I believe learning is beneficial to me. | .821 | .065 | .195 | .067 | .120 | -.185 | -.003 |
| I think learning mathematics is useful to me. | .821 | .163 | .040 | .015 | .209 | .079 | .122 |
| I believe studying mathematics is important to me. | .813 | .181 | -.041 | .236 | .075 | .190 | -.019 |
| I feel I am pressurized to learn mathematics. | -.548 | .392 | .081 | -.138 | .295 | -.219 | -.128 |
| I am pretty skilled in the study of mathematics. | .519 | .231 | .006 | .107 | -.033 | .209 | -.280 |
| I am proud of my ability to cope with difficulties in mathematics. | .502 | .337 | .233 | .030 | -.012 | .110 | .131 |
| I enjoy doing math. | .417 | .656 | .007 | -.080 | .125 | .087 | -.100 |
| I love learning mathematics. | .281 | .655 | .219 | .085 | -.054 | -.100 | -.006 |
| I do not feel nervous at all when I am taking exams in mathematics. | .013 | .604 | .309 | .043 | -.266 | .289 | .278 |

**Continuation of Appendix C**

| Statement | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I think I have a mathematical mind. | .444 | .564 | .170 | .180 | -.026 | .057 | -.009 |
| If I have my own way, I will stop learning mathematics. | .262 | .544 | -.129 | .046 | .060 | .141 | -.011 |
| I try my best although I do not like mathematics. | -.065 | .479 | .117 | .088 | .227 | .076 | .001 |
| I feel pressured when learning mathematics. | .154 | .463 | .066 | .199 | .318 | .044 | -.218 |
| I am uneasy when taken mathematics exams. | -.254 | .452 | .009 | .261 | -.211 | .064 | .321 |
| I put much energy into the study of mathematics. | .132 | .351 | -.113 | -.205 | .113 | .260 | .156 |
| I am confident that I can handle my problems in mathematics without assistance. | .116 | .029 | .846 | .147 | -.104 | .164 | .001 |
| I can handle my problems in mathematics without assistance. | .036 | -.067 | .837 | -.040 | .213 | .114 | -.024 |

**Continuation of Appendix C**

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I can learn mathematics without difficulty. | .196 | .243 | .521 | .029 | -.032 | .220 | .015 |
| I usually get higher marks than my friends in mathematics. | .145 | .141 | .498 | .250 | .254 | -.195 | -.119 |
| I find activities in mathematics very helpful. | -.051 | .054 | .195 | .034 | -.134 | .030 | -.008 |
| My friends do better than me in mathematics. | .070 | .280 | -.090 | .741 | .205 | .051 | -.163 |
| In class, I see others to be better than me in mathematics. | .160 | -.115 | .128 | .708 | .037 | .023 | .106 |
| My friends are not better than me in mathematics. | .179 | .154 | .091 | .683 | -.037 | .117 | -.226 |
| I get really uptight during mathematics test. | .030 | -.017 | .399 | .521 | -.033 | -.145 | .226 |
| I do not see myself to be good in mathematics. | .212 | .055 | -.157 | .393 | .315 | .180 | .361 |

**Continuation of Appendix C**

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I get really jittery during mathematics tests. | -.109 | .177 | .302 | .382 | .252 | .236 | .341 |
| I do put a lot of effort in the study of mathematics. | -.023 | -.016 | .029 | -.109 | .689 | -.036 | .335 |
| I do not put a lot of effort in the study of mathematics. | .057 | -.015 | -.129 | .063 | .687 | .229 | -.172 |
| I do not try to do well in mathematics. | .224 | .165 | .028 | .189 | .626 | .116 | .146 |
| I am not pretty skilled in the study of mathematics. | -.043 | .459 | .342 | .083 | .487 | .045 | -.106 |
| I do badly in tests of mathematics as compared to that of my friends. | .003 | .292 | .118 | .260 | .371 | .113 | .140 |
| I think I do pretty well in mathematics. | .070 | .089 | .155 | .082 | .197 | .759 | .052 |
| Mathematics is not a difficult subject. | .157 | .100 | .312 | .063 | .031 | .616 | -.051 |
| I think I am pretty good in mathematics. | .480 | .291 | .160 | .129 | .082 | .491 | -.083 |

**Continuation of Appendix C**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I am at ease when learning mathematics. | .193 | .246 | .334 | -.121 | .008 | -.339 | -.242 |
| Learning mathematics is a lot of fun to me. | .136 | .240 | -.076 | -.063 | .109 | .332 | -.230 |
| I do not try very hard to score good marks in mathematics. | .095 | .021 | -.073 | -.080 | .147 | -.060 | .772 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 10 iterations.

## Appendix D

### Principal Analysis of the Seven Components Extracted at the First Stage

| Component | Initial Eigen values | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | %of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 7.422 | 20.059 | 20.059 | 7.422 | 20.059 | 20.059 | 4.035 | 10.905 | 10.905 |
| 2 | 2.729 | 7.375 | 27.434 | 2.729 | 7.375 | 27.434 | 3.776 | 10.207 | 21.112 |
| 3 | 2.478 | 6.696 | 34.131 | 2.478 | 6.696 | 34.131 | 3.022 | 8.168 | 29.280 |
| 4 | 2.226 | 6.016 | 40.147 | 2.226 | 6.016 | 40.147 | 2.656 | 7.178 | 36.457 |
| 5 | 1.824 | 4.930 | 45.076 | 1.824 | 4.930 | 45.076 | 2.597 | 7.018 | 43.476 |
| 6 | 1.705 | 4.607 | 49.684 | 1.705 | 4.607 | 49.684 | 2.144 | 5.796 | 49.271 |
| 7 | 1.553 | 4.197 | 53.881 | 1.553 | 4.197 | 53.881 | 1.705 | 4.609 | 53.881 |

**Appendix E**

**Principal Analysis of Final Six Components Extracted for the Study**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 5.284 | 26.422 | 26.422 | 5.284 | 26.422 | 26.422 | 2.854 | 14.271 | 14.271 |
| 2 | 2.004 | 10.019 | 36.441 | 2.004 | 10.019 | 36.441 | .370 | 11.851 | 26.123 |
| 3 | 1.812 | 9.059 | 45.500 | 1.812 | 9.059 | 45.500 | 2.130 | 10.651 | 36.773 |
| 4 | 1.652 | 8.260 | 53.761 | 1.652 | 8.260 | 53.761 | 2.122 | 10.609 | 47.382 |
| 5 | 1.369 | 6.844 | 60.604 | 1.369 | 6.844 | 60.604 | 2.066 | 10.330 | 57.711 |
| 6 | 1.203 | 6.016 | 66.620 | 1.203 | 6.016 | 66.620 | 1.782 | 8.909 | 66.620 |

## Appendix F

## Confirmatory Analysis of Components

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| I believe learning is beneficial to me. | .847 | | | | | |
| I think learning mathematics is useful to me. | .840 | | | | | |
| I believe studying mathematics is important to me. | .725 | | | | | |
| I think I have a mathematical mind. | | .485 | | | | |
| I enjoy doing math. | | .717 | | | | |
| I love learning mathematics. | | .705 | | | | |
| If I have my own way, I will stop learning mathematics. | | .620 | | | | |
| I think I do pretty well in mathematics. | | | .823 | | | |
| Mathematics is not a difficult subject. | | | .690 | | | |
| I think I am pretty good in mathematics. | | | .680 | | | |
| Learning mathematics is a lot of fun to me. | | | .512 | | | |
| I can handle my problems in mathematics without assistance. | | | | .892 | | |
| I am confident that I can handle my problems in mathematics without assistance. | | | | .857 | | |

**Continuation of Appendix F**

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| I can learn mathematics without difficulty. | | | | .518 | | |
| My friends are not better than me in mathematics. | | | | | .813 | |
| My friends do better than me in mathematics. | | | | | .807 | |
| In class, I see others to be better than me in mathematics. | | | | | .740 | |
| I do put a lot of effort in the study of mathematics. | | | | | | .854 |
| I do not put a lot of effort in the study of mathematic | | | | | | .767 |
| I do not try to do well in mathematics. | | | | | | .496 |

## Appendix G

## List of Statements Deleted

7. I try my best although I do not like mathematics

8. I am proud of my ability to cope with difficulties in mathematics

9. I get really uptight during mathematics test

14. I do not see myself to be good in mathematics

15. I find activities in mathematics very helpful

16. I get really jittery in test of mathematics

18. I do not feel nervous at all when learning mathematics

19. I do not try very hard to score good marks in mathematics.

22. I feel I am pressurized to learn mathematics

24. I put much energy into the study of mathematics

25. I do badly in test of mathematics as compared to that of my friends

26. I feel pressured when learning mathematics

30. I am not pretty skilled in the study of mathematics

31. I am at ease when learning mathematics.

36. I am pretty skilled in the study of mathematics

37. I usually get higher marks than my friends in mathematics

38. I am uneasy when taken mathematics exams

**Appendix H**

**Cluster Analysis of Components for the Instrument**

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | Perceived usefulness | Perceived interest | Intra-individual comparison | Perceived competence | Social comparison | Perceived effort |
| I believe learning is beneficial to me. | .847 | | | | | |
| I think learning mathematics is useful to me. | .840 | | | | | |
| I believe studying mathematics is important to me. | .725 | | | | | |
| I think I have a mathematical mind. | | .485 | | | | |
| I enjoy doing math. | | .717 | | | | |
| I love learning mathematics. | | .705 | | | | |

**Continuation of Appendix H**

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | Perceived usefulness | Perceived interest | Intra-individual comparison | Perceived competence | Social comparison | Perceived effort |
| If I have my own way, I will stop learning mathematics. | | .620 | | | | |
| I think I do pretty well in mathematics. | | | .823 | | | |
| Mathematics is not a difficult subject. | | | .690 | | | |
| I think I am pretty good in mathematics. | | | .680 | | | |
| Learning mathematics is a lot of fun to me. | | | .512 | | | |
| I can handle my problems in mathematics without assistance. | | | | .892 | | |

**Continuation of Appendix H**

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | Perceived usefulness | Perceived interest | Intra-individual comparison | Perceived competence | Social comparison | Perceived effort |
| I am confident that I can handle my problems in mathematics without assistance. | | | | .857 | | |
| I can learn mathematics without difficulty. | | | | .518 | | |
| My friends are not better than me in mathematics. | | | | | .813 | |
| My friends do better than me in mathematics. | | | | | .807 | |
| In class, I see others to be better than me in mathematics. | | | | | .740 | |

**Continuation of Appendix H**

| Statement | Component | | | | | |
|---|---|---|---|---|---|---|
| | Perceived usefulness | Perceived interest | Intra-individual comparison | Perceived competence | Social comparison | Perceived effort |
| I do put a lot of effort in the study of mathematics. | | | | | | .854 |
| I do not put a lot of effort in the study of mathematics. | | | | | | .767 |
| I do not try to do well in mathematics. | | | | | | .496 |

## Appendix I

### Introductory Letter from Department Science and Mathematics Education

**DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION**

*E-MAIL:* dsme@ucc.edu.gh
dsme@gmail.com
*TELEGRAMS & CABLES:*
UNIVERSITY, CAPE COAST
*TELEPHONE:*
*OFFICE:* 03321-34890

FACULTY OF EDUCATION
UNIVERSITY OF CAPE COAST
CAPE COAST, GHANA

Your Ref.: Our Ref.: SED/504.1/126 Date: October 5, 2010.

**TO WHOM IT MAY CONCERN**

**RESEARCH VISIT**

I am introducing the bearer, **MR. MOHAMMED NURUDEEN ALHASSAN** an **M.PHIL (MATHEMATICS EDUCATION)** student of this Department with Registration Number **ED/MDP/09/0001** who is embarking on a research which will require the participation of staff/students in your institution /organization.

I would be grateful if you could give him your usual co-operation.

Thank you.

Yours faithfully,

Dr. Jonathan A. Fletcher
***Supervisor***

## Appendix J

### Letter to the co-ordinator- SRMIS

C/O Khadijah M.N. Alhassan,
Dean's Office,
School of Physical Sciences,
UCC,
29th October, 2010.

THE CO-ORDINATOR,
SRMIS
UCC

Dear Sir,

REQUEST FOR L-100 B.ED (MATHEMATICS) STUDENTS INFORMATION

It would be of great relief to me if you could kindly provide to me a list of all L-100 B.ED (Mathematics) students to enable me randomly select some of them who would be willing to be part of a research I am currently working on. The list should include the student name and registration number.

Sir, when the end of first semester results are published I will also need their raw scores in MAT 102-Algebra and Trigonometry for analysis. This should include the student name, registration number and the raw scores of the students in MAT 102.

I am a graduate student from the department of Science and Mathematics Education-UCC, investigating into the Relationship between First Year Students' Self-Concept, Intrinsic Motivation and Mathematics Achievement. Attached is an introductory letter from my principal supervisor for your perusal. I am counting on your usual cooperation.

Yours faithfully,

Signed

(Mohammed Nurudeen Alhassan)

## Appendix K

## Post-hoc Statistical Power Calculator for Multiple Regression

This calculator will tell you the observed power for your study, given the observed alpha level, the number of predictors, the observed $R^2$, and the sample size.

For more information about this calculator, including properties, formulae, and references, please click here.

Please supply the necessary parameters, and then click the 'Calculate' button.

| | | |
|---|---|---|
| Alpha Level: | 0.05 | Also known as the p-value, probability, or type I error rate. By convention, this value should be less than or equal to 0.05 to claim statistical significance. |
| Number of Predictors: | 1 | The total number of predictors in the model, not including the regression constant. |
| Observed $R^2$: | 0.134 | The model $R^2$. |
| Sample Size: | 89 | The total number of valid cases used in the analysis. |

Observed Power: 0.959367

## Appendix L

## Regression Coefficient Confidence Interval Calculator

This calculator will compute the 99%, 95%, and 90% confidence intervals for a regression coefficient, given the value of the regression coefficient, the standard error of the regression coefficient, the number of predictors in the model, and the total sample size.

Please supply the necessary parameters, and then click the 'Calculate' button.

| | | |
|---|---|---|
| Regression Coefficient: | 8.342 | The regression coefficient associated with a specific independent variable in the linear model. |
| Standard Error: | 2.267 | The standard error associated with the regression coefficient in question. |
| Number of Predictors: | 1 | The total number of independent variables in the linear model. |
| Sample Size: | 89 | The total number of valid cases used in the analysis. |

| | |
|---|---|
| 99% Confidence Interval: | $2.371794 < B < 14.312206$ |
| 95% Confidence Interval: | $3.836092 < B < 12.847908$ |
| 90% Confidence Interval: | $4.572983 < B < 12.111017$ |

Where B is the regression coefficient.

## Appendix M

### Effect Size Calculator for Multiple Regression

This calculator will tell you the effect size for multiple regression ($f^2$), given a value of $R^2$. Please supply the necessary parameter, and then click the

$R^2$: 0.134 Also known as the squared multiple correlation or the coefficient of determination.

Effect Size ($f^2$): 0.154