RELATIONSHIP BETWEEN PRE-SERVICE TEACHERS' SELF-CONCEPT, INTRINSIC MOTIVATION AND MATHEMATICS ACHIEVEMENT

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Abstract

The research examined the relationships between pre-service teachers' self-concept, intrinsic motivation and achievement in mathematics in a university setting. The target population for the study was Bachelor of-Education (B.Ed) (Mathematics) students in the Department of Science and Mathematics Education of the university. The sample for the correlational study was made up 89 pre-service teachers in their first year of the four year B.Ed (Mathematics) programme conveniently selected for the study. The instruments for the study were a questionnaire and an achievement test on a course in algebra and trigonometry. The study identified a strong positive correlation between pre-service teachers' self-concept and their intrinsic motivation, a moderate positive correlation between self-concept and mathematics achievement, and a moderate positive correlation between intrinsic motivation and mathematics achievement. The study further established that intrinsic motivation is a predictor of mathematics achievement. It was therefore recommended that lecturers who teach mathematics on the B.Ed (Mathematics) programme should make every effort to design and implement teaching strategies which foster the development of pre-service teachers' self-concept and intrinsic motivation in order to facilitate higher mathematics achievement among these pre-service teachers.

Keywords: Pre-service teachers, self-concept, intrinsic motivation, mathematics, achievement.

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 use 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 school level and from the latter to the tertiary level.

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-C6. Similarly, for elective mathematics, 30.29% of the 9,776 students who sat for the examination passed with grades A1-C6. Also, 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). In 2007, Ghanaian eighth graders were 46th out of 47 countries (TIMSS, 2007) with Ghana placed last in the 2011 edition (TIMSS, 2011). The reasons for the poor performance include: poorly-resourced schools; large classes; a curriculum hardly relevant to the daily lives of students; lack of qualified teachers; weak grip of content knowledge; and inability to apply basic mathematical principles by students (Ottevanger, Akker, & de Feiter, 2007; TIMSS, 2003 & 2007). Other reasons are 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 as well as ineffective supervision of instruction (WAEC, 2006; Etsey, 2005, Agyeman, 1993; Evans & Neagley, 1970).

Although these reasons are valid, one cannot be certain whether other equally important variables do not contribute to 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 mentioned in the frequently cited reasons for students' poor performance in mathematics.

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 manner in which a section of teachers teach the subject to the students. The reasons attributed to this failure, did not cover the possibility that students' perceptions of their ability or otherwise to do mathematics can influence their mathematics achievement positively or negatively.

Regrettably in Ghana, little or no attention is given to the possibility that a student's self-concept and intrinsic motivation in the study of mathematics can affect her or his mathematics achievement. A vacuum therefore existed (before the present study) in our understanding of the possible effect that self-concept and intrinsic motivation have on students' mathematics achievement.

Purpose of the Study

The study examined the relationships that might exist between pre-service teachers' self-concept (SC), intrinsic motivation (IMOT) and mathematics achievement (MA) and the effect self concept and intrinsic motivation have on mathematics achievement. The study was designed 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.

Research Questions

The following research questions guided the study:

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

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) found that as children become older, the rating of academic self-concept becomes more reliable and more stable. This claim is based 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 could 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 encompasses a comparative component in which students assess 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, determining the extent to which self-concept affects mathematics achievement.

Relationship between Self-Concept and Intrinsic Motivation

Positive self-perceptions of ability have shown to relate to measures of intrinsic motivation (Gottfried, 1990; Meece, Blumenfeld & Hoyle, 1988; 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 a favourable precondition for initiation and persistence of effort in learning and in achievement situations (Craven & Marsh, 1997; Helmke, 1989, 1991& 1992). Perseverance in the face of a challenge or difficulty is also a key feature of a mastery goal and this 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 & Mutton, 1989).

In a study involving 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 were. Green, Nelson, Martin and Marsh (2006) have observed 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 as well as that between these two variables and achievement, hence the need to examine whether such relationships exist.

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 studies 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, Mclnerncy 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 mutually reinforce 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, and Quay (1997) indicated that self-perceptions were significant predictors of subsequent school withdrawal. Likewise, academic self-concept and achievement expectancies were 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; Vrugl, 1994) because results from these studies have suggested that 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 their 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 consider 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 becomes 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's (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 Areepattamarmil 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. The study by Vialle, Heaven and Ciarrochi focused on self-esteem and not on self-concept yet both of these constructs are very closely related and are often used synonymously.

According to Byrne (1996) 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 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 and 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 states that academic achievement exerts a positive effect on academic self-concepts of students (Jen & Chien, 2008). This model maintains that past achievement, whether successful or unsuccessful, affects the formation of self-concept but that self-concept does not influence achievement (Barker, Dowson & Mclnerney, 2005). This model implies that academic self-concept emerges 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 leads to improved academic performance and that achievement does not influence self-concept (Barker, Dowson & Mclnerney, 2005). It is the position 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 & Mclnerney, 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. The present study therefore looked into the relationship that exists between students' self-concept and mathematics achievement in order to contribute to knowledge in our understanding of 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's (1985) results supported the hypothesis that academic intrinsic motivation was 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). As the longitudinal study, Gottfried's 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 B.Ed (Mathematics) students in this current research.

Fortier, Vallerand and Guay (1995) found that perceived academic competence positively related to intrinsic motivation. The study comprised 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 were used to determine school performance. It seems that students who felt competent and self-determined in the school context developed an autonomous motivational profile towards 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 that 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 Hatter'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 et. AI, 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 et. al, (1992) found that motivational orientation predicted children's standardized achievement scores. In addition, the researchers found that children with an intrinsic motivational orientation had higher reading and mathematics scores and higher overall achievement scores than their extrinsic counterparts. A later 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 (Barter, 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 were used 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 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 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. 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 judgment 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. Alphabet 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 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 (i.e the goal theory) to explain the dynamic interactions among motivational variables. This statement assumed that some kind of interaction existed among motivational variables, but these interactions had 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 using the goal theory avoid the explicit discussion of self-concept and 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 students' mathematics achievement.

Studies have repeatedly shown strong relationships between students' self-concept and measures of intrinsic motivation (Meece, Blumenfeld & Hoyle, 1988), and between 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 positively correlated with self-perceived abilities in Nicholls' and Skaalvik's (1997) studies. The finding was consistent with an understanding that performance goais are not always dysfunctional for self-perceptions and achievement, for all students at all of the time (Urdan, 1997; Dowson & Mclnerney, 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's (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. The present research expected self-concept and intrinsic motivation to predict mathematics achievement.

Methodology

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). Correlation studies are mainly concerned with achieving a fuller understanding of the complexity of phenomena or, by studying the relationships between the variables which we hypothesized as being related (Cohen, Manion & Morrison, 2000).

Population and Sample

The target population was all first year Bachelor of Education (Mathematics) students in the Department of Science and Mathematics Education. The sampling design used was non-probability convenience sampling. Students who were available and consented to participate in the work were used. In all 96 students were sampled, but only 89 submitted their completed questionnaires.

The instruments for the study were a questionnaire referred to as SC-IMOT on a 5-point likert scale ranging from strongly agree (coded 5) to strongly disagree (coded 1) and End of first semester examination in Algebra and Trigonometry. The SC portion was adopted from TIMSS, 2003 and IMOT portion was adapted from the Intrinsic Motivation Inventory (IM1) of McAuley, Duncan, and Tammen (1987).

Data Collection Procedure for the Study

The authors administered the questionnaire to 96 respondents who were to indicate the extent to which they disagreed or agreed 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 with confidentiality. The total number completed and returned questionnaires was 89. In addition, two letters 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).

Validation of Instruments

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. The content validity as well as face validity of the instruments were established by two Senior Lecturers who are experts in assessment and research methods respectively.

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) staled 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-Richardson-method, and the Cronbach alpha method. This study however employed 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 were 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 mentioned before, this study used the correlation study research design and there was a range of possible answers for each statement in the questionnaires. Therefore the Cronbach alpha method was considered 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 a-coefficients with the help of the SPSS computer software program. 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 a-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 (a = .70); intrinsic motivation thirteen items (a = .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.

Results and Discussion

The following section shows how the research questions were answered. It contains tables, figures and diagrams of the analysis in response to the research questions. The findings on each research question are discussed before the next research question is considered.

Research Question One: Findings and Discussion

Research question one was: "what is the relationship between students' self-concept and intrinsic motivation towards the study of mathematics?" It sought to find out if a significant relationship exists between self-concept and intrinsic motivation in the study of mathematics. The Table 1 shows that, the mean score on each of the constructs was approximately 4, indicating that, students generally responded favourably to the statements on these two constructs. Deviations were less than 1 standard unit from the mean, which is minimal.

Table 1: 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 (Listwise) 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.

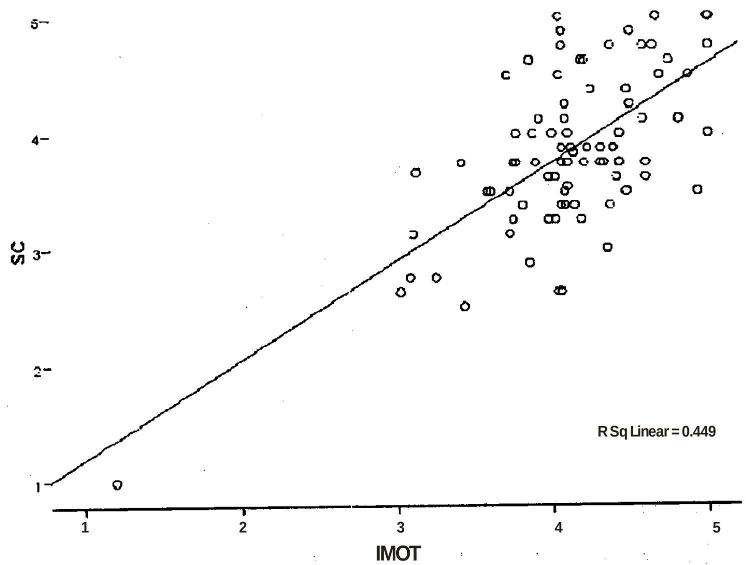

Figure 1. A scatter plot of students' Mathematics Self-concept and their Intrinsic Motivation in the study of Mathematics

A scatter plot summarizes the results in Figure 1. 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 2: 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).

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 2).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's (2000) conclusion that intrinsically motivated students engage in behaviours of interest and importance, and this is maximized 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) has stated that, developing academic intrinsic motivation is 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 a 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 the results of others in the subjects is likely to be the basis 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 this, of course, depends on the importance and 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 into 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 basis of her or his intrinsic motivation. In this study, students saw 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.

Research Question Two: Findings and Discussion

Research question two was: “what is the relationship between students’ self-concept and mathematics achievement?” It sought to find if there exists a significant relationship between students' self-concept and mathematics achievement.

Table 3: Descriptive statistics of students’ self-concept and achievement in Mathematics

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 3 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 achievements core was satisfactory by the university’s Academic Board standards.

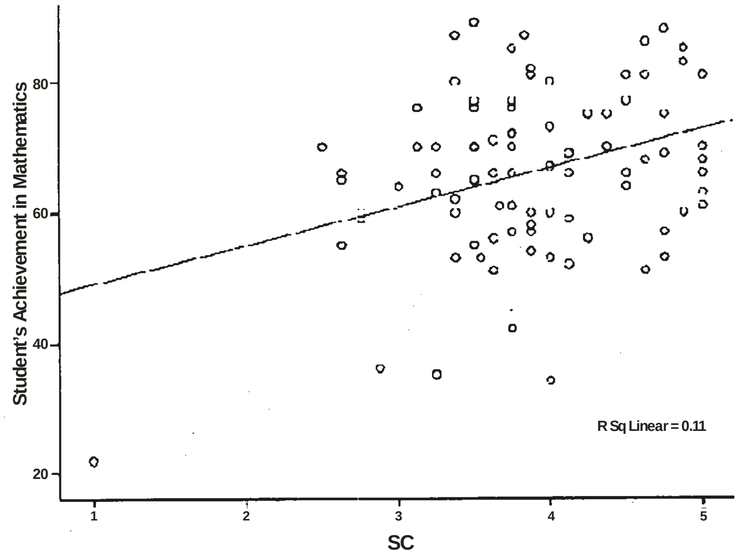

Figure 2. A scatter plot showing students' mathematics achievement and their self-concept.

A scatter plot summarizes the results as in Figure 2. 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 4: 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).

A Pearson product-moment correlation coefficient was computed to assess the relationship between students' self-concept and mathematics achievement. There was a moderate and significant positive correlation between the two variables, $r = .332$, $n = 89$, $p = .001$ (as shown in Table 4). 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 conclusion (as cited in Hamachek, 1995) 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 the basis 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 a moderate achiever in mathematics is more likely to be a student with a moderate self-concept. Hence, students' self-concept significantly correlates moderately and positively with their mathematics achievement.

Research Question Three: Findings and Discussion

Research question three was: "what is the relationship between students' intrinsic motivation and mathematics achievement?" It was designed to find if there exists any relationship between intrinsic motivation and mathematics achievement.

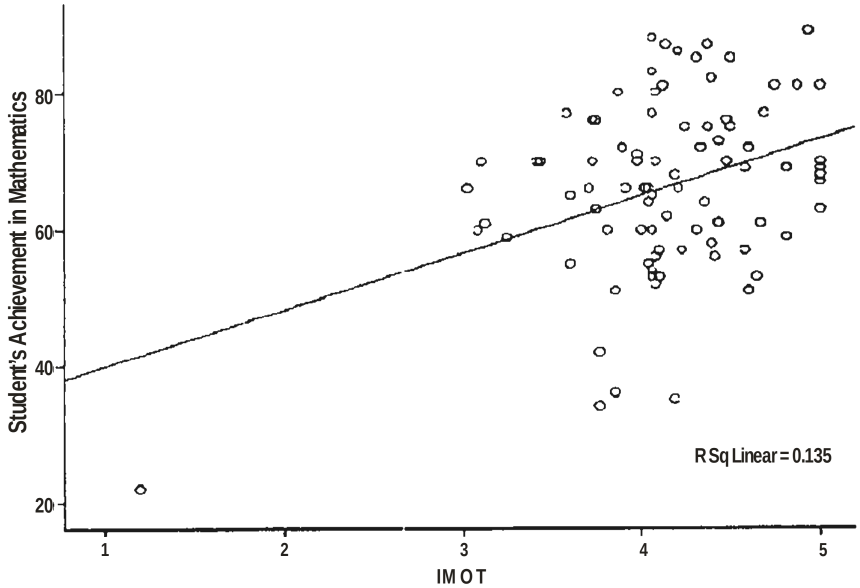

Figure 3. A scatter plot showing Students' Mathematics Achievement and their Intrinsic Motivation

A scatter plot summarizes the results in Figure 3. 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 3, four students exhibit low mathematics achievement but high intrinsic motivation. It also shows that one student obtained both exceptionally low intrinsic motivation and mathematics achievement.

Table 5: Correlation between Mathematics Achievement (MA) and Intrinsic Motivation (IMOT)

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

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

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 5), 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) study in which 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 moderately and positively with their mathematics achievement.

Research Question Four: Findings and Discussion

Research question four was "to what extent is first year students' mathematics achievement affected by their Self-concept and Intrinsic motivation?" This question sought to find out if mathematics achievement can be 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.

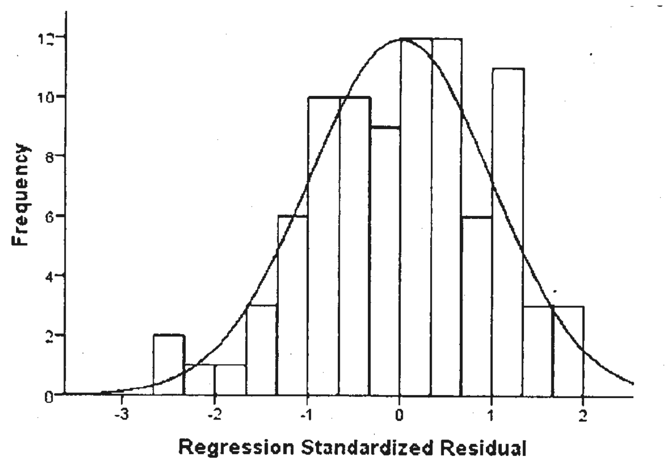

Figure 4: A histogram showing regression standard residual of students' self-concept, intrinsic motivation and mathematics achievement.

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 4) 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 tests 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 meaning the residual values are uncorrelated. In this research the Durbin-Watson test statistic was 1.893 which is approximately 2, thereby fulfilling yet another condition for conducting multiple regression analysis.

Table 6: 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: ΔR^2 = -.014 for step 2 (Ps<.246).*p<.05, **P<.001. Dependent Variable: Student's Mathematics Achievement.

In model I, self-concept and intrinsic motivation were regressed on mathematics achievement. These two predictor variables accounted for 15% (as shown in Table 6), of the variability in mathematics achievement, which is significant, F (2, 86) = 7.482, p = .001 (as shown in Table 7). 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) and Skaalvik and Rankings (1995, 1996) assertions. In model 2, a backward stepwise linear regression analysis revealed that self-concept is not a significant predictor of mathematics achievement, which explains why it was dropped. The results obtained in Table 6 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 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 7.

Table 7: 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 + 8.134 (IMOT)

This result means that students' intrinsic motivation is a significant predictor of students' mathematics achievement as shown by the prediction equation [MA = 31.592 + 8.134(IMQT)] at the bottom of Table 7. 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 positive change in intrinsic motivation, mathematics achievement is predicted to be about 8 units higher. 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 Calculators. The power of final model is .959, with confident interval $3.836 \leq \beta \leq 12.848$. The final model has an effect size of .2, which is moderate and in line with the conclusions drawn from the model.

The finding here, goes contrary to Goldberg and Cornell's (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 (β = .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's (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. 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.

Conclusion

To conclude, intrinsic motivation is the only variable that has a significant and direct likely positive effect on mathematics achievement. In this research, 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.A summary of the research findings is given below:

1. The study identified a strong positive correlation between self-concept and intrinsic motivation.
2. A moderate positive relationship between students' self-concept and their mathematics achievement.
3. The research identified a moderate positive correlation between mathematics achievement and intrinsic motivation.

The main conclusion of the research is that although both self-concept and intrinsic motivation are significantly related to mathematics achievement, it is intrinsic motivation that can predict students' achievement in mathematics.

Recommendations

Based on the findings of the present research, the following recommendations are made:

1. The Department of Science and Mathematics Education should make every effort to design and implement teaching strategies that foster the development of students' 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 have the ability to enhance students' self-concept and intrinsic motivation.
4. Lecturers concerned should establish formative assessment strategies that will enhance students' intrinsic motivation with regard to the learning of mathematics.

Limitations of the Study

One limitation of the study is that the data were collected from the first year students majoring in mathematics in the Department of Science and Mathematics Education in only one university so the findings were limited to only this group in that university. The second limitation is that, the respondents were conveniently selected so again, it is to this group only that any generalisations could be made.

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