The Factors that Influence Mathematics Achievement at the Berbice Campus

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Abstract

MTH 111 is a first year first semester Algebra course for all Natural Sciences students at the Berbice campus. At the first sitting of the course about 50% of the students secure passing grades of 40% and above. The aim of the research was to determine the factors which influence student performance in the course and isolate the best set of predictors. Pearson's correlation conducted on the data collected from 111 students enrolled on the MTH 111course at the Campus over the academic years 2010/2011 and 2011/2012 revealed that prior academic achievement, self-efficacy, academic resources, self-regulation and learning styles were positively correlated to MTH 111 performance at the $p < .05$ *level. Multiple regression analysis utilizing the stepwise method indicated that the best set of predictors were prior academic achievement, learning styles and academic resources which accounted for 44.1 % of the variation in MTH 111 performance at the* $p < .05$ *level.*

Keywords: academic performance, prior academic achievement, self-efficacy, self-regulation, academic resources, learning styles, mathematics achievement

1. Introduction

The factors that influence mathematics achievement has for decades been of interest to policy makers, education practitioners, researchers and society at large because of the far reaching consequences of underperformance in the subject. The success students achieve in Mathematics has consequences not only for the students' personal and professional lives but also for national development. The announcement to recruit graduate teachers in Mathematics from abroad by the Cabinet Secretary, Dr Roger Luncheon, at the behest of the Ministry of Education (Stabroek Editor, 2011) aimed at filling the gap in the paucity of effective Mathematics teachers in the country. Additionally, the meeting held to formulate added measures to improve Mathematics performance by the Minister of Education, Mr Shaik Baksh, with the various heads of secondary schools after the 2010 Caribbean Secondary Education Certificate (CSEC) realizedonly a 34 % pass rate in Mathematics(KNews, 2010)underscores the seriousness with which the underperformance in the subject is viewed. While the performance in mathematics at CSEC came under the national spotlight the completion of Algebra (MTH 111**)** at the University of Guyana, Berbice Campus needs to be addressed given the fact that successful completion of the course could generate an impact not only on students' personal and professional lives but also on the mathematics performance of secondary school students since graduates represent a potential supply of mathematics teachers to supplement the depleted labour market.

1.2 Statement of the Problem

MTH 111 is a first year first semester Algebra course for all natural science students at the Berbice campus. Over the academic years 2005 to 2011, student performance in the course has been poor. At the first sitting about 50% of the students achieve less than 40% of the marks. The results of the academic year 2010 to 2011 show an approximate 65 % failure rate, a rise of 9.7% over the last academic year's performance. The implication of such low student achievement in the course means that many students cannot pursue the follow-up Mathematics 121 (MTH 121) course. Moreover, failure to achieve 40% or more in this course means that a student will take longer than the stipulated time to graduate a specific programme of study. Poor performance in this area also lowers the Grade Point Average (GPA) of students.

This leads one to ask the questions: Is the underperformances in MTH 111 related to prior mathematics achievement at the CSEC level or is the underperformance related to other factors?

1.3 Research Questions

The investigation sought answers to the following issues and concerns:

1. Is there a significant relationship between students' prior mathematics performance and that demonstrated on MTH 111 course?
2. Is there a significant relationship between students' mathematics self–efficacy and performance demonstrated on MTH 111 course?
3. Is there a significant relationship between students' academic self-regulation and performance demonstrated on MTH 111 course?
4. Is there a significant relationship between academic resources and student performance demonstrated on MTH 111 course?
5. Is there a significant relationship between students' learning styles and performance demonstrated on MTH 111 course?
6. What is the best set of predictors of performance demonstrated on MTH 111 course?

1.4 Objectives of the study

The purposes of the study were to:

1. Identify the factors that influence student performance in MTH111 (Algebra) in the Division of Natural Sciences at the Berbice Campus.
2. Identify the best set of predictors ofMTH 111 performance.
3. Provide instructors and students with a means of remediation.

1.5 Definitions of terms germane to investigation

- **Prior mathematics performance** means performance demonstrated at CSEC or level considered eligible for acceptance in the university/programme.
- **Mathematics self-efficacy** means students perceptions of their ability to perform a mathematical task (Bandura, 1994; Pajares, Self-Efficacy Beliefs in Academic Settings, 1996).
- **Academic self-regulationfactors** refer to students' ability to monitor, evaluate and make plans for their learning – their study habits.
- **Academic resources** refer to the physical and material resources required to enable students to achieve academic excellence.
- **Mathematics performance** is the final grade consisting of course work assessments and at end of semester examination.
- **Learning style** is the diverse ways that students learn.

1.6 Assumptions of the Study

The study assumed that the instrument developed by the researcher can reliably measure the constructs under investigation and the veracity of students self-reports can be relied on.

1.7 Associated significance of the Study

It was envisioned that the isolation of the factors that influence student achievement in MTH111 in the Division of Natural Sciences at the Berbice Campus would present instructors and learners with a means of designing and using intervention strategies thereby fostering improved results; enable the instructors and students at the Turkeyen Campus to take proactive measures in the teaching and learning of Algebra; and add to the body of knowledge existing on the predictors of mathematics achievement in higher education since no study to date has investigated the factors that influence mathematics achievement with the population identified using the variables in the research questions posed.

1.8 Limitations of the Study

The method of data collection, the unique characteristics of the sample and the type of statistical analyses used usually impose limitations on studies. Since the study was an analytical survey one based along correlational lines, the implied limitations were that students might have given the socially acceptable response to the statements posed by the various research questions; the study did not involve lecturers reports or direct classroom observations; inferences from the study's findings were limited to students at the Tain Campus; the use of correlation and multiple regression analysis strategies does indicate causality of behaviour.

2. Review of Related Literature

The literature has a plethora of investigations designed to identify factors that exert some influence on students' performance in academic settings. Among the factors identified as predictors are prior academic achievement, self-efficacy beliefs, self-regulation, students' learning styles and academic resources.

2.2Prior academic achievement

Of all the constructs in the cognitive domain, the one considered the strongest predictor of academic success is prior academic achievement (ACT, 2007) which according to Sxhiefe and Csikszentmihalyi (1995) strongly influences students' mathematical ability. Morrison and Schmit (2010), using logistic regression analysis, found that American College Testing (ACT**)** mathematics score and high school GPA were significant predictors of achieving a C or better in Mathematics for Liberal Arts. Similarly, Hailikari, Nevgi, and Komulainen (2008) in a study involving 139 students at a university found that prior knowledge was the strongest predictor of student achievement on mathematics. According to ACT (2007), prior knowledge does not only affect student performance but also determines student persistence in college and serve to reduce the difference in success among racial/ethnic and income groups. But, research by Rech and Harrington (2000) into the effect of ACT on mathematics achievement between black and white men found a significant difference between their scores even though their mathematics background were similar based on ACT mathematics score. Given the relationship of prior mathematics achievement to subsequent mathematics achievement the significance of the variable is worth investigating in the light of the troubling mathematics performance demonstrated at MTH 111.Besides prior mathematics achievement, students' self-efficacy beliefs have also been found to affect academic performance.

2.3Self-efficacy

The concept of self-efficacy has its roots in Bandura's Social Cognitive Theory and rests on the premise that individuals' beliefs about themselves propel them to act in ways to either overcome obstacles in pursuit of desired goals or cave in to them (Pajares, 2002). Self –Efficacy is defined as the conviction that one can successfully execute the behavior required to produce the outcome (Bandura, Self Efficacy: Toward a Unifying Theory of Behavioral Change, 1977). The more self-efficacy persons possess the more likely they are to persist at an activity even in the face of adversity (Pajares, 1996). The self-efficacy that a learner possesses directly affects his or her ability to learn. Self-efficacy is a fundamental belief in one's ability to reach a goal. If you believe that you can learn new behaviours, you will be much more successful in doing so (Fritscher, 2009, p. 1).Bandura (1994) opined that people who have immense confidence in their ability usually stay committed to the task and in the event of failure their lack of success does not crush them but attribute failure to the amount of effort put in by them. He identified four effective ways by which students with high self-efficacy keep themselves focussed.

The first most effective mode is through mastery experience. When students achieve success they develop strong efficacy beliefs. However, failure experiences undermine their beliefs. Further, students who are accustomed to quick successes usually are unable to persevere in the event of failure. Such experiences tend to lower self-efficacy beliefs regarding the particular activity/subject. The second way students create and sustain their personal efficacy beliefs is through the vicarious experiences provided by social models. Observation of peers achieving success usually engender self- efficacy in students. They believe that if others can do it so can they. The converse is also true. Thus the success of models in engendering the requisite behavioural response hinges on models possessing the competences which are aspired.

The third way in which students efficacy beliefs can be fostered is through social persuasion. The impact of such persuasion on students' performance is evidenced in the self-fulfilling prophesy (Katz, 1960; Wilkins, 1976). Students who are convinced verbally that they can accomplish a particular task usually exert greater effort and persevere until the task is accomplished. Telling a student that he /she cannot accomplish a task usually produces self-doubt in them and causes them to avoid challenging tasks that can endue them with personal self-efficacy. Bandura cautions however, that unrealistic persuasion should be avoided because it could cause students to develop false beliefs about their abilities which are usually disconfirmed when the success envisioned does not occur. He recommends that students should not be given a task before they are ready and thus avoid the consequences of self-doubt which arise as a result of failure. Students' progress, he believes, should be measured against their past achievements and not the achievement others.

The fourth way in which students' self-efficacy could befostered is through reducing their stress reaction and altering their negative emotional tendencies and misinterpretation of their physical state. In this way students will view their reaction to a particular task as a challenge to be overcome and work towards that goal rather that avoid the task altogether. Evidently, students who do not receive passing grades in MTH 111 may attribute failure to lack of ability which would undoubtedly impact them emotionally. They may develop a dislike for the course and ultimately utilize avoidance techniques. However, the determination of students' state of mind required the use of the observation technique not employed by the study to gather data.

According to Schunk (2008) high achievers usually possess high self-efficacy levels while the converse is true of low achievers. Notwithstanding this people with high self-efficacy have been found to display low expectancy outcomes. Low expectancy outcomes however are not related to self-efficacy beliefs but are expressed in cases where students believe that a teacher might not have graded them fairly.

The ability of self-efficacy to engender success has been found to be a strong predictor of academic achievement in college (Robbins, et al., 2004; Zajacova, Lynch, & Espenshade, 2005). Similarly, Kitsantas, Winsler, and Huie (2008) found that self-efficacy partly predicted academic performance. Further Onyeizugbo (2010) examined self-efficacy and test anxiety as correlates of academic performance of undergraduate students, using correlation and multiple regression analysis and found that a positive correlation existed between self-efficacy and academic performance. Moreover,Suthar and Tarmizi (2010) using logistic regression analysis to determine the effects of students' beliefs on mathematics and achievement of university students, found significant relationships between student beliefs of the importance of mathematics and mathematics ability with mathematics achievement.

But, contrary to these findingsHailikari, Nevgi, and Komulainen (2008), found that general student self-perceptiondid not directly influence student achievement at course level and that statements such as "I'm good at mathematics", were not valid predictors of student achievement. Evidently, students' confidence in their ability alone to achieve an outcome is not the sole and sufficient predictor of mathematics achievement but that other variables such as students' belief about the importance of mathematics and mathematics ability are relevant (Suthar & Tarmizi, 2010). Moreover, Pajares (1996) believed that self-efficacy will have no bearing on performance if schools lack effective teachers, necessary equipment, or the resources students require to perform academic tasks.

2.4Academic resources

The availability of academic resources appears to play a pivotal role in student performance. TheWorld Bank (2000) report on higher education attributes the many problems facing universities and students in developing countries to lack of resources due primarily to insufficient financial funding. The World Bank cites inadequate libraries and computer laboratories that are rarely open among others as evidence of the paucity of funding received by these institutions.

Research by Yousuf, Imran, Sarwar, and Ranjha (2011) utilizing the Nominal Group Technique to investigate the non-cognitive variables of academic achievement considered necessary for better performance at higher education by students at the masters level, found that 'book consultation' among other variables accounted for students' success at university level.Allen (1987)literature review of reasons for any qualitative differences in the experiences of blacks who attended colleges not in keeping with their ethnicity found that adequate computer facilities in addition to other non-cognitive variables were essential to their success.Further, research by Huon, Spehar, Adam, and Rifkin (2007)among 514 first year students (mainly Science majors)enrolled on a psychology course at the University of Wales, using multiple regression, foundthatthe use of textbooks, web-based lectures notes and online quizzes did not guarantee a high mark but was correlated to students individual assessment and final marks. Additionally, studentspreferred resources linked to what would be assessed rather than those that engaged deeper levels of learning.

Given the fact that the University of Guyana is a public institution ofhigher learning which receives funding from the Government of Guyana (GOG) and the inability of such funding to provide necessary resources to promote students' academic pursuits an investigation into the effect of the availability of academic resources as defined by this studyon student performance in MTH111 appears opportune.In addition to prior academic achievement and self-efficacy and academic resources, researchers have also found that a relationship exists between students' ability to self-regulate i.e. make plans for their own learning and academic achievement.

2.5Self-regulation

Self-regulation may be definedas the ability of students to monitor, evaluate and make appropriate plans for their learning. According to Kitsantas(2002) and Zimmerman (2008) cited in Kitsantas, Winsler, and Huie (2008)academic self-regulation is displayed by students who are independent, self-initiated learners with the ability to use a variety of learning strategies, such as organizing, transforming, note taking, to accomplish specific learning goals.

In a study conducted to isolate the variables that predicted success in Intermediate Algebra -Mathematics 108-Belcheir (2002)found that students' study skills and motivational levels besides knowing their gradeat mid–term, predicted how well they would perform on the common final examination. In additionBenford and Gess-Newsome (2006) posited that students whowithdrew, failed or obtained poor grades in gateway courses that included mathematics, used ineffective study skills. A meta-analysis conducted by Robbins, et al. (2004) into the relationship between psychological and study skills factors and college outcomes suggested that study skills are precursors of positive class performance, which later drive achievement and persistence behaviour. Additionally, partial support was found for the effect of other self-regulatory practices such astime management in predicting academic performance during the first year and influencing the second year performance as well(Kitsantas, Winsler, & Huie, 2008).

Zimmerman (1990, p. 14) believed that self-regulated learners usually employ systematic metacognitive, motivational and behavioural approaches to learning, are responsive to feedback regarding their learning and hold strong views of academic accomplishments. He recommended that instructional approaches which focus onthe metacognitive, motivational and behavioural aspects of learningshould be utilisedand that attemptsto foster thesedimensions in students would engender long lasting academic learning.Effective study skills has some impact student performance and where manifested the student is likely to exhibit independence using a variey of learning styles to achieve and improve their academic performance in MTH 111.

2.6Learning Styles

The term learning style refers to the concept that individuals differ in regard to what mode of instruction or study is most effective for them (Pashler, Daniel, Rohrer, and Bork, 2008, p. 105). According to Silver, Strong, and Perini (2000) the concept dates back to ancient Greek all the way to the Renaissance. They linked the learning style concept to Hippocrates "FOURNES" which when not in equilibrium cause personsto exhibit four types of personalities and William Blake's description of the four Zoas of human existence: the body and its senses;the heart and its capacity for love; the head and its ability to reason; and the spirit and its potential for creative imagination seem similar to that of Hippocrates. Silver et al. (2000) believed that evidence of the learning style concept can also be found in the spiritual stories of Indians of the North American Plains. The four human personality traits are given as wisdom, clarity of perception, introspection, and understanding one's emotions. Carl Jung (1923) cited in Silver et al. (2000) reclassified human "FOURNESS"and advanced that humans use perception and judgement as cognitive functions to process information.

According to Jung perception is used to process information either through the senses or intuition while judgement is demonstrated through logic of thinking or subjectivity of feeling. Jung's model of the way people process information seems to have motivated educational researchers to develop the many theories regarding the learning styles of students. In this regard, Silver et al. (2000, p. 28) identifies four types of learners: the mastery learner who operates under the sensing thinking realm and learns best from drill, demonstration, practice , hands on experience;the understanding learner who operates under the intuitive-thinking realm and learns best through lectures, reading logical discussion and debates, and projects of personal interest; the interpretative learner who operates under the sensing-feeling realm and learns best from group experiences and projects, loving attention, personal expression and personal encounters, role playing; and theself-expressive learner who operates under the intuitive-feeling realm and learns best from creative and artistic activities, open ended discussions of personal and social values, activities that enlighten and enhance myths, human achievement, dramas.

Small (2001) suggest that the content of College Algebra should focus on real world problems, emphasize problem solving in the modelling sense, and include elementary data analysis. He opined that teaching should be student centered, make use of appropriate technology and aim to develop communication skills via small group activities and projects to infuse positive experiences and confidence among students.

While no specific learning style was implied by Small the suggested learning activities could be used to describe the three types of learners identified bySilver et al. (2000) i.e. mastery, intuitive and interpretative. Further, Ng, Pinto, and Williams (2011)investigated the effects of learning styleson course performance of approximately forty students on a business statistics course. They used an interpretive and learner centered approach as well as learning activities that emphasised the applicability of the course studied tothe real world. The study found that learning style was not a significant determinant of students' overall course scores for the entire group of students despite designing the course to facilitate the diverse ways in which students processed information and emphasising deeper approaches to learning. However, learning styles were significantly related to the average obtained at examination for some subjects from the same sample used in the investigation discussed.

The findings of Ng et al. (2011) while specific to the survey statistics course investigated, have implications for the performances demonstrated byMTH 111students. The possible positive effect that accomodating the diverse ways in which students learn might have contributed to whatever increment in student achievement observed in the course. Limited,support is given by the "meshing hypothesis' concept which posits that instruction is best provided in a manner that suits the learning style of students (Pashler et al., 2008).Herington and Weaven (2008) utilizing an action research approach to explore methods of improving the learning styles and outcomes of first year university students within larges class environments found that the employment of a student centered teaching approaches did not enable students to employ deeper methods of self regulating but served as a motivating tool. They attributed the lack of development of a more sustained deeper learning style to the previously developed learning style of students which may have to be unlearnt before a new one is learnt. They further opined that enabling students to transcend surface learning might pose a significant problem for tutors since acquiring a deeper learning style might entail several interventions.

However Riener and Willingham(2010) believe that the learning style theory is a myth. They agree that since differences among learners tend to affect their performance, they should be taken into account by teachers. They contend though that other factors such as learners ability, background knowledge, and interest vary from person to person and when learning styles are emphasized these important elements are neglected in the analysis of their effect on learning. On the contrary, Rech and Harrington (2000) believe that when mathematical backgrounds of ethnic groups are similar but mathematics achievement is different that the learning preference, among other variables, of these group should be investigated to determine what interventions could occur to improve performance. Clearly, any research into the factors that influence MTH111 (Algebra) performance should also take cognizance of the preferred way in which students learn since the diverse findings indicate the possibility of the variable influencing performance at the course and examination level. Additionally, the findings may confirm or disconfirm the importance of utilizing a student centered approach to the teaching of MTH111.

3. Methodology

An analytical survey based along correlational lines was used to determine the relationships between the variables identified in the research(Collis & Hussey, 2009).

3.2 Population

The population of the study comprised193 students enrolled in MTH 111 in the Division of Natural Sciences at the Berbice Campus of the University of Guyana during the academic years 2010/2011 and 2011/2012. GivenCollis and Hussey (2009)caveat that a sample size of 132 from a population of 200is required if inferences are to be made about the population and that the population under study closely approximated 200, a random sample of 132 students was selected. Of the 132 students sampled, the response rate was approximately 84% (111). The data revealed that 82.9% of the students were within the 17 to 20 age group, with females outnumbering males by 8.2%. Biologywas the major of 47.7% of the students. The ethnic composition of the sample was 69.4% Indian Guyanese, 17.1% African Guyanese, 12.6% mixed, and .9% Chinese Guyanese. Further details are provided in Table 1.

3.3 Instrumentation

Data from 2 sourceswereused to isolate influencers of MTH111performance. The primary source was a five-sectionedquestionnairecomprising close-ended multiple-choice items which was administered to students. While the first sectionsolicited demographic data and prior mathematics achievement; the other sections solicited opinions on the availability of academic resources; mathematical self-efficacy beliefs, academic self-regulation and learning styles.

The availability of academic resources, self-efficacy; self-regulation and learning style posed statements that required students to respond using threedifferent Likert 5 point scales formatsthat solicited responses that ranged from strongly agree to strongly disagree, every time to never and very true of me to not at all.Individual items were scored 1 to 5 and the reverse for negatively and positively worded statements respectively. Responses werethen summed to provide a sub score for each of the variables investigated.

The researcher developed questionnaire consisted of statements adapted and or modifiedfrom surveys carried out by Benford and Gess-Newsome (2006),Lee, Zeleke, and Meletiou-Mavrotheris (2004), Belcheir (2002) and Cheoney and Cooney (2005).Though the studiesof Benford and Gess-Newsome (2006), Lee et al. (2004), Belcheir (2002) andCheoney and Cooney, (2005)did not exactly parallel the proposed study,some statements were considered suitable to provideanswers to the research questions posed by the study. Only two of the studies specified the reliability of the instruments used. Lee et al. (2004) indicated that the instrument developed by them consisted of a modified collection of items taken from the validated instruments of Bigg's Study Process Questionnaire (1987) and Bessant's Learning Preference Survey (1995) among others. Cheoney and Cooney (2005), whose Mathematics and Statistics Perception scale statements guided the self efficacy statements on the instrument developed by the researcher, indicated a Cronbach Alpha of.946.

The researcher developed instrument was piloted tested using 15 MTH 111 students not included in the sample population, to ascertain the veracity of the statements posed, whether they were understandable and appropriately worded and the time taken to complete.

Tests of internal consistency indicatedCronbach Alpha indicesof .902, .695 and .50 for the self-efficacy,learning styles and self-regulation variables respectively. When adjustments were made to the learning style variable by removing a question as suggested by the reliability analysis conducted using SPSS17.0 the internal consistency index was .763.A known method for improving the internal consistency of a measurement instrument/concept is to include more items (Stats Soft , n.d)hence the number of statements for the variable self-regulation was increased to 11. A measurement specialist attached to the University of Guyana Turkeyen Campus also reviewed the instrument. Consequently the construct academic resources wasrevised to enable students to give their opinion on a series of statements by selecting from a range of responses (5 = strongly agree to 1= strongly disagree) instead of the multiple choice format previously used which required them to select a single answer.

Tests of internal consistency of the returned instrument yielded Cronbach Alphas for self-efficacy, .907; learning styles, .833;self-regulation, .751; and academic resources .836. The reliability indices were higher than those obtained when the instrument was piloted tested (.902, .763, .50 for the variable self-efficacy, learning styles and self-regulation variables respectively). The single item multiple choice responseformat of the academic resource statements on the piloted tested instrument did not allow for tests of reliability to be conducted on the construct.
The survey data was supplemented by students'MTH 111and prior academic performances obtained from the records of the University of Guyana Berbice Campus and used to verifyresponsesregarding the variables obtained from the student survey.

3.4The Procedure

Taking cognizance of the ethical issues implied permission was sought from the Director and Assistant Director of the University of Guyana, the Coordinator of the Faculty of Natural Sciences, the Lecturer of MTH111 and studentsrespectively.Letterssought permission to enter the site and collect data. In addition to explaining the purpose of the research and how participants and the campus as a whole could benefit, the letters gave assurances of confidentiality. The instruments were distributed by the researcher to the students at a meeting that was set for such a purpose. Prior to the distribution of the questionnaire the researcher explained the purpose of the survey and asked students to answer the questionnaire truthfully since it will have consequences for the findings and any intervention strategies that may be subsequently developed there from. Students gave permission to access their academic records by the signing of the consent letter that outlined the purpose of the research and explained howthe information obtained will be used. The researcher also signed this letter as an indication of good faith.

3.8 Data Analysis

There are varying views regarding appropriate statistical analyses which could be used with data collected via Likert formats.

Research indicates that Likert data can be analysed using parametrictests (Boone & Boone, 2012; Brown, 2011; Creswell, 2008; Norman, 2010) even when the sample size is small, distributions are not normal, and unequal variances without fear of arriving at wrong conclusions(Norman, 2010). Creswell (2008) suggestion thatsince data obtained using Likert scales or Likert type scales could be classifiedas either interval or ordinal, the researcher has the choice of analysing the data using parametric or non parametric tests. Further, he suggested in treating Likert data on interval scales researchers should develop multiple categories or choices within a scale,determine whether their data are normally distributed, and establish equal distance between each value of the scale(Creswell, 2008, p. 176). The caveat that where the equal distance principle cannot be applied, data from Likert or Likert type scales should be treated as ordinal scales should be noted.

Given the controversial views regarding the treatment of Likert data and taking cognizance of Creswell's views, the Likert data collected coded 1 to 5 was converted to continuous data by summing the responsesto the statements measuring each variable to arrive at a sub score for the scale.This allowed for the treating of the Likert scale datacollected as interval data (Boone & Boone, 2012; Brown, 2011; Creswell, 2008). Additionally, the MTH 111 performance data collected comprised students' composite scores on the mid-term and final examinations and the prior academic performance data comprised of the grade students obtained at CSEC and categorised on a scale of 1 to 5 with 5 being the highest grade attainedwere also treated as interval data. Pearson Product Moment Correlation Coefficient (r) was then used to ascertain whether significant relationships existed between the dependent and independent variables as specified in the research questions posed and the Coefficient of Determination (r^2) the proportion of common variability. Independent variables with significant path coefficients were input into a multiple regression model to isolate the best set of predicators of MTH 111. The stepwise method was employed in the analyses.The criterion for determining significant path coefficients was set at the 0.05 confidence level. Prior to statistically analysing the data missing values were replaced by the mean of the respondent scores on the items on the scale (Wuensch, 2009). SPSS17.0 was used to analyse the data.

4. Results and Discussion

Research question 1

Research question 1 sought to ascertain whether a significant relationship existed between students' prior mathematics performance and that demonstrated on MTH 111.The Pearson'scorrelation was used to determine the relationship between prior mathematics performance i.e. Caribbean Secondary Education CertificateMathematics grade and MTH 111performance. The analysis indicated a moderate butpositive correlation of r of $.553$ as indicated in Table 2.Since the correlation was positive at $p < .05$, it could be posited that high grades atCSEC are related to high performance in MTH 111and that 30.58% of the variability (r^2 =0.3058)in MTH 111 performance was somewhat related to prior mathematics performance at CSEC**.**This is consistent with the findings of Sxhiefe and Csikszentmihalyi (1995)that prior academic achievement influences students' mathematical ability.

Research question 2

To ascertain whether any significant relationship existed between the description of students' mathematics self-efficacy and their performance on MTH 111, the Pearson correlation coefficient was calculated. The analysis yielded a moderate butpositive correlation r of. 419 at the $p < .05$ as indicated in Table 3. This is consistent with the findings of Onyeizugbo (2010) who examined self-efficacy and test anxiety as correlates of academic performance of undergraduate students and found that a positive correlation existed between self-efficacy and academic performance but inconsistent with the findings of Hailikari et al. (2008), who found that general student self-perceptiondid not directly influence student achievement at course level. However, since the coefficient of determinationr^2 = 0.1756 (17.56%) it could be inferred that mathematics self-efficacy does not explain much of the variability in MTH 111 performance and that other variables might.

Research question 3

Research question 3 sought to determine whether a significant relationship existed between students' academic self-regulation and performance at MTH 111.The Pearson correlation between the variables yielded a positive but weak correlation of rof .360at the $p < .05$ level as shown in Table 4. This is consistent with the findings of Robbins, et al. (2004)that good study skills are precursors of positive class performance.However, since the coefficient of determination $r^2 = 0.1296$ (12.96%) it could be inferred that academic self- regulation does not explain much of the variability in MTH 111performanceand that other variables might be responsible.

Research question 4

Research question 4 sought to ascertain whether there was a significant relationship between academic resources and student performance at MTH 111.The Pearson correlation between the variables yielded a moderate but positivecorrelation $r$of $.447$at the $p < .05$ as indicated inTable 5. This is consistent with research by Huon et al. (2007) that the use of academic resources was correlated to students' individual assessment and final marks and supportive of the World Bank (2000) position that academic resources are pivotal to the success of students and universities in developing countries.However, since the coefficient of determination $r^2 = 0.1998$ (19.98%) it could be inferred that academic resources is not able to explain much of the variability in MTH 111 performance.

Research question 5

The focus of research question 5 was to determine whether a relationship existed between students' learning styles and performance at MTH 111.The Pearson correlation between the variables revealed a moderate but positive relationship between students preferred learning styles and MTH111performanceof $.414$at the $p < .05$ level (Table 6). The indications are that the more the teaching methods cater for these diverse learning styles of students the better the performance in MTH 111**.**This is consistent with the findings of Pashler et al. (2008) that the learning styles of students impact performance but inconsistent with those Herington and Weaven (2008). However, it could be inferred from the coefficient of determination r^2= 0.1713 (17.13%) that learning styles does not explain much of the variability inMTH 111 performance and that other variables might be accountable.

Research question 6

Research question 6 sought to ascertain the best set of predictors ofMTH 111**.**The variables with significant path coefficients were input into a multiple regression model and the stepwise method was used to identify the best set of predictors of MTH 111 performance. The analysis in Table 7 revealed that the best set of predictors were the variables prior mathematics performance, academic resources and learning styles as evidenced by Model 3. All three variables are statistically significant at the $p < .05$ $level.$ The Standardized Beta coefficients in the table reveal that the greatest influence on MTH 111 performance was prior mathematics performance (beta = .435) followed by learning styles (beta = .254) and then academic resources (beta = .213).

The unstandardized coefficient for prior mathematics performance was 9.366 indicating that for every one point improvement in prior mathematics performance as measured by the CSEC grade there will be an increase in MTH111 performance by 9.366 points when all other variables are held constant. The results are consistent with the findings of (American College Testing, 2007; Morrison & Schmit, 2010) which indicate that prior knowledge in mathematics strongly influences academic achievement.

The unstandardised coefficient for learning styles was .897. When examined in the light of the summed responses as the overall for each individual to the learning style statements the indications were that each time the teacher accomodates another student centered learning style in the teaching and learning sequence, student performance will rise by .897 holding the other variables constant. The results are consistent with the "meshing hypothesis' which advocates that the best instruction is provided in a manner that suits the learning style of students (Pashler et al., 2008). However, these findings appear inconsistent with those of Herington & Weave (2008) who found that student centered teaching approaches did not enable students to employ deeper methods of self regulation but as a motivating tool for increased participation in class activities.

The unstandardised coefficients for academic resources was .646 indicating that every one point increase in the availabiliy of academic resources will see students' performance rising by .646 holding all the other variables constant. This is not specifically consistent with the findings of Allen (1997) and Yousuf et al. (2011) that adequate computer faciliities as posited by the former and "book consultation" by the latter were pivotal to student success in higher education. It does however indicate that academic resources as defined by the study are significantly related to student performance in MTH 111**.**

The variable self efficacy was not found to be a statistically significant predictor of MTH 111 even though there was a postive relationship bewteen the variables. This was consistent with Hailikari et al. (2008) findings that general student self-perception did not directly influence their achievement at course level and that statements such as "I'm good at mathematics", were not valid predictors of student achievement.

Academic self-regulation (study habits) was also not found to be a statistically significant predictor of MTH 111 even though there was a statistically significant relationship between the variables.

These findings are inconsistent with the findings of Belcheir (2002) who found study skills to be a predictor of mathematics performance on final examinations in collge. The equation derived for the regression line that best predicts MTH 111 performance is:$\hat{y} = -40.417 + 9.366x_1 + .897x_2 + .646x_3 \pm 14.90961$ where $\hat{y}$represents estimates of the dependent variable MTH 111 performance; -40.417 the constant/ intercept; and x_1 prior mathematics performance; $x_2$learning style; and x_3 academic resources the independent variables andε the error term (14.90961).

Analysis of Variance

The significant F value in model 3 indicates that there is a linear relationshipbetween the predictors (prior mathematics performance, academic resources, learning styles and mathematics self-efficacy) and the criterion (MTH 111 performance). The relationship is not due to chance at$p < .05$ *level* (Table 8).

Model Summary

There is a reasonably high linear relationship between the dependent variable MTH 111 performance and the independent variables as indicated in Table 9 by the multiple regression correlation of$R = .664$. Additionallythe multiple regression coefficient of determination R^2 indicates that the independent variables combined, in Model 3, are able to explain .441 or 44.1% of the variation in MTH 111 performance. The standard error of estimate for the model is14.90961 suggesting that estimates of MTH 111 performance is likely to vary positively or negatively by the amount.

5.0Conclusion

The study has revealed that there was a significantpositive relationship betweenthe independent variables prior academic performance, self-efficacy, self- regulation, academic resources, learning styles and the dependent variableMTH 111 performance at $p < .05$ level, hence itcould be advanced that these variables exert some influence on the performances students displayed at MTH 111**.**

The study has also revealed that prior academic performance, learning styles and academic resources were the best predictors of mathematics performance on the first year course at the campus at $p < .05$level and that these variables only accounted for 44.1% of the variation atMTH 111. It should be noted that the data in the study was based on students' self-reports and did not consider teacher variables or classroom observationswhich could account for any difference observed.

5.1 Implications

The implications of the findings are that for students to display the requisite academic performance at MTH 111administrators and lecturers must ensure that they possess the requisite prior knowledge of mathematics, have high mathematics self-efficacy beliefs and have access to the necessary academic resources. Further, students need to have exposure to a variety of learning styles in the teaching and learning sequence andpossess the ability to employ good self-regulation practices in the assimilation of mathematical knowledge. Staff employed to teach them should possess skills in accommodating a variety of student centered learning styles in the teaching and learning sequence.

5.1.1 Recommendations

Taking cognizance of the study's findings and its associated implications it recommended that:

- Since the university has the policy of accepting Grades I, II, III or equivalents for admission to the programmes in the Division of Natural Science and MTH 111performance is positively influencedby these admission criteriathere may be need for the university to re-examine this criteria in the light of the poor performance demonstrated on the MTH 111 course by students. Additionally, the university can develop a no credit mathematics course inwhich prospective students are invited to participate so as to bring them on par with the level that is required for the successful completion ofthe MTH 111course**.**
- Since high mathematics self-efficacy beliefs of students significantly impacts mathematics performance at the campus this should be fostered by providing them with more opportunities to acquire and practice the skills needed to build confidence, mastery and high efficacy beliefs.
- Mathematics material with built in study skills should be developed and disseminated to students to assist them in becoming self-regulated learners and thus employ effective study skills that positively impact mathematics achievement.

- The university provides comprehensive academic resources including courses to facilitate/complement the professional/pedagogical development of staff to cater for differing learning styles.
- The university provides students with the requisite resources to enhance their academic potential.
- The lecturers of the MTH 111 course should ascertain from current students their learning styles and accommodate themin the teaching and learning sequence to cater for the diverse needs of the students.

5.2 Directions for future research

Taking cognisance of the findings of the studypossible avenues for research include studies which involve teacher reports and class room observationson the teaching practices of lecturers can be conducted which may help to uncover additional predictors of academic achievement at the campus. The conduct of asimilar study at the Turkeyen campus to identify the variables that influences MTH 111 performances is also another avenue for research.

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Table 1 Characteristics of Sample

Descriptor	Details	N	Percent (%)
Age of student	17-20	92	82.9
	21-24	13	11.7
	25-28	3	2.7
	33 or Older	3	2.7
Gender	Male	51	45.9
	Female	60	54.1
Ethnicity	Indian Guyanese	77	69.4
	African Guyanese	19	17.1
	Chinese Guyanese	1	.9
	Mixed	14	12.6
Major	Agriculture	13	11.7
	Computer Science	32	28.8
	Biology	53	47.7
	Chemistry	6	5.4
	Mathematics	7	6.3
N		111	100

Table 2: Correlation, Prior Mathematics Performance as a function of MTH 111 Performance

Correlations

		MTH 111 Performance	Prior Mathematics Performance
MTH 111 Performance	Pearson Correlation	**1**	**.553****
	Sig. (2-tailed)		**.000**
	N	**111**	**111**
Prior Mathematics Performance	Pearson Correlation	**.553****	**1**
	Sig. (2-tailed)	**.000**	
	N	**111**	**111**

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

Table 3: Correlation, Mathematics Self-Efficacy as a function of MTH 111 Performance

Correlations

		MTH 111 Performance	Mathematics Self-Efficacy
MTH 111 Performance	Pearson Correlation	**1**	**.419****
	Sig. (2-tailed)		**.000**
	N	**111**	**111**
Mathematics Self-Efficacy	Pearson Correlation	**.419****	**1**
	Sig. (2-tailed)	**.000**	
	N	**111**	**111**

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

Table 4 Correlation, Academic Self-Regulation as a function of MTH 111 Performance

Correlations

		MTH 111 Performance	Academic Self-Regulation
MTH 111 Performance	Pearson Correlation	**1**	**.360****
	Sig. (2-tailed)		**.000**
	N	**111**	**111**
Academic Self-Regulation	Pearson Correlation	**.360****	**1**
	Sig. (2-tailed)	**.000**	
	N	**111**	**111**

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

Table 5: Correlation, Academic Resources as a function of MTH 111 Performance

Correlations

		MTH 111 Performance	Academic Resources
MTH 111 Performance	Pearson Correlation	**1**	**.447****
	Sig. (2-tailed)		**.000**
	N	**111**	**111**
Academic Resources	Pearson Correlation	**.447****	**1**
	Sig. (2-tailed)	**.000**	
	N	**111**	**111**

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

Table 6: Correlation, Learning style as a function of MTH 111 Performance

Correlations

		MTH 111 Performance	Learning Styles
MTH 111 Performance	Pearson Correlation	**1**	**.414****
	Sig. (2-tailed)		**.000**
	N	**111**	**111**
Learning Styles	Pearson Correlation	**.414****	**1**
	Sig. (2-tailed)	**.000**	
	N	**111**	**111**

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

Table 7: Predictors of MTH 111 performance

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	**-7.075**	**6.719**		**-1.053**	**.295**	**-20.393**	**6.242**		
	Prior Mathematics Performance	**11.918**	**1.719**	**.553**	**6.933**	**.000**	**8.511**	**15.325**	**1.000**	**1.000**
2	(Constant)	**-31.075**	**8.448**		**-3.679**	**.000**	**-47.820**	**-14.331**		
	Prior Mathematics Performance	**10.604**	**1.630**	**.492**	**6.507**	**.000**	**7.374**	**13.834**	**.964**	**1.038**
	Learning Styles	**1.128**	**.267**	**.320**	**4.226**	**.000**	**.599**	**1.657**	**.964**	**1.038**
3	(Constant)	**-40.417**	**8.956**		**-4.513**	**.000**	**-58.172**	**-22.662**		
	Prior Mathematics Performance	**9.366**	**1.655**	**.435**	**5.660**	**.000**	**6.086**	**12.646**	**.886**	**1.129**
	Learning Styles	**.897**	**.274**	**.254**	**3.267**	**.001**	**.353**	**1.441**	**.865**	**1.156**
	Academic Resources	**.646**	**.245**	**.213**	**2.634**	**.010**	**.160**	**1.132**	**.800**	**1.249**

Table 8: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**13016.185**	**1**	**13016.185**	**48.068**	**.000[a]**
	Residual	**29515.725**	**109**	**270.786**		
	Total	**42531.910**	**110**			
2	Regression	**17203.681**	**2**	**8601.841**	**36.678**	**.000[b]**
	Residual	**25328.229**	**108**	**234.521**		
	Total	**42531.910**	**110**			
3	Regression	**18746.177**	**3**	**6248.726**	**28.110**	**.000[c]**
	Residual	**23785.733**	**107**	**222.297**		
	Total	**42531.910**	**110**			

a. Predictors: (Constant), Prior Mathematics Performance

b. Predictors: (Constant), Prior Mathematics Performance, Learning Styles

c. Predictors: (Constant), Prior Mathematics Performance, Learning Styles, Academic Resources

Table 9: Goodness of Fit, Regression Analysis Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	**.636[b]**	**.404**	**.393**	**15.31407**
3	**.664[c]**	**.441**	**.425**	**14.90961**