THE RELATIONSHIP BETWEEN MATH SELF-EFFICACY AND COMPLETION RATES OF DEVELOPMENTAL MATH STUDENTS

ABSTRACT OF APPLIED PROJECT

An applied project submitted in partial fulfillment of the requirements for the degree of Education Specialist at Morehead State University

by

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Director of Applied Project: __________________________

The purpose of this correlational research study was to examine relationships between (1) student demographics and completion of a developmental mathematics course and (2) students' "mathematics self-efficacy" measured by the Mathematics Self-Efficacy Scale (MSES) (Betz & Hackett, 1993) and completion of a developmental mathematics course at Morehead State University. The study was designed to extend the scant research on the relationship between mathematics self-efficacy and completion of mathematics courses to a developmental mathematics course at Morehead State University Fall semester, 2010.

The Research Questions were:

Question one: Can successful completion of an undergraduate developmental mathematics course be predicted by student demographic characteristics?

Question two: Can successful completion of an undergraduate developmental mathematics course be predicted by student self-efficacy?

After receiving the approval of Morehead State University's Institutional Review Board (IRB), informed consent was solicited from all students (N = 95) enrolled in the researcher's three undergraduate developmental mathematics courses during the Fall semester, 2010. The MSES was administered to both face-to-face and online classes by Dr. Beverly Klecker. Demographic data were collected with the
administration of the MSES. The collected data were kept in a locked file cabinet in Dr. Klecker's office until all grades had been submitted for the Fall semester, 2010. Data analyses began Spring semester, 2011.

The researcher computed reliabilities with data from the study (Wilkinson, & the Task Force on Statistical Inference, 1999) and found them to be acceptable; the subscale, Everyday Math Tasks, had a Chronbach’s Coefficient Alpha reliability of $\alpha = .94$. The subscale Math Courses had $\alpha = .95$, and for the Total Score $\alpha = .95$. These reliability coefficients were well above the $\alpha = .90$ required for making high-stakes decisions for individuals (American Educational Research Association, American Psychological Association, National Council of Measurement in Education, 1999). The data were entered into a Microsoft Excel (2007) spreadsheet and were analyzed using Minitab16 Statistical Software (2010) to describe the demographic characteristics of the sample and scores on Part I, Part II, and Total Score on the MSES. Pearson’s $r$ correlations between subscales and total scale were computed to confirm dimensionality of the MSES. Pearson’s $r$ was used to measure relationships between variables.

There were considerably more female students (64.21%) than male (35.79%) in this sample. For this study, all students ages 25 and older were defined as “Non-Traditional.” Almost 77% of the students were “Traditional” students being no older than 24, while about 23% were “non-traditional” status.
There were no statistically significant \( (p < .05) \) relationships between student demographic variables and completion of a developmental mathematics course. On campus class delivery (compared with online delivery) was found to be a weak predictor, \( r^2(94), p = 0.10 \). Face-to-face delivery explained only 10% of the variance in course completion. There were no statistically significant relationships, \( r(94), p < .05 \), between the student measures on the MSES and course completion. In the experience of the researcher, this particular sample of students performed above average in comparison to students in previous semesters of the same courses. Over 69% of this sample passed the course. When looking at the students in on-campus classes only, 81% of the students passed the course. In past years, it was typical to see a pass rate under 60%.

In further research, the MSES could be used as a pretest/posttest to examine student growth in mathematics self-efficacy as students take a developmental course. Additionally, one might want to see if mathematics self-efficacy increases after completing a developmental course. A qualitative study using a sample of both completers (N= 66 students) and non-completers (N = 29 students) could further explore intrinsic and extrinsic motivators of developmental students.

Accepted by: _______________, Chair
APPLIED PROJECT

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Graduate School
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2012
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partial fulfillment of the requirements for the

Education Specialist Degree in Counseling

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For my mom.

Teach strong.
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CHAPTER I
INTRODUCTION

The K-12 public schools in Kentucky were behind the rest of the country academically according to state report card data published by The National Center for Public Policy (2008). While Kentucky had improved from the 1992 data, student achievement in the middle and high school years still trailed that of other states. The report card showed that only 44% of young adults enrolled in post-secondary education by the age of 19. According to the Kentucky Council on Postsecondary Education (CPE) (2010), 38.2% of incoming freshman students were under-prepared in at least one area of study and 28.2% of students were under-prepared in math. Only 27% of our state’s eighth graders were proficient in math, 28% in reading, and 26% in writing (The National Center for Public Policy and Higher Education, 2008).

Morehead State University is one of Kentucky’s eight public universities. According to Morehead State University’s 2009-2010 profile, over the past 10 years (data are from 2000-2009) undergraduate enrollment has been between 6,750 and 7,921 the majority of whom are in-state students (83.1%-86.1%).

Morehead State University was reported to be below the state average in most areas academically and in reference to socioeconomic status. Looking at data from the CPE’s report on the class of 2008 cohort, 49.2% of Morehead State University’s incoming freshmen were under-prepared in at least one subject. In math, 37.1% were under-prepared, 30.3% were under-prepared in English, and 23.9% in reading. Looking at the students who were under-prepared in more than one subject, 19.7%
were lacking in two subjects and 18.2% in three, so 24.5% needed remediation in only one area. Statewide, according to 2005 data, prepared first time freshman seemed to be retained after their first year at a rate of about 73% while underprepared students were retained at a rate of 55% (Hiemstra, 2005). The most current available data for graduation rates was from the 1999 cohort, and 41.6% of this cohort completed a degree at MSU in six years or less. Of these graduates, women graduated at a rate of 45.4% and men graduated at a rate of 39.3%. Fewer than 20% (19.7%) of the students in this cohort seeking an associate’s degree graduated in five years or less.

Statement of the Problem

The current goal of the Kentucky Council on Postsecondary Education is to double the number of bachelor’s degree holders by the year 2020 (Kentucky Council on Postsecondary Education, 2007). According to this report, Double the Numbers, with current trends, Morehead State University will fall short of that goal by 211,000 students.

Over the past few years, the Kentucky Council on Postsecondary Education has gathered data related to the preparedness of MSU students. The first report released in 2005 is the most comprehensive report that the CPE has released and has been the groundwork for new legislation and policies for K-16 educational reform. This study began as a result of a policy implemented in 2001 mandating that all incoming undergraduates with ACT scores 17 or below in math, English or reading, be placed in remedial course work. This particular study follows the class of 2002
through their first two years of college. The report is based on 26,646 students who entered public universities or two year institutions as full or part-time students. The limitation to this study is that it does not account for those students who were placed in a remedial class, but then were able to test out of the class thus reclassifying them as prepared students. Overall, in 2005, 54% of students entering Kentucky’s postsecondary institutions were under-prepared in at least one subject and many in more than one subject. Keep in mind that about 3,900 of these students were from out of state. Forty-eight percent of the Kentucky graduates were under-prepared in at least one subject and 29% needed remediation in two or three subjects compared to 32% of the entire cohort. The highest level of under-preparedness falls in the subject of math (43%) (Hiemstra, 2005).

At MSU alone, the number of students in this cohort was 1,418. Of these students, 39% were prepared while 61% were not (above the state average of 53.7%). Of the eight four-year institutions tracked, Morehead State University was second highest in remediation needs. In mathematics, 47.3% of the students needed remediation, while 29.5% were under-prepared in English and 39.5% in reading. It was noted that some students had remediation needs in more than one subject. The data showed that 18% of the credential-seeking cohort (1,357 students) were under-prepared in all three subjects, while 17.8% were under-prepared in two and 26.7% in one subject. Of the recent Kentucky graduates attending MSU, 62.8% were under-prepared which is slightly higher than the overall percentage. At MSU 904 students in this cohort were Kentucky graduates and 48.6% of them were under-prepared in
Math, 31.4% in English and 42.7% in reading. In addition, 20.9% needed remediation in all three (Hiemstra, 2005).

A report released in 2010 included data about students who first entered college in 2002, 2004, 2006, and 2008 (2010 information was not yet available) (Kentucky Council on Postsecondary Education, 2010). A review of these statistics found that in 2008 Morehead State University had 37.1% of incoming freshman that were underprepared in mathematics. This is a drop from 45.2% in 2002. However, in the fall of 2009 the CPE raised the college readiness standard from an ACT sub score of 18 in mathematics to 19. This means that students who previously would not have needed to take a developmental course prior to a credit bearing course would need to take a developmental course. In the fall of 2008, 33.5% of MSU freshman were underprepared in mathematics (Morehead State University Office of Institutional Research & Assessment, 2009) and in the fall of 2009 43.7% of MSU students were not college ready (Morehead State University Office of Institutional Research & Assessment, 2010). These numbers do not include the students who were not “College Algebra ready” (ACT math subscore of 20).

Purpose of the Study

The purpose of this correlational research study was to examine relationships between (1) student demographics and completion of a developmental mathematics course and (2) students’ “mathematics self-efficacy” measured by the Mathematics Self-Efficacy Scale (MSES) (Betz & Hackett, 1993), and completion of a developmental mathematics course at Morehead State University. The construct
"mathematics self-efficacy" is an extension of Badura's (1977) self-efficacy construct. The study was designed to extend the scant research on the relationship between mathematics self-efficacy and completion of mathematics courses to a developmental mathematics course at Morehead State University Fall semester, 2010.
CHAPTER II
REVIEW OF THE LITERATURE

High-School Effects on Degree Completion

Using data from the National Center for Education Statistics “High School and Beyond” database, Adelman (1999) conducted the second of three longitudinal studies to find variables involved in bachelor’s degree attainment. This study began in 1980 when this cohort was in 10th grade and ended in 1993 when the students were approximately 30 years of age. This gave the students 11 years to enter college and complete a bachelor’s degree.

The study was intended for use by those who make decisions at the secondary level concerning guidance curriculum. The study should also be of interest to (a) those who make decisions for students at the post-secondary level, (b) advisors, (c) those who report and interpret trends in education, (d) students themselves, and (e) researchers who study these issues.

In this longitudinal study from the NELS: 88 High School and Beyond database Adelman (1999) stated, “...as in all NCES longitudinal studies, the population was selected from national probability samples...” (p. 109). This study started with a “...stratified sample of secondary schools with an over-sampling of schools in minority areas, and a random sampling of 10th grade students within those schools...” (Adelman, 1999, p. 109). It was weighted to represent the 3.7 million 10th graders at the time. The researchers used college transcripts and self-reporting to gather data. At the beginning of the study, there were 28,000 (reflecting the 3.7
million 10th graders). “Each participant carries a weight in inverse proportion to the probability that he or she would be selected by chance” (p. 109). By the end, the number of participants was 8,873 with each student carrying “a half dozen different weights depending on what question is asked” (p. 109). Adelman (2006) added to this research by shedding more light on the previous data collected and adding to it with a similar cohort that began high school in 1992 and followed these students through 2000.

According to Adelman (1999, 2006) the number one predictor of whether or not a student would complete his or her bachelor’s degree was the rigor of the high school mathematics curriculum. Adelman found that a student who took one math class higher than Algebra II more than doubled his or her chances of obtaining a bachelor’s degree compared with students who took only one class below Algebra II (assuming the natural progression of math courses is Algebra I, Geometry, Algebra II, then Trigonometry). Adelman (1999) found in the 1982 cohort that 31% of students whose highest level of math was geometry attained a bachelor’s degree while 64.7% of those who took trigonometry attained bachelor’s degree completion. For the class of 1992 that number jumped from 16.7% to 60%.

Trusty and Niles (2003) supported Adelman’s findings after looking at data from the NELS:88 database which spanned two different cohorts of students and tracked them each through 12 years of school. The purpose of this study was more practical than theoretical. The authors wanted to see how high school background variables affected college graduation rates. The data spanned 12 years studying 5,257
students from eighth grade to eight years after high school. All students indicated their intention to attain at least a bachelor’s degree after high school. Also, all students used in the study attended college immediately following high school graduation and completed at least one full year of college.

A secondary analysis of data from 3,116 participants was used in this study. The participants were scattered evenly across the regions of the United States and each race was represented: (5% Asian Americans, 9% Latino, 11% African American, 74% White, 1% Native American). The dependent variable was whether or not the student completed a bachelor’s degree within eight years of completing high school. Background variables were gender, SES, race-ethnicity, and eighth grade cognitive ability scores. Intensive math classes were typically Algebra 2, trigonometry, pre-calculus, and calculus. Using logistic regression coefficients, results showed a strong correlation between students taking math-intense courses and bachelor’s degree completion. If a student finished high school with one math class higher than Algebra 2, his/her odds of earning a bachelor’s degree within eight years more than doubled ($B = .86$) a 140% increase.

Trusty & Niles (2004) reported that women were 70% more likely than men to complete their degree. Socioeconomic status ($B = .53$) had a strong positive effect on degree completion. In fact, a one $SD$ increase in SES raised the completion rate 70%. The researchers reported that a surprising result was that eighth grade reading ability was a significant predictor of college completion ($B = .20$). Trusty and Niles did not use any post-high school variables in their study. The implications were that
middle and high school students would benefit greatly from academic and career planning from their school counselors and parents.

Trusty and Niles (2004) took data from the NELS: 88 study (the first of three longitudinal studies like Adelman, 1999) and looked at high school variables, as opposed to college variables, that predicted bachelor’s degree attainment. Students who have “realized potential” are those that show early talent (above average reading and math scores) and high expectations (expecting to attain a bachelor’s degree). Those not completing the bachelor’s degree are considered “lost talent.”

There were 3,116 participants from the NELS:88 study, (NELS:88; National Education, 2002), all of whom “…scored above the mean on reading and math cognitive ability tests while in the eighth grade…” (Trusty & Niles, 2004, p. 3) and thus considered “early talent.” All students expected to earn a bachelor’s degree. The dependent variable was whether or not the student completed a bachelor’s degree within 8 years of graduating from high school. The author’s used logistic regression to analyze the effects of the variables. This is consistent with the Adelman (1999) method. Background variables were first entered followed by high school variables.

Trusty used the Long-Term Educational Development Model (LTED) which showed contributing factors from high school that have a high correlation to bachelor’s degree attainment. All factors in the model were statistically significant, however some such as math intensity ($B = .55$) and SES ($B = 0.50$) stood out. For this group, a “1-standard deviation increase in SES raised the odds of bachelor’s degree completion by 64%” (Trusty & Niles, 2004, p. 9).
The odds for a girl to complete a bachelor’s degree were 65% higher than males. Good attendance raised the odds by 51% (again, a 1 SD increase) and participation in extracurricular activities raised the odds 33%. When parents were involved in their students’ activities, there was a “positive but weak” (p. 9) correlation to performance ($B = 0.10$). However, a stronger indicator was the parental expectations of high achievement ($B = 0.29$) which translates to odds of 1.34. Just by expecting their children to attain a bachelor’s degree raised the odds of completion by 34%. A one course increase in an intensive science class raised the odds by 37%. A student who took one more class than Algebra II in the math curriculum raised the odds by 73%.

Yan and Lin (2005) supported this finding when studying differences by race using the NELS:88 longitudinal data. Caucasian students (standardized coefficient of .24) benefited more than African Americans (.08), Asian (.15), and Hispanic American (.15), from high parental expectations in the group of students studied in their research.

Trusty and Harris (1999) reported that socio-economic status (SES) as measured in their study by log odds ($Bs$) was a strong predictor for both males ($B = 1.20$, odds = 3.32) and females ($B = .94$ and odds = 2.56). In the authors’ analyses, “…lower SES more than doubled the odds of lost talent for female, and more than tripled the odds of lost talent for males…” (p. 374). The authors suggested many reasons that lower SES contributes to lower expectations. Culturally, children have a tendency to do as their parents did. Therefore low SES students need a higher degree
of resilience. Adelman (1999) found that whether or not the student’s parents had a bachelor’s degree had little to no relevance in whether the student attained one. In this report, 37.9% of completers had parents who had earned a bachelor’s degree or higher, 32.2% of completers had parents with some postsecondary education and 29.9% of completers had parents with no postsecondary education.

**Post-Secondary Effects on Degree Completion**

Adelman (1999), using a secondary analysis of the NELS:88 NCES database, found that many variables that might seem to be relevant to degree completion had no predictable relevance in his sample of students. For example, financial aid had little to no relevance when predicting degree completion ($t = 1.42$), and for the 1992 cohort the relevance dropped even lower ($t = .66$) so Adelman (2006) did not study this factor further. Continuous attendance ($t = 5.25$) did have an effect on degree completion (Adelman, 2006). As long as the student was continuously enrolled in an institution (otherwise known as persistence) the student was likely to complete a bachelor’s degree (increased odds by 43.4%). Also, the sooner the student entered post-secondary education after high school, the higher the completion rate ($t = 1.26$) (Adelman, 2006).

One other important factor that seemed to emerge in the 2006 report by Adelman was how student withdrawal from courses without penalty affected degree completion. Adelman (2006) used the ratio of courses from which a student withdrew (without penalty) and repeated, to those in which the student was enrolled. Measuring this in the final step of his logistic model ($\Delta P = -0.4865$) indicated
that withdrawing from or repeating a course 20% or more of the time decreased a student’s probability of earning a bachelor’s degree by almost half.

While Adelman (1999) has shown that high school mathematics is the number one predictor of bachelor’s degree completion, college-level remediation must also be examined. Adelman (1999) found that of those students being remediated in reading, 74% were also under-prepared in two other subject areas. Of those needing remediation in mathematics, he found only 16% were enrolled in two or more remedial classes. So, while poor math skills yield poor math preparedness, poor reading skills affected all classes including the ability to read math problems. Only 39% of the students who were remediated in reading completed a bachelor’s degree compared to 60% of students who took one or two other types of developmental courses and 69% who needed no remediation at all.

**Context of the Study**

Bandura (1977) developed a theory of learning that has been named Social Learning Theory. This theory states that behavior is influenced by an interaction between one’s environment and one’s cognitive meditational processes. This perception of cognition and action is known as self-efficacy. Bandura stated:

*Not only can perceived self-efficacy have directive influence on choice of activities and settings, but, through expectations of eventual success, it can affect coping efforts once they are initiated. Efficacy expectations determine how much effort people will expend and how long they will persist in the face of obstacles and aversive experiences. The stronger the perceived self-
efficacy, the more active the efforts. Those who persist in subjectively threatening activities that are in fact relatively safe will gain corrective experiences that reinforce their sense of efficacy, thereby eventually eliminating their defensive behavior. Those who cease their coping efforts prematurely will retain their self-debilitating expectations and fears for a long time (p. 194).

Corey (2001) defined self-efficacy in the context of Bandura’s Social Learning Theory, “Self-efficacy is the individual’s belief or expectation that he or she can master a situation and bring about desired change” (p. 258). Hackney and Cormier stated, “Self-efficacy refers to the perception a client has about the ability and confidence to handle a situation or to engage in a task successfully” (p. 209).

Though small, there is a growing body of researchers who are studying the impacts of self-efficacy on academic achievement. Understanding a student’s perception of self might help us predict his/her achievements (or lack thereof) academically. Schunk (1989) stated:

For various reasons, students fail in school, and they begin to doubt their learning capabilities and to view academic successes as uncontrollable. Students become frustrated and give up readily on tasks. Lack of effort and persistence leads to further failures, which reinforce the negative beliefs. Eventually, students interpret their successes as externally caused: The task was easy, they were lucky, the teacher helped them. They attribute their
failures to low ability, which negatively affects self-efficacy, motivation, and achievement (p. 8).

Zimmerman, Bandura, and Martinez-Pons (1992) looked at how ninth and tenth grade students’ self-efficacy and personal goal setting at the beginning of a semester along with parental goal setting, predicted achievement at the end of the semester. They distinguish between students who are self-regulated learners and are proactive in their learning by setting challenging goals for themselves and demonstrate motivation. Zimmerman, et. al (1992) stated:

Self-regulated learners exhibit a high sense of efficacy in their capabilities, which influences the knowledge and skill goals they set for themselves and their commitment to fulfill these challenges... Numerous studies have shown that students with a high sense of academic efficacy display greater persistence, effort, and intrinsic interest in their academic learning and performance (p. 664).

In this study by Zimmerman, Bandura, and Martinez-Ponz (1992) two subscales from the instrument *Children's Multidimesional Self-Efficacy Scales* were administered to randomly selected ninth and tenth grade social studies classes. Social studies was selected since all students were required to take it and the students were not placed there by ability. The first scale, *Self-efficacy for self-regulated learning*, included 11 items that measured the students’ perception of their ability to use self-regulated learning strategies. The second scale, *self-efficacy for academic achievement*, included nine items that measured how the students perceived their
abilities in "mathematics, algebra, science, biology, reading and writing language
skills, computer use, foreign language proficiency, social studies, and English
grammar" (p. 667). The students answered each item on a scale of 1 (not well at all)
to 7 (very well). The researchers hypothesized that there would be a significant causal
path found between the two scales and that was the case. Most importantly
Zimmerman, Bandura, and Martinez-Ponz (1992) stated,

Students' perceived self-efficacy for academic achievement predicted both
their final grade in the course, \( p = .21 \), and their personal goals, \( p = .36 \)....The combined direct and indirect causal effect of students' perceived
self-efficacy for academic achievement on their final grades was \( p = .37, p < .05 \) (p. 671).

Warwick (2007) used the Analytic Hierarchy Process (AHP) on a small
sample of first year computing students at a university in the United Kingdom (UK).
The AHP "...is a multi-attribute decision making framework that has found fairly
wide application within organizational decision making..." (p. 183). Warwick's
factors used in this pilot study were: mathematical self-efficacy, previous education
experience in mathematics, and perceived relevance of mathematics as part of the
course of study.

Warwick (2007) described the process:

All of the 27 students in the sample were asked to complete a questionnaire in
which they were given a clear description of each factor and then asked to
make pair-wise comparisons between the factors. The factors within each
level were presented in pairs and the student was asked to judge which of the pair was the most important in determining their ability to do well on the module...or to self-efficacy (p. 186).

The most relevant result to this study was that there was significant correlation between AHP score and the end of the module (course) assessment scores. “Pearson’s rank-order correlation coefficient of 0.51” (p. 191) in the second model showed better results than the first model (0.41) indicating that just using the model of mathematical self-efficacy offered the best results.

Hagedorn, Lester, and Cypers (2010) suggested that if a student earns a C in a low-level math class such as a remedial class, even though this is a passing grade and shows competency, he or she was less likely to attempt a transfer level course and attain degree completion. They conducted a longitudinal study across nine years at a large urban community college system. In this study, 4,824 students were tracked via transcript from the fall of 1995 through the spring of 2004. Students earning an A, B, C or P were considered “completers.” Conversely the grade of D, F, No Pass or W would be seen as non-completion. Since a student must take “transfer level” courses to attain degree completion, then these developmental students must pass at least one course beyond the developmental level. The A, B and Pass students passed their transfer course at rates of 28%, 22% and 36% respectively. Only 17% of D students, 10% of F students, 20% of No Pass students and 19% of W students eventually passed their transfer course. C students showed a low course completion rate of 18% aligning more with the non-completers than completers and indicating that perhaps
these students were not quite ready to take a higher level math course. Their results were similar to those of the failing students. Though the study does not test self-efficacy levels, the authors are very convinced that earning a C or lower in a lower-level mathematics course, “...lowers self-efficacy potentially at greater rates that [sic] other nonsuccessful grades...” (p. 253).

Hackett, Betz, O’Halloran and Romac (1990) conducted an experimental investigation on 149 undergraduate students in an introductory psychology course. There were several instruments and questionnaires administered to the students including: *Educational survey and global ability measures, Task self-efficacy and interest ratings*, and *Career-related self-efficacy and interest measures*. The latter included the college course subscale of the *Math Self-Efficacy Scale*.

Finally, a postexperimental questionnaire was also administered. The subjects were randomly assigned to small groups and given one of four conditions: verbal task success, verbal task failure, math task success, or math task failure. After receiving instructions they completed the educational survey, read a written description of the experimental task, then completed the self-efficacy and interest rating scale. The subjects were told that this was a measure of their abilities. These items were collected and the students were told they had 10 minutes to complete one of several tasks according to their group. Next the subjects completed an alternate task and were asked for self-efficacy and interest ratings on these irrelevant tasks. Lastly the career-related self-efficacy and post-tests were administered.
Hackett, Betz, O'Halloran and Romac (1990) hypothesized that (a) task success would be followed by an increased level of task-relevant self-efficacy and interest and that (b) the opposite would prove to be true as well; (c) the effects of task performance would generalize to career-related self-efficacy and interests; and (d) there would be an interaction between task success or failure and gender. A very significant finding of this quite complicated experiment was that task performance influenced ratings of task self-efficacy and interest ratings. Successful experiences produced an increased level of task-relevant self-efficacy and interest over time and task failure produced a decreased level of task relevant self-efficacy and interest over time. Task self-efficacy strength pretest scores correlated most highly with task self-efficacy level pretest scores ($r_s = .81$). Hackett, Betz, O'Halloran and Romac (1990) stated:

For the task self-efficacy and interest variables, self-efficacy level and strength scores correlate most highly ($r_s = .81$) on Pretest, .85 on Posttest 2, and .84 for the alternate task, whereas the self-efficacy rating correlate moderately with interest ratings obtained at the same time ($r_s$ range from .35 to .53) (p. 175).

Similarly, Cooper and Robinson (1991) measured Mathematics and Career Self-Efficacy of college freshman whose majors were mathematics oriented and compared those results with the students’ scores on the Fennema-Sherman Mathematics Anxiety Scale, scores on the Missouri Mathematics Placement Test which is an abbreviated version of the Ohio State Mathematics Placement Test, and
ACT-9 scores. The authors also wanted to see what additional factors such as parental and teacher support played a role in mathematics and career self-efficacy. Perceived support from both was found to be small but statistically significant to the level of mathematics and career self-efficacy, ($r = .09, p < .05$ and $r = .17, p = < .001$, respectively). The correlations between mathematics and career self-efficacy variables with math anxiety, ability and performance were of moderate strength (mathematics self-efficacy correlated $r = -.41, p < .001$ with math anxiety and $r = .22, p < .001$) with math performance. Using a full model multiple regression analysis, they found that 48% of the variance in mathematics performance was accounted for in ACT scores. No gender differences were found with this population with regard to mathematics self-efficacy, math anxiety or math performance (chi-square = 6.05, D.F. = 8, $p = .64$) which the authors found to be consistent with this particular population of chosen math related majors in previous research. Also with regard to gender, it does not appear that the females students have greater parental [$X(m) = 3.79, X(f) = 3.84$] and teacher support [$X(m) = 3.69, X(i) = 3.78$] for their non-traditional chosen career paths ($F = .34, D.F. = 1,288, p = .56$ and $F = .88, d.F. = 1,288, p = .35$, respectively).

Spence and Usher (2007) studied 164 college level remedial students at a two-year school in the southeastern United States, half of which took the course online and the other half in a traditional classroom setting. All students used courseware for submitting homework and exams and the online students use the courseware as their primary source of instruction. The authors wanted to know what differences in age,
motivation and mathematics achievement occurred in the two instructional settings, and how these factors might predict the level of engagement with the courseware if computer self-efficacy and/or mathematics self-efficacy for self-regulated mathematics learning might also predict student achievement.

The students engaged in a variety of instruments including: a subscale of the Computer Self-Efficacy Scale, a subscale of Bandura's Children’s Multidimensional Self-Efficacy Scales specifically measuring self-efficacy for self-regulated mathematics learning, Computer Playfulness Scale, and Bandura’s Guide for Constructing Self-Efficacy Scales which measured mathematics grade self-efficacy. Mathematics achievement was indicated by the final exam score of each student. Spence and Usher (2007) found that traditional students reported higher mathematics grade self-efficacy than the online students and achieved higher scores as well. Perhaps students with less confidence tend to want to hide in the online setting trying to avoid embarrassment? In both settings mathematics grade self-efficacy was positively related to self-efficacy for self-regulation ($r = .52$, $p < .0001$).

Mathematics grade self-efficacy was negatively related to age (-.10). Looking at the adjusted mean, the traditional students reported higher mathematics grade self-efficacy than the online students (4.05 and 3.56, respectively). One interesting finding was that one regression model showed that mathematics grade self-efficacy ($\beta = .438$) and age ($\beta = .161$) jointly predicted achievement, $F(6,157) = 11.28, p < .0001$, accounting for 30% variance. In short, mathematics grade self-efficacy was the
primary predictor of achievement in this study backing up findings from other similar studies.

Summary of Review of Literature

In summary, students who graduated with a bachelor’s degree in six years or less tended to have similar contributing factors to their success. These students likely had a rigorous high school curriculum including at least one math class above algebra II. They likely had parental support and the expectation from their parents that they would attain a bachelor’s degree. Also, these students likely had academic resources in their middle and high school years that contributed to their academic and career planning.

Many of these factors also contributed to a student’s self-efficacy or lack thereof. In addition to mathematics courses taken in high school, the emerging research found that a student’s perception of her or his ability to successfully complete a college mathematics course was a major contributor to her or his success in the course.

Definition of Terms

Math 090. A developmental mathematics course, Prealgebra, designed for students whose Math ACT subscore is 18 or below and whose majors do not require College Algebra (Math 152), but rather a liberal arts math such as Math 123 Intro to Statistics, Math 131 General Math Problem Solving or Math 135 Math for Technical students.
Math 091. A developmental mathematics course, Beginning Algebra, designed for students whose Math ACT subscore is 18 or below and whose majors require them to eventually take College Algebra. Students in this course will likely take Math 093 then Math 152 after passing this course. This class can serve as a prerequisite course to Math 123, Math 131, and Math 135.

Math 093. A developmental mathematics course, Intermediate Algebra, designed for students whose Math ACT subscore is exactly 19 and whose majors require them to take College Algebra or higher. Students in this course are eligible to take the credit bearing courses Math 123, 131, and 135, but since their major requires Math 152, they must first pass this course before taking College Algebra.

Course completion. Students enrolled in a developmental mathematics course must earn an overall grade of 70% (C) or higher in order to successfully complete the course and move on to the next course.

On-campus class. Students enrolled in the on-campus classes in this study were graded on class attendance, hours in the tutoring lab, homework completion, and tests. They met on campus two to three hours per week for class. Lectures were given over the material for the week and the class was paced by the instructor with due dates and deadlines. Late penalties were enforced for late work. All homework and tests were completed and submitted through a software system.

Online class. Students enrolled in online developmental classes are not required to ever meet on campus or complete tutoring lab hours. Their grade was determined by homework, tests, and online discussions. These students used the
same software system with the same homework and tests. The curriculum was exactly the same. Students had access to video lectures posted by me for them as well as the default instruction found in the software. Math 091 online was run as a self-paced course with no late penalties and no set due date. Math 093 online ran as an instructor-paced course like the on-campus class.

**Mathematics self-efficacy.** Mathematics self-efficacy is defined in this study by the authors of the Mathematics Self-Efficacy Scale Manual used in this study (Betz & Hackett, 1993) as “…beliefs regarding ability to perform various math-related tasks and behaviors…” (p. 2).
CHAPTER III

METHODOLOGY

This was a correlational research study using a convenience sample of developmental mathematics students who took the Mathematics Self-Efficacy Scale (MSES) (Betz & Hackett, 1993) at the beginning of the Fall semester in 2010. Those results were compared with demographics of the same students and course completion rates at the end of the semester through the use of Pearson’s $r$ to identify correlations and possible predictors of course completion among the variables with alpha set $a$ priori at .05.

Research Questions

Question one: Can successful completion of an undergraduate developmental mathematics course be predicted by student demographic characteristics?

Question two: Can successful completion of an undergraduate developmental mathematics course be predicted by student self-efficacy?

Informed Consent for the Study

After receiving the approval of Morehead State University’s Institutional Review Board (IRB), informed consent was solicited from all students (N=95). The MSES was administered by Dr. Beverly Klecker. The students were informed that participation in the study had nothing to do with their grade and that the instructor for the course would not see any of the results until after all grades for the course had been submitted. The students were also given Dr. Klecker’s contact information and
told that they could at any time opt-out of the study. This information was included with the Student Demographic Form (Appendix).

**Population and Sampling**

The participants for this study were all students enrolled in one of the researcher’s undergraduate developmental mathematics courses at Morehead State University in the Fall semester, 2010. There were three on-campus face-to-face classes and two online classes that participated in the study for a total of 95 students. One Math 090 on campus class, two Math 091 classes (one on-campus and one online), and two Math 093 classes (one on-campus and one online) were included. See Table 1 in “Results” for further demographic descriptions.

**Instrumentation**

The instrument used in this study was the *Mathematics Self-Efficacy Scale (MSES)* by Betz and Hackett (1993) (Appendix). The MSES measures an individual’s self-efficacy in performing both math-related tasks and completion of a math-related course with a grade of “B” or higher. In Part I of the MSES, each participant was given 18 math-related tasks and asked to rate the level of confidence that he or she had in performing the tasks on a scale of 0 (no confidence at all) to 9 (complete confidence). Using the same confidence scale, in Part II the participant indicated his or her level of confidence in completing 16 math-related courses with a final grade of a “B” or higher.
Validity and Reliability

Ciechalski and Smith, Jr. (2001) stated that the validity and reliabilities of the scale and subscales of the Mathematics Self-Efficacy Scale as reported by Betts and Hackett (1993) were acceptable. The researcher computed reliabilities with data from the study (Wilkinson, & the Task Force on Statistical Inference, 1999) and found them to be acceptable. The subscale Everyday Math Tasks had a Cronbach Coefficient Alpha of $\alpha = .94$. The subscale Math Courses had $\alpha = .95$, and the Total Score $\alpha = .95$. These reliability coefficients were well above the $\alpha = .90$ required for making high-stakes decisions for individuals (American Psychological Association, American Psychological Association, National Council of Measurement in Education, 1999).

Procedure

The study began the second week of the Fall semester, 2010. This date was chosen to insure most students in the sample had dropped or added the courses as needed. For the on campus courses the teacher/researcher had an outside party administer the demographic sheet and MSES to all students present in class on that particular day. Students had the option of not participating and were given the administrator’s contact information should anyone choose to remove themselves from the study. When all participants were finished, the administrator put all instruments in sealed envelopes. The date was recorded on each envelope and then the envelopes were locked away in a file cabinet in the administrator’s office. The
teacher/researcher did not see nor open these envelopes until after all grades were finalized for the Fall 2010 semester.

For the online courses, the hard copy of the demographic sheet and the MSES were exactly reproduced to an electronic format on a secure web-site. The teacher/researcher did not have access to this web-site. The second party had the web-site password protected and was the only person allowed access to any data. The online students had access to this web-site for several weeks to insure as many participants as possible could respond. As with the on campus data, the teacher/researcher was not allowed access to any information until all grades for the Fall 2010 semester had been recorded. The data evaluation began during the Spring 2011 semester.

Beginning with the demographics reported by each participant and continuing through each question in the instrument, all questions and categories were given numerical codes. The demographic questions were consistent with that which the university asks for admission purposes. Each student has a university issued ID number which was used. Sex was coded as 1 (female) and 2 (male) as were all other demographic questions except for "age" and "Major." Age was entered exactly as the participants recorded, and majors were grouped together as seen in Table 1 in the results section.

The MSES asks participants to record their answers on a 10 point scale (0-9) so all data were entered the same. Data were also entered as scored by Part I, Part II,
and Total Score. Once all data were coded and entered into an Excel (2007) spreadsheet, it was then loaded into SAS (9/1) where various tests were run.

Assumptions

This study was conducted under the following assumptions: (1) most students would finish the course and stay in the study through the end of the semester, (2) all students who chose to participate in the study filled out the MSES with the most honest answers that applied to them and, (3) the teacher/researcher would conduct the classes with the same expectations and teaching methods as had been demonstrated in previous semesters.

Limitations of the Study

The limitations of this study included: (1) obtaining timely assessment responses from the online students, (2) using only the teacher/researcher’s classes as a sample rather than all developmental mathematics classes at Morehead State University, and (3) generalizing from the on-campus classes. The on-campus classes were an unusually high-achieving group. Thus, the sample was different than what might be seen in other developmental mathematics classrooms.

Data Analysis

Data were analyzed to report descriptions of demographic characteristics of the sample and scores on the MSES. The categorical variables were dummy coded for the analysis. Pearson’s $r$ correlations between subscales and total scale were used to confirm dimensionally of the MSES. Analyses were then performed to answer the research questions:
Question one: Can successful completion of an undergraduate developmental mathematics course be predicted by student demographic characteristics? Categorical data were dummy coded and Pearson’s $r$ was used to calculate relationships and predictors of course completion with alpha set a priori at .05.

Question two: Can successful completion of an undergraduate developmental mathematics course be predicted by student self-efficacy? Pearson’s $r$ was used calculate relationships between the MSES total score and two subscale scores and course completion with alpha set a priori at .05.

Timeline

January, 2007: Wrote Proposal

September 2008: Committee meeting approval of research project

August 19, 2010: Final decision to use Mathematics Self-Efficacy Scale for research

August 23, 2010: Obtained consent to conduct study from Morehead State University Office of Research and Sponsored Programs.

August 31, 2010: The Mathematics Self-Efficacy Scale was administered to on campus classes and opened online for all online classes

December 17, 2010: End of the Fall 2010 Semester

December 20, 2010: Final grades reported for Fall 2010

January 19, 2011: Grade changes submitted for Fall 2010

January 19, 2011-May 5, 2011: Analyzed Data
CHAPTER IV
RESULTS

Demographic Characteristics of the Students in the Sample

Table 1 presents frequencies (N) and percentages (%) by the demographic characteristics of the students responding to the Mathematics Self-Efficacy Scale.

Table 1. Demographic Characteristics of Students Responding to Mathematics Self-Efficacy Scale (Total N=95)

<table>
<thead>
<tr>
<th>Variables</th>
<th>N*</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>61</td>
<td>64.21</td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>35.79</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional (24 or under)</td>
<td>72</td>
<td>76.60</td>
</tr>
<tr>
<td>Non-Traditional (over 24)</td>
<td>22</td>
<td>23.40</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>2</td>
<td>2.17</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>90</td>
<td>97.83</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American or Black</td>
<td>5</td>
<td>5.32</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Native Hawaiian or other Pacific Islander</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White</td>
<td>88</td>
<td>93.62</td>
</tr>
<tr>
<td>Identifies with more than one group</td>
<td>1</td>
<td>1.06</td>
</tr>
<tr>
<td><strong>Grade Classification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-time Freshman</td>
<td>45</td>
<td>47.37</td>
</tr>
<tr>
<td>Returning Freshman</td>
<td>18</td>
<td>18.95</td>
</tr>
<tr>
<td>Sophomore</td>
<td>18</td>
<td>18.95</td>
</tr>
<tr>
<td>Junior</td>
<td>9</td>
<td>9.47</td>
</tr>
<tr>
<td>Senior</td>
<td>3</td>
<td>3.16</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2.11</td>
</tr>
</tbody>
</table>

*Note: Frequencies may not sum to Total N because of non-response to the item.
Table 1 (Cont’d). Demographic Characteristics of Students Responding to

*Note: Frequencies may not sum to Total N because of non-response to an item
There were considerably more female students (64.21%) than male (35.79%) in this sample, at Morehead State University, though there are different conditions that might label a student “Non-Traditional” all students ages 25 and older are defined as “Non-Traditional” thus that is how the students in this sample were grouped. Almost 77% of the students were “Traditional” students being no older than 24, while about 23% were “non-traditional” status.

While most students (47.37%) labeled themselves as “First-time Freshman” there were still over half of the students who were not. Both “Returning Freshman” as well as “Sophomore” groups each totaled 18.95% while “Juniors” made up 9.47% of the sample and “Seniors” accounted for 3.16%. There were two students (2.11%) who
responded as “other” which likely meant they were students who had earned a degree previously.

Most of the sample (93.68%) reported a status of “Full-time” student. There were five classes included in this sample. Three of the classes met “On-campus”, face-to-face making up 57.89% of the sample while the other two classes were “Online” and accounted for 42.11% of the sample. These five sections were made up of three different courses. “Math 090” (Pre-Algebra) was taught solely on-campus and is a course designed for students who earned an 18 or less on the math portion of the ACT. These students will go on to take a liberal arts math of some sort: Math 123 (Introduction to Statistics), Math 131 (General Math and Problem Solving) or Math 135 (Math for Technical Students). There were 18.95% of the sample from this class.

“Math 091” (Beginning Algebra) was taught both online and on-campus. This course is designed for students who earned an 18 or lower on the math portion of the ACT but who are in a major that requires they take College Algebra. These students will take Math 093 then College Algebra. About 46% of the sample was enrolled in this course. Lastly “Math 093” (Intermediate Algebra) was also taught both online and on-campus. This course is designed for students who earned exactly 19 on the math portion of the ACT and will take Math 152 (College Algebra) as part of their course of study. About 35% of the sample came from this course.

The final “Grade” distribution was somewhat a-typical for a developmental math course. Twenty-six percent earned “A” (90% and above), 24% earned “B” (80%-89%), about 19% earned “C” (70%-79%) which are all passing grades. The
“IP” grade (50%-69%) is designed for students who did not earn a passing grade but did not fall into the failing category either. There is no typical “D” grade in developmental classes, so this grade allows students a one semester repeat of the course without hurting their GPA. In this sample, 9.47% fall into this grade, The remaining 21% either failed the course, “E,” stopped participating in the course, “U,” or withdrew “W.”

The modal response to “Major” was “Education” (18.96%) which included all education majors P-12. All “Business” majors (11.57%) were grouped as well as anyone planning a post-graduate course of study in “Biology Pre-Professional” such as pre-physical therapy, pre-dentistry etc. (5.26%). It’s worth noting that almost 16% of the sample declared themselves “Undecided.”

### Table 2. Descriptive Statistics Mathematics Self-Efficacy Scale

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday Math Tasks</td>
<td>96</td>
<td>5.77</td>
<td>1.52</td>
</tr>
<tr>
<td>Math Courses</td>
<td>96</td>
<td>4.24</td>
<td>1.76</td>
</tr>
<tr>
<td>Total Scale</td>
<td>96</td>
<td>5.07</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Table 2 presents the means and standard deviations of the two subscales (1) Everyday Math Tasks, (2) Math Courses, and the total scale. The mean of Everyday Math Tasks was 5.77 with a standard deviation of 1.52. The mean of the subscale Math Courses was 4.24 with a standard deviation of 1.76. The Total Scale mean was 5.07 with a standard deviation of 1.42. Chronbach’s alpha reliabilities were computed for all three measures with the data from the study (Wilkinson & the Task Force on

34
Statistical Inference, 1999). The reliabilities were: Total Scale $\alpha = .95$, Everyday Math Tasks $\alpha = .94$; Math Courses $\alpha = .95$. Pearson’s $r$ was used to explore correlations between the subscales and total scale in the data collected for this study (Table 3). This was done to confirm the dimensionality of the instrument that was described by Betts and Hackett (1993).

**Table 3. Pearson Correlation Coefficients Scale and Subscales**

<table>
<thead>
<tr>
<th></th>
<th>Everyday Math Tasks</th>
<th>Math Courses</th>
<th>Total Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday Math Tasks</td>
<td>1.00</td>
<td>0.51</td>
<td>0.87</td>
</tr>
<tr>
<td>Math Courses</td>
<td>0.51</td>
<td>1.00</td>
<td>0.87</td>
</tr>
<tr>
<td>Total Scale</td>
<td>0.87</td>
<td>0.87</td>
<td>1.00</td>
</tr>
</tbody>
</table>

There is a moderate linear correlation ($r(94) = .51$) between the two subscales Everyday Math Tasks and Math Courses. The moderate linear correlation of each subscale indicated that each subscale measured separate constructs. These constructs were defined by Betts and Hackett (1993) as one’s self-efficacy in performing both math-related tasks and completion of a math-related course with a “B” or higher. Each subscale has a strong linear correlation with the total scale score ($r(94) = 0.87$).

**Mathematics Self-Efficacy Scale (MSES)**

Table 4 presents the means and standard deviations of the responses of the 95 students in this study of the MSES.
Table 4 Means and Standard Deviations of Responses to the MSES (N=95)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Means</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>95</td>
<td>5.17</td>
<td>2.49</td>
</tr>
<tr>
<td>Item 2</td>
<td>95</td>
<td>4.97</td>
<td>2.33</td>
</tr>
<tr>
<td>Item 3</td>
<td>95</td>
<td>5.20</td>
<td>2.28</td>
</tr>
<tr>
<td>Item 4</td>
<td>95</td>
<td>4.23</td>
<td>2.43</td>
</tr>
<tr>
<td>Item 5</td>
<td>95</td>
<td>8.29</td>
<td>1.29</td>
</tr>
<tr>
<td>Item 6</td>
<td>95</td>
<td>6.47</td>
<td>2.06</td>
</tr>
<tr>
<td>Item 7</td>
<td>95</td>
<td>6.08</td>
<td>2.09</td>
</tr>
<tr>
<td>Item 8</td>
<td>95</td>
<td>6.18</td>
<td>2.21</td>
</tr>
<tr>
<td>Item 9</td>
<td>95</td>
<td>4.79</td>
<td>2.23</td>
</tr>
<tr>
<td>Item 10</td>
<td>95</td>
<td>5.38</td>
<td>2.23</td>
</tr>
<tr>
<td>Item 11</td>
<td>95</td>
<td>6.68</td>
<td>2.12</td>
</tr>
<tr>
<td>Item 12</td>
<td>95</td>
<td>4.06</td>
<td>2.40</td>
</tr>
<tr>
<td>Item 13</td>
<td>95</td>
<td>5.28</td>
<td>2.43</td>
</tr>
<tr>
<td>Item 14</td>
<td>95</td>
<td>5.80</td>
<td>2.41</td>
</tr>
<tr>
<td>Item 15</td>
<td>94</td>
<td>6.79</td>
<td>1.99</td>
</tr>
<tr>
<td>Item 16</td>
<td>95</td>
<td>6.96</td>
<td>1.74</td>
</tr>
<tr>
<td>Item 17</td>
<td>95</td>
<td>5.97</td>
<td>2.33</td>
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<tr>
<td>Item 18</td>
<td>95</td>
<td>5.61</td>
<td>2.34</td>
</tr>
<tr>
<td>Item 19</td>
<td>94</td>
<td>5.71</td>
<td>2.18</td>
</tr>
<tr>
<td>Item 20</td>
<td>95</td>
<td>4.89</td>
<td>2.23</td>
</tr>
<tr>
<td>Item 21</td>
<td>94</td>
<td>4.32</td>
<td>2.27</td>
</tr>
<tr>
<td>Item 22</td>
<td>94</td>
<td>4.27</td>
<td>2.36</td>
</tr>
<tr>
<td>Item 23</td>
<td>94</td>
<td>2.71</td>
<td>2.24</td>
</tr>
<tr>
<td>Item 24</td>
<td>94</td>
<td>4.47</td>
<td>2.24</td>
</tr>
<tr>
<td>Item 25</td>
<td>95</td>
<td>4.77</td>
<td>2.37</td>
</tr>
<tr>
<td>Item 26</td>
<td>95</td>
<td>4.75</td>
<td>2.51</td>
</tr>
<tr>
<td>Item 27</td>
<td>95</td>
<td>4.88</td>
<td>2.41</td>
</tr>
<tr>
<td>Item 28</td>
<td>95</td>
<td>4.72</td>
<td>2.45</td>
</tr>
<tr>
<td>Item 29</td>
<td>95</td>
<td>4.42</td>
<td>2.44</td>
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<tr>
<td>Item 30</td>
<td>93</td>
<td>4.32</td>
<td>2.42</td>
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<tr>
<td>Item 31</td>
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<tr>
<td>Item 32</td>
<td>95</td>
<td>3.15</td>
<td>2.49</td>
</tr>
<tr>
<td>Item 33</td>
<td>95</td>
<td>2.01</td>
<td>2.11</td>
</tr>
<tr>
<td>Item 34</td>
<td>95</td>
<td>2.64</td>
<td>2.35</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>5.07</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Note: Scale range: 0 = no confidence at all to 9 = complete confidence
The Mathematics Self-Efficacy Scale is divided into two sections. Part I (items 1-18) asks questions concerning confidence in performing specific math tasks. Part II (items 19-34) has students rate the confidence they have in earning a final grade of A or B in college math courses or courses that use math (Betz & Hackett, 1993). The item scale range for the Mathematics Self-Efficacy Scale was 0 = no confidence at all to 9 = complete confidence, with a scale mean of 5.07 (Table 2).

There were 95 observations in the MSES analysis. Almost all items were answered by all respondents. Of the 34 items, 27 items were answered by all 95 students, seven items were answered by 94 students, and one item elicited 93 responses. The item with the highest mean score (8.29) and the least variance (SD 1.29) was item 5, “How much confidence do you have that you could successfully multiply and divide using a calculator?” The item with the lowest mean score (2.01) was item 34 from Part II, which asked the confidence level of earning a final grade of A or B in “Biochemistry.” The item with the highest variance (SD 2.51) was again from Part II, item 26 and asked the confidence level of earning a final grade of A or B in “Philosophy.” Exactly half of the items had a mean of 5 or greater, and exactly half of the items had a mean below 5. The maximum of 9 “Complete Confidence” was answered for each item. The minimum, 0, “No Confidence” was answered for 25 items.

Following the above descriptive analyses of the demographic variables and the responses to the items and subscales of the MSES, analyses were conducted to answer the Research Questions.
**Question one**: Can successful completion of an undergraduate developmental mathematics course be predicted by student demographic characteristics?

The first analysis completed to answer this question was a simple linear correlation using Pearson's $r$. The categorical variables--delivery method, course completion, and course number--were dummy coded prior to the analysis. Minitab (2010) was used for the inferential statistical analyses. Table 5 presents the results of the Pearson $r$ analysis.

**Table 5. Pearson Correlations: Demographic Variables by Course Completion**

<table>
<thead>
<tr>
<th></th>
<th>Delivery Method</th>
<th>Course Completion</th>
<th>Course Number</th>
<th>Sex</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Completion</td>
<td>-0.314</td>
<td>0.002*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Number</td>
<td>0.378</td>
<td>0.000</td>
<td>-0.109</td>
<td>0.292</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>0.075</td>
<td>0.471</td>
<td>0.125</td>
<td>0.228</td>
<td>0.042</td>
</tr>
<tr>
<td>Age</td>
<td>0.334</td>
<td>0.011</td>
<td>-0.026</td>
<td>0.802</td>
<td>0.211</td>
</tr>
<tr>
<td>Race</td>
<td>0.277</td>
<td>0.007</td>
<td>-0.045</td>
<td>0.668</td>
<td>0.084</td>
</tr>
</tbody>
</table>

*Notes: Cell Contents: Pearson correlation p-value  *$p <.05$ correlation between course completion and variable*

The delivery method of the class had a low negative correlation with completion of the course, $r(94) = -0.31$. The delivery methods were coded (1= face-to-face, 2=online) thus, online delivery was negatively correlated and face-to-face
delivery was positively correlated with completing the class. Although the correlation was statistically significant \((p < .05)\) the linear correlation was weak. Pearson’s \(r\) must be squared to use as a predictor. Gravetter and Wallnau (2010) explained:

To describe how accurately one variable predicts another, you must square the correlation. Thus, a correlation of \(r = .5\) means that one variable partially predicts the other, but the predictable portion is only \(r^2 = 0.5^2 = 0.25\) (or 25\%) of the total variability (pp. 520-21).

Thus, Pearson’s \(r^2 = 0.31^2 = 0.10\). The mode of delivery predicted only 10\% of the variance between students who completed the class and students who did not complete the class. Clearly, this was not a strong predictor. None of the demographic variables were statistically significantly \((p < .05)\) correlated with course completion.

**Question two:** Can successful completion of an undergraduate developmental mathematics course be predicted by student self-efficacy?

Table 6 presents Pearson’s \(r\) correlations between course completion and the students’ scores on the subscales and total scale of the *MSES*.

**Table 6 Pearson Correlation Coefficients of Course Completion to Scale and Subscale Scores on the MSES**

<table>
<thead>
<tr>
<th></th>
<th>Everyday Math Tasks</th>
<th>Math Courses</th>
<th>Total Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Completion</strong></td>
<td>(r = 0.092)</td>
<td>(r = 0.092)</td>
<td>(r = 0.106)</td>
</tr>
<tr>
<td></td>
<td>(p = 0.374)</td>
<td>(p = 0.376)</td>
<td>(p = 0.306)</td>
</tr>
</tbody>
</table>
All of the linear correlations were weak and were not statistically significant. Successful completion of the undergraduate developmental mathematics course in this study could not be predicted from the students' scores on subscale or total scale scores of the MSES.
CHAPTER V
CONCLUSIONS

Discussion

The data from the sample of ninety-five undergraduate students in developmental mathematics courses at MSU fall 2010, were flat, that is, there was very little variance in the scores. Considering the lack of variance observed in the descriptive tables, it was not surprising that there were not strong statistically significant \((p < .05)\) predictors from the subsequent analyses.

From the studies in the review of the literature, it was expected that the researcher would find a relationship between student demographic variables and the MSES overall score and/or subscale scores. However, the only statistically significant linear relationship was between type of delivery of course (face-to-face vs. online) was, \(r(94) = 0.31, p < .05\), indicating a weak positive linear relationship between face-to-face delivery and completion of course. When Pearson’s \(r\) was squared to use as a predictor (Gravetter & Wallnau, 2010) the difference in delivery explained only 10% of the variance in course completion, leaving 90% of the variance unexplained. There were no statistically significant relationships between the scores on the MSES and completing the course.

In the researcher’s experience, this particular sample of students performed above average in comparison to previous semesters of teaching the same courses. Over 69% of this sample population passed the courses. When looking at the on
campus classes alone, 81% of those students passed the course. It is more typical to see a pass percentage under 60%.

Recommendations

If this research project were to be repeated, it might be beneficial to administer the MSES to all students at both the beginning of the semester and the end of the semester in order to see student growth throughout the semester. One might want to see if mathematics self-efficacy increases after completing a developmental course. To add to this research, it would be helpful to track these students through their required credit bearing course to see if mathematics self-efficacy would predict course completion.

Because the researcher did not find any characteristics to predict course completion of a developmental mathematics course, further study into the research subjects might prove insightful. A qualitative study conducted using a sample of both completers (N= 66 students) and non-completers (N = 29 students) could further explore intrinsic and extrinsic motivators of developmental students.
References


Council on Postsecondary Education Web site:

http://cpe.ky.gov/doublethenumbers


http://www2.moreheadstate.edu/files/units/ira/2009_2010_MSU_PROFILE_V1_5.pdf


Dear Student:

The purpose of this questionnaire is to investigate the relationship between math self-efficacy and the completion rates of developmental math students. There are no right or wrong answers to the items. I would ask you to be as accurate as possible in your responses to the items based on your experiences at this particular time. All individual answers will be kept confidential and your instructor, Mrs. Schroeder, will not see any of the results until after grades are submitted for the Fall 2010 semester. All students have the option to not participate in this survey. If at a later date you wish for your survey to be omitted from this study please contact:

Dr. Beverly Klecker  
503D Ginger Hall  
(606)783-2536  
b.klecker@moreheadstate.edu

Please provide information about yourself:

Name or Student ID: __________________________

Sex: ( ) Female  ( ) Male

Age: ___

Ethnicity: Are you Hispanic or Latino? ( ) Yes ( ) No

Races: (Select one or more):

  o African American or Black
  o American Indian or Alaskan Native
  o Asian
o Native Hawaiian or other Pacific Islander
o White

Course of Study (Major): ____________________________
( ) Undecided

Grade Classification:
o First-time Freshman
o Returning Freshman
o Sophomore
o Junior
o Senior
o Other

Enrollment Classification:
o Full-time
o Part-time
Sample MSES Questions

Part I

<table>
<thead>
<tr>
<th>No Confidence at all</th>
<th>Very little Confidence</th>
<th>Some Confidence</th>
<th>Much Confidence</th>
<th>Complete Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How much confidence do you have that you could successfully:

1. Add two large numbers (e.g., 5379 + 62543) in your head............................ 0 1 2 3 4 5 6 7 8 9

2. Determine the amount of sales tax on a clothing purchase.................................. 0 1 2 3 4 5 6 7 8 9

3. Figure out how much material to buy in order to make curtains.................................. 0 1 2 3 4 5 6 7 8 9

Part II: Math Courses

Please rate the following college courses according to how much confidence you have that you could complete the course with a final grade of "A" or "B". Circle your answer according to the 10-point scale below:

<table>
<thead>
<tr>
<th>No Confidence at all</th>
<th>Very little Confidence</th>
<th>Some Confidence</th>
<th>Much Confidence</th>
<th>Complete Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19. Basic College Math.................. 0 1 2 3 4 5 6 7 8 9

20. Economics................................. 0 1 2 3 4 5 6 7 8 9
To whom it may concern,

This letter is to grant permission for the above named person to use the following copyright material:

**Instrument:** *Mathematics Self-Efficacy Scale*

**Authors:** Nancy E. Betz & Gail Hackett

**Copyright:** *1993 by Nancy E. Betz and Gail Hackett*

for his/her thesis research.

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The entire instrument may not be included or reproduced at any time in any other published material.

Sincerely,

Robert Most  
Mind Garden, Inc.  
www.mindgarden.com