SUCCESS OF ENTERING COLLEGE FRESHMEN TAKING DEVELOPMENTAL MATHEMATICS AT TEXAS WOMAN'S UNIVERSITY

A THESIS

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BY

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To the Dean of the Graduate School:

I am submitting herewith a thesis written by Jessica Rachelle Kosine entitled "Success of Entering College Freshmen Taking Developmental Mathematics at Texas Woman's University." I have examined this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master's of Science with a major in Mathematics.

Don E. Edwards

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We have also read this thesis and recommend its acceptance:

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Dean of the Graduate School

DEDICATION

To my parents, Joseph and Daisy Kosine, I owe my life to you. I wouldn't be here without you. Thank you both for your unconditional love, your never ending support, all of the joy and laughter we've shared, memories we've created and many more to come. Most of all, thank you for never giving up on me.

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ABSTRACT

JESSICA RACHELLE KOSINE

SUCCESS OF ENTERING COLLEGE FRESHMEN
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The purpose of this study was to measure the overall success in students' performances using several different variables in developmental mathematics when comparing the redesign and paired redesign course to traditionally taught lecture and computer based developmental mathematics courses at Texas Woman's University.

This study followed a design similar to the University of Alabama. The design implemented by the University of Alabama was aimed toward differentiating weaker and stronger students. The weaker students received special instruction to stress key mathematical concepts, while stronger students were allowed to work on their homework at their own pace. Texas Woman's University slightly modified this design. Traditional computer and lecture based courses with the same course curriculum were used as control groups for comparisons.

Statistical analyses revealed the results from this study supported the redesign effort. Data supported that students who were enrolled in the redesign or paired redesign courses produced, overall, greater mean scores than students who were enrolled in traditionally taught lecture and computer based courses.

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CHAPTER I

INTRODUCTION

Every college and university sets certain academic standards for freshmen in order to enter a program of higher education. Most often, placement exams are administered to new students to determine readiness for college level courses.

Many of these students are placed in developmental courses, with the majority being placed in a developmental mathematics course. Over the years, the rate of remediation in mathematics for entering college freshmen has tremendously increased. The increased need for remediation has created many problems in the world of higher education - not only for the colleges and universities, but for the students as well.

Many students end up failing developmental courses and must retake them several times before they can register for a credited mathematics course. This repetition increases the financial burden upon the student and the family, may prolong graduation and could lead to dissatisfaction of the college experience as a whole. Because mathematics courses play such a vital role in many degree plans, students may choose to change their majors based on the increased burden of re-taking developmental mathematics. Due to this increased burden of required additional mathematics courses that certain students may have difficulty passing, it is possible that they might give up on their first career choice. Ultimately, and unfortunately, the worst case scenario for the struggling student is completely withdrawing from the college or university of their choice. Therefore, there is

a great need to remediate these students efficiently and effectively in order to ensure retention and, ultimately, graduation.

Texas Woman's University first recognized this trend when numerous sections of developmental mathematics needed to be created to accommodate the number of students required to enroll in developmental mathematics. According to the Texas Woman's University Mathematics and Computer Science Department, several problems could arise if enrollment continues to grow at the present rate - problems such as: a shortage of professors, a lack of class times and a lack of class rooms. The increased demand would create a waiting list for students, which, as a direct result, would prolong graduation for students requiring developmental mathematics. Based on these projections, Texas Woman's University Mathematics and Computer Science Department researched several redesigned courses and developed a team of faculty members to implement one that significantly produced successful pass rates among students in developmental mathematics at the University of Alabama.

Purpose of the Study

The purpose of this study was to measure the overall success in students' performances using several different variables in developmental mathematics when comparing the redesign and the paired redesign course to traditionally taught lecture and computer based developmental mathematics courses at Texas Woman's University. These sections all have the same learning objectives, concepts, homework assignments and tests. Homework and tests were completed online using a computer program called

"MyMathLab". The sections were different in the way students were presented the material in class.

The paired course required co-enrollment in a computer literacy course and developmental mathematics, which were both taught in computer labs using software online. Students independently worked at their computer station and received help on-line by using the computer software or, if they had questions, received "one-on-one" instruction from the professor. The paired course aimed at improving quantitative skills, which proved critical for student's success in subsequent courses, particularly mathematics and science. Technology also played a role as a vital learning application.

The traditional lecture courses involved a professor who lectured over the concepts that paralleled the material in the on-line computer software. Students were required to complete homework outside of class.

The course redesign aimed to utilize different teaching methods including: power point presentations, hands-on mathematics manipulatives, implementing various classroom activities, pairing weaker students with stronger students to work on assignments, skills tests to determine students' needs to understand concepts, and utilizing a reward system for successful students.

Texas Woman's University measured success by examining relationships among different variables in this study. One way to examine the relationship between the developmental redesign mathematics, traditional lecture and traditional computer courses was to compare "pre" and "post" scores on mathematics placement and Accuplacer

exams from the fall semester of 2008 to determine the effect the redesign had on mathematics students.

This study also aimed to examine the relationship between the pass rates (Success will be defined four different ways: improving Accuplacer scores, by earning a C or better in developmental mathematics, by scoring a 16 or greater on the mathematics placement exam, and being TSI (Texas Success Initiative) complete - meaning students earned both a C or better in developmental mathematics and a score of 16 or greater on the placement exam. Texas Success Initiative completion qualifies the student to register in a credited mathematics course.) among the sections from the course redesign of the fall semester of 2008, all of the traditional sections from the fall semester of 2008, and all of the traditional sections from the fall semester of 2007.

Finally, the study examined the relationship between the sections TSI Status (If students did not earn a C or better in developmental mathematics *and* score a 16 or greater on the placement exam, they were considered TSI incomplete and were to re-enroll in developmental mathematics the following semester) among the sections from the course redesign in the fall semester of 2008, all of the traditional sections in the fall semester of 2008 and all of the traditional sections in the fall semester of 2007.

Delimitations

The study began during the fall semester of 2007 when "MyMathLab" software was first introduced to students taking developmental mathematics. The course redesign was implemented the following fall semester of 2008 using the same software.

Since this course redesign was funded through a grant, the time line has expired and there will be no further investigation on behalf of this study, however other studies are being investigated.

Assumptions

It is assumed that the redesigned course will produce significantly higher mathematics post-placement exam scores, post-Accuplacer scores, an increase in pass rates and an increase in the TSI complete status than through traditionally taught courses at Texas Woman's University.

Significance

The significance of this study was to implement a course redesign and to evaluate student's progress in this course redesign to understand how they can become better students of mathematics. A significant increase in overall student performance in the course redesign would contribute to an increase in student effectiveness in subsequent courses and long-term educational goals. This study also contributes to the understanding of how students most effectively become active learners and could guide students into subsequent curriculum offerings.

This study could result in enhancing quantitative skills that will prove critical for student's success in subsequent courses, particularly in mathematics and science. It is also important to note the possibility of a significant monetary savings to the university and its students due to more cost-effective out-of-class and on-line activities. A

successful course redesign would also enable faculty to spend more time on diagnostic activities and indirect interventions.

Many incoming freshmen need to enroll in developmental courses. These courses need to be geared toward the students' needs to ensure that they can pass the course and move on to the next course without obstacles holding them back. This allows for a student's long-term success in their college degree program. The ultimate goal is to encourage TWU students toward a successful educational career.

This study aimed for "success" with the redesign course so the Department of Mathematics and Computer Science at Texas Woman's University would have necessary knowledge to predict future enrollment in developmental mathematics.

Does a course redesign significantly increase the pass rates among first time college freshmen taking developmental mathematics compared to traditional methods of teaching?

CHAPTER II

LITERATURE REVIEW

History of Course Redesign

Colleges and universities continue to play an essential role in providing under-represented populations access to higher education. These institutions face the overwhelming task of providing courses to remediate the growing number of students. Being held accountable, colleges are reminded of their role for maintaining academic standards in aiding retention. While there are substantial enrollments, an increase in diverse student populations and financial burden leads to limited resources, therefore colleges and universities are challenged to develop course redesigns in order to promote student achievement. (Evans and Phelps 2006)

The purpose of this study is to provide a basis for the assessment of remedial education programs. While colleges are accountable for the education of the growing student population, they also have to take into consideration the demographics in which these students live. There are a significant number of blacks and Latinos that enter college with the ultimate goal of earning a baccalaureate degree or higher; however to some students these degrees are difficult to attain. (Twigg 2005)

This under-represented class of students may not be able to pursue their dreams if they cannot pass the placement exams set by the educational institutions - some with higher standards than required. This is the dilemma facing some of our students today. It

is imperative that academic institutions take a proactive approach in attaining the resources needed to ensure these students or, for that matter, any student with difficulty in passing a placement exam is successful in their quest at higher education.

"This research was requested by the Commission for a College Ready Texas, and prompted by the Commission's charge to provide expert resources and general support to vertical teams (which are directed by the Texas Legislature to develop college readiness standards) and the State Board of Education (which is responsible for introducing college readiness into state curriculum standards for Texas public schools). To fulfill its charge the Commission needs objective information about the factors associated with college readiness in Texas. The report presents the key findings from a large-scale empirical study investigating several issues related to "college readiness in the state of Texas. In particular, the research was designed to isolate the factors that determine college success in Texas." (Miller)

The problem is how to teach or what resources do we use to assist students in passing placement exams. Analysis of the demographic statistics is important in determining how to instruct these students. Each student learns in his or her own way. There are a variety of methods that could be used to help these students. For instance, some students will need one-on-one instruction, where as others may do better individually with computer aided assistance. Some students need both methods, so faculty should be available to assist them when needed. One of the problems with students needing one-on-one assistance is that faculty cannot always be available to

nurture them. Keeping faculty available around the clock would be costly. Colleges and universities would have to make a sacrifice elsewhere in order to support these groups of students. (Twigg, 2003)

"Remediation is the most common approach to preparing students academically and socially during their early stages of college. However, despite its profound importance and its significant costs, there is very little rigorous research analyzing its effectiveness. The goal of this article is to provide a conceptual framework for the evaluation of remedial education programs. Based on previous literature, we review a list of ingredients for successful interventions, present a number of approaches to remediation that make use of these ingredients, discuss alternative research designs for systematic evaluations, and enumerate basic data requirements." (Levin and Calcagno)

What other alternatives are there to reach our students? We can customize students' learning environments with computer technology. They can interface with instructional learning tools such as: online tutorials, videos lectures and notes, exercises and quizzes. Those who opt to forgo technology and who feel they learn better with human interaction could select a partner for support. The reality of it is that there is no one right way. The success of this thought is that whatever it takes to get a student into the curriculum they have chosen is only contributable to the successful programs they choose. (Twigg, 2003)

University of Alabama Model

There is currently little research on course redesign despite the growing need for developmental courses to fully remediate students and ensure a successful higher education. Historical redesign models have provided significant results. We have seen an increase in passing/success rates, improved retention, increased student satisfaction and reduction costs to universities and students.

One successful model is the Emporium Model at the University of Alabama. The Emporium Model is aimed toward redesigning a developmental mathematics course. It allowed students to work at their own pace without deadlines from instructors. This allowed the students more freedom to access resources at their convenience. This approach worked well, because each student's learning capability differs. The stress of "keeping up" with the rest of the class was eliminated giving the student a more positive attitude and learning experience (Twigg, Improving Learning and Reducing Costs: Redesigning Large-Enrollment Courses).

"More than 60% of all community college students are placed into remedial, non-credit bearing courses. Concerns over the lack of articulation across the K-12 and postsecondary educational systems have led to concerns over whether students have had the opportunity to learn and demonstrate the skills required for success in college level classes. To measure the degree to which the expectations across these systems are consistent, the degree of alignment between the examinations at these two levels was explored. The California Community College placement test content was compared to the

high school level California Standards Tests in General Mathematics, Algebra 1 and Geometry. Only the General Mathematics was aligned across a substantial number of standards. Taking into consideration past studies, it appears that the major source of misalignment between the two testing systems occurs within the content areas of Integers and Rationals, Trigonometry and Graphing." (Shelton and Brown)

"The University of Alabama redesigned Intermediate Algebra, a pre-General Studies course enrolling 1500 students each year, in order to address poor student performance. Nearly 60% of the students in the fall 1999 traditional course earned a D, F, or W grade, and students often needed to take the course two or three times before passing. Modeled in part on the Math Emporium at Virginia Tech, the course redesign involved the development of a student-centered, computer-assisted, self-paced tutorial course structure that allowed the individual student to focus precisely on his or her questions and difficulties. The software used in the course was expected to provide quick feedback to students, instant assessment of skills competencies, and a steady flow of information to instructors and tutors. The redesign anticipated reducing the cost-per-student from approximately $122 to $86, a 30% savings. Instead of spending time on lectures and presentations, the plan included having instructors devote time directly to each student's specific, immediate needs. Instead of spending time grading homework, quizzes, and exams, the instructors planned to engage students in more direct, personalized tutorial assistance." (Lazer)

Since personnel is the major cost item in instruction, reducing the time that faculty and others invest and transferring some of these tasks to technology is key, such as: online tutorials, automated assessment, course management systems, shared resources and staffing substitutions. By assessing where there is duplication of effort, faculty is ever aware of cost savings. (Twigg)

Using a model based in part on the Math Emporium at Virginia Tech, the redesign of Intermediate Algebra at the University of Alabama will generate cost savings by decreasing the number of faculty needed to teach the course. (Lazer)

In a recent study on The Costs and Benefits of Remedial Education, done at the University of Illinois at Urbana-Champaign, Elizabeth Barnett writes that approximately 1 to 2 billion dollars - roughly one to two percent of the total higher education expenditures - is annually spent on all remedial education with estimates that taxpayers are paying about half the cost of all remedial courses. (Trenholm)

The General Linear Model

To better understand some of the statistics used to analyze the data in this study, a brief understanding of the general linear model needs to be introduced. The general linear model is the basis for several statistical tests, the ANOVA, ANCOVA and regression. (Trochim)

The Two-Variable Linear Model

Consider a bivariate plot, as shown in figure 1, consisting of pre and post exam scores. According to figure 1, it appears that there is a positive relationship. To best

describe this plot of data points, the general linear model can be referred to in order to get a more accurate picture of how the data points are related. The data points represented in figure 1 have a straight line drawn through them. This line is referred to as the best fit line. The general linear model can then determine a more accurate relationship through the basic equation of a line:

$$y = mx + b$$

where m is the slope of the line and b is the y-intercept. The slope of a line is calculated by taking the change in y values divided by the change in x values ($y=\Delta x/\Delta y$). The y-intercept is the value of y when x=0.

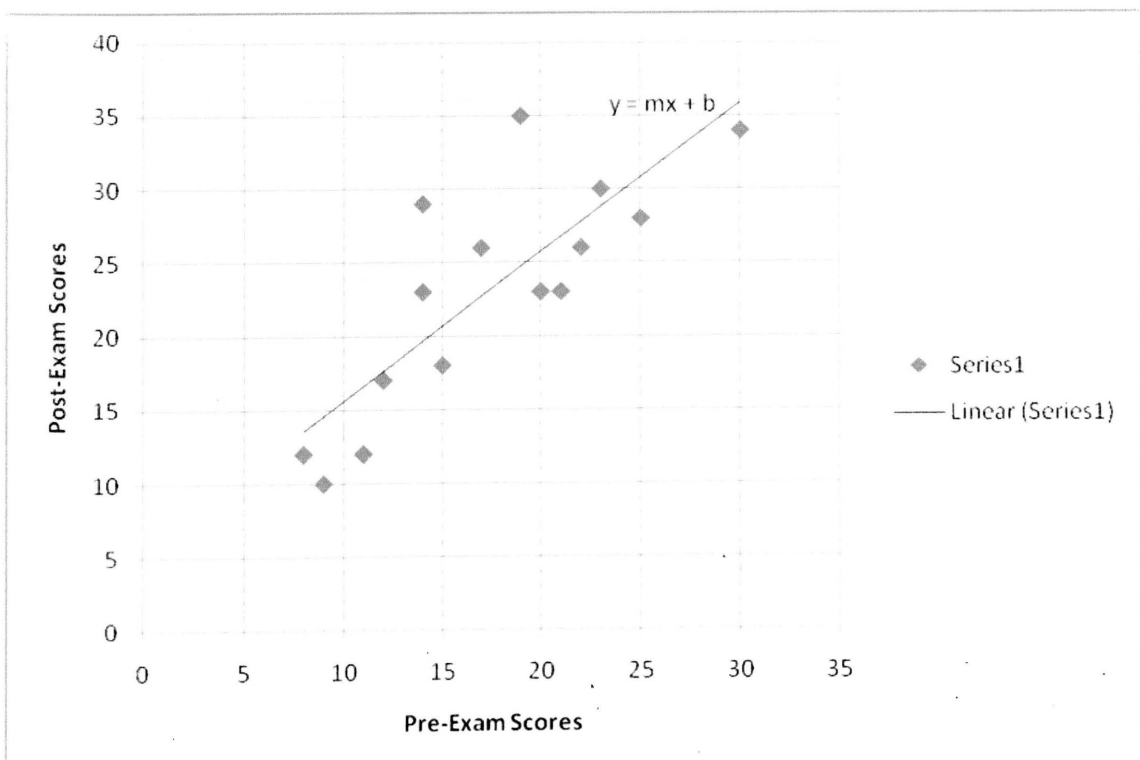

Figure 1. General Linear Model

However, the variables in this equation will change to:

$$y = b_0 + b_1x + e$$

Where b_1 is the slope of the line and b_0 is the y-intercept and e is a new variable which is called the error. The error "describes the vertical distance from the straight line to each point." (Trochim) Therefore, when the data values for the pre and post exam scores (or any other data set) are input into a program or other computer software, the output will give estimates for b_0 and b_1 along with the error so x and y values can be predicted as accurately as the model will allow. (Trochim) The most general form of the model permits multiple dependent variables and the deployment of any form of parametric correlation or mean difference design: $\mathbf{Y} = \mathbf{X\Theta} + \mathbf{E}$, where Y is an n by p matrix of response data for $p \geq 1$, X and Θ are design and parameter matrices, respectively, and E represents model errors. Models with $p > 1$ are fully multivariate.

CHAPTER III

METHODOLOGY

The General Perspective

The purpose of this study was to measure the overall success in students' performances using several different variables in developmental mathematics when comparing the redesign and paired redesign course to traditionally taught lecture and computer based developmental mathematics courses at Texas Woman's University.

The Type of Design

This study followed a design similar to the University of Alabama. The design implemented by the University of Alabama was aimed toward differentiating weaker and stronger students. The weaker students received special instruction to stress key mathematical concepts, while stronger students were allowed to work on their homework at their own pace. Texas Woman's University slightly modified this design. Students who were placed in the redesign course were given special teaching methods. At the beginning of each new chapter, students took a skills test to determine readiness of the new material to be covered. If students passed the skills test (>=70%), then they were allowed to work on their homework in the computer lab. If students failed the skills test (<70%), then students received special instruction in class to reinforce conceptual material. Special instruction consisted of the following: power point presentations; hands-on mathematics manipulatives; multiplication tables; algebra times; team activities and activities with a

partner, where the weaker students were paired with stronger students. Students who received special instruction were to work on their homework outside of class. After chapter homework was finished, all students took a chapter test. Students then repeated this process for the next chapter.

The Researcher's Role

The researchers had various roles in this study. First of all, the researcher was to gather data from developmental mathematics participants. Researchers were to analyze the results of the course redesign from the fall semester of 2008 and compare this course to traditionally taught courses from the fall semester of 2008 and the fall semester of 2007.

Secondly, the researcher aided professors of the traditional lecture, computer and redesign courses of developmental mathematics in administering the Accuplacer exam, which was used as a pre- and post-measure.

Thirdly, the researcher met with several faculty members to fully understand remediation at Texas Woman's University.

The Setting

The setting was Texas Woman's University, Department of Mathematics and Computer Science.

Participants

Participants consisted of entering college freshmen enrolled in developmental mathematics for the fall of 2007 and the fall of 2008 semesters. Any student repeating

this course was removed from analyses. Participants were both male and female between the ages of 16 and 52. Although some of these students enrolled in developmental mathematics as a refresher course, the majority of these students were placed in developmental mathematics because they scored less than 16 out of 25 on the mathematics placement test, which is given prior to university enrollment.

Student selection. Students who were advised to enroll in developmental mathematics were allowed to enroll in any developmental mathematics section, including the course redesigns. Therefore, students were not selected by the researcher. A control section was chosen randomly by the Department of Mathematics and Computer Science.

Data Collection Sources

Sources used were Pioneer Portal and an online database for collection of Accuplacer exam scores.

Data Collection Procedures

The researcher collected data of participants' mathematics placement scores with faculty aid in Pioneer Portal. Participant's demographical data was collected by the Department of Undergraduate Studies and sent to the researcher. The researcher was allowed access to an online database to collect Accuplacer exam scores.

Data Analysis

Data analysis was conducted using SPSS 15.0 statistical software, statistical analyses consists of calculating frequencies and percentages descriptive statistics, cross

tabulations, correlations, ANCOVA, ANOVA, multiple regression and multiple logistic regression. Effects were determined based on these results.

Pilot Study One- Beginning in the fall semester of 2007

Pilot study one was implemented at TWU for developmental mathematics courses by beginning the use of "MyMathLab" software. "MyMathLab" is an online software course with homework assignments, tests, video lectures, an electronic book, examples, extra homework problems, sample test questions and online tutorials to aide in conceptual understanding. It also gears students towards learning through technology versus a lecturing professor. Courses were self-paced, meaning that students completed homework and tests at their own pace.

Pilot Study Two- Beginning in the fall semester of 2008

Redesign was introduced in the fall semester of 2008. The Accuplacer exam was administered to the control and redesign sections the first week of classes. Homework and tests are still completed online using "MyMathLab". Computer based- homework and tests are given online with assigned due dates. Accuplacer exam is administered the last week of classes.

A significant increase in success rates is expected.

CHAPTER IV

RESULTS

The purpose of this study was to first examine the relationship of student's success in developmental mathematics through three different sections from the fall semester of 2008. These sections are comprised of one control group (a traditional lecture section) and two experimental groups (the paired redesign section and the original redesign section).

The second part of this study examined the relationship between both of the experimental redesign sections from the fall semester of 2008, and all of the traditional sections from the fall semester of 2007 and the fall semester of 2008.

Finally, gender, age, and ethnicity were examined as potential confounds of the relationship between section type and mathematics success.

Demographics

This study consisted of 407 entering freshmen students who enrolled in developmental mathematics at Texas Woman's University. As shown in Table 1, the majority of the students were female (98.8%), with only a few males (1.2%). Due to the small number of males in the study, statistical comparisons between genders were not possible. The majority of the students were 18 years old (71.1%) followed by 19 years old or older (24.7%), with a small number of 17 years old (4.2%). Due to the small number of 17 year olds and 19 years old or older, statistical comparisons between age

were not possible. The majority of ethnicities were comprised of three main groups: African American (40.9%), Hispanic (28.5%) and Caucasian (24.5%). A small percentage of the students were Asian (3.9%) or classified as Other (2.2%). Due to the relatively small sample sizes in the Asian and Other category, only Caucasian, African American and Hispanic students were included for comparisons between ethnic groups. Looking at course grades, a majority of the students received an A in developmental mathematics (56.8%), while 20.1% received a B, 11.8% received a C, and 11.3% received an F or withdrew from the course.

As shown in Table 2, students were between 17 and 52 years old (M = 19.06, SD = 3.74). Across the whole sample, students had higher means on the post mathematics placement exam (M = 15.78, SD = 3.92) than the pre exam (M = 10.62, SD = 3.15), higher means on post Accuplacer total exam (M = 127.38, SD = 33.82) than pre exam (M = 105.32, SD = 31.80), higher means on post Accuplacer arithmetic exam (M = 72.90, SD = 22.54) than the pre exam (M = 56.70, SD = 21.82) and higher means on the post Accuplacer algebra exam (M = 54.47, SD = 17.11) than the pre exam (M = 48.46, SD = 17.43).

Table 1

Frequencies and Percentages of Gender, Age, Ethnicity, Section and Grade

	N	%
Gender		
Male	5	1.2
Female	402	98.8
Age		
17 Years	17	4.2
18 Years	290	71.2
19+ Years	100	24.6
Ethnicity		
Caucasian	100	24.6
African American	166	40.8
Hispanic	116	28.5
Asian	16	3.9
Other	9	2.2
Letter Grade		
A	231	56.9
B	82	20.2
C	48	11.8
F	43	10.6
W	2	0.5

Table 2

Means and Standard Deviations of Age, Pre and Post Exam Scores

	N	Mean	SD	Min	Max
Age	407	19.06	3.74	17	52
Mathematics Placement Exam					
Pre-Score	401	10.62	3.15	3	22
Post-Score	388	15.78	3.92	2	24
Accuplacer Total Exam					
Pre-Score	92	105.32	31.80	53.3	186.5
Post-Score	89	127.38	33.82	51.6	193.4
Accuplacer Arithmetic Exam					
Pre-Score	93	56.70	21.82	20.4	114.4
Post-Score	89	72.90	22.54	23.0	110.9
Accuplacer Algebra Exam					
Pre-Score	92	48.46	17.43	21.0	95.9
Post-Score	89	54.47	17.11	21.4	93.1

As shown in Table 3, relationships among age and pre and post exam scores were examined using Pearson's Product Moment correlations. Age was not correlated with any of the pre or post measures, all r's, *ns*. Significant positive correlatations were found between pre and post scores for each measure, all $r > .509$, $p < .01$ - indicating that individuals with increased scores on the pre-test tended to have increased scores on the post-test.

Table 3

Pearson's Product Moment Correlation between Students' Age and Pre and Post Exam Scores

	1	2	3	4	5	6	7	8
1 Age								
2 Pre-PE	-.075							
3 Post-PE	.025	.511 **						
4 Pre-A Ar	.069	.429 **	.421 **					
5 Post-A Ar	.034	.535 **	.549 **	.509 **				
6 Pre-A Alg	-.024	.384 **	.443 **	.303 **	.377 **			
7 Post-A Alg	-.056	.433 **	.469 **	.233 *	.445 **	.699 **		
8 Pre-AT	.033	.508 **	.539 **	.852 **	.564 **	.757 **	.552 **	
9 Post-AT	-.006	.581 **	.603 **	.458 **	.891 **	.607 **	.802 **	.657 **

Note- * $p < .05$, ** $p < .01$. PE = Placement Exam; A = Accuplacer; Ar = Arithmetic; Alg = Algebra; T = Total

Non parametric χ^2 tests of association were conducted to examine relationships between the experimental and control groups with ethnicity and letter grade. A significant association was found between section type and ethnicity, $\chi^2(23) = 19.25$, $p < .01$. The traditional lecture section was made up of primarily Caucasians (56.5%), followed by African Americans (30.4%) and Hispanics (13.0%). However, the paired redesign section was primarily made up of African Americans (56.5%), followed by Hispanics (34.8%) and Caucasians (8.7%). The majority of the students in the original redesign section were African Americans and Hispanics (42.5%), then Caucasians (15.0%). The results failed to reveal significant associations among letter grade, with section type, all χ^2s, *ns*.

Section

Hypothesis One

The post-scores from the placement exam, combined Accuplacer exam, Accuplacer arithmetic exam and the Accuplacer algebra exam were analyzed to determine whether the section the student enrolled in impacted their post-exam scores. Four separate one-way Analyses of Covariance (ANCOVAs) were conducted to test the hypothesis that the post exam scores will be greater for the redesigned sections than the traditional section, controlling for the variance (pre-exam scores), which were taken at the beginning of the semester. Means and standard deviations are displayed in Table 5. Marginally significant differences were found for the placement exam, $F(2, 86) = 2.60$, $p < .10$. The paired redesign section (M =16.92, SD = 3.83) and the original redesign (M = 16.22, SD = 2.65) had marginally greater placement scores than the traditional lecture

section ($M = 13.32$, $SD = 3.80$). Marginally significant differences were also found for the Accuplacer arithmetic exam, $F(2, 86) = 2.45$, $p < .10$. The original redesign ($M = 77.50$, $SD = 20.22$) had marginally greater Accuplacer arithmetic scores than the paired redesign section ($M = 72.94$, $SD = 21.72$) and greater scores than the traditional lecture section ($M = 62.06$, $SD = 24.96$). The one-way ANCOVA of the Accuplacer total and Accuplacer algebra post scores, controlling for pre scores, failed to reveal any significant differences, indicating that there were no differences for the post exam scores by section. The hypothesis was partially supported that the redesign sections had greater overall mean scores than the traditional lecture sections for post-exam scores.

Table 4

Frequencies and Percentages of Ethnicity and Letter Grade by Section for Fall 2008

	Fall 2008 Section							
	Paired Redesign		Original Redesign		Traditional Lecture			
	n	%	n	%	n	%	χ^2	p
Ethnicity							19.25	.001
Caucasian	2	8.7	6	15.0	13	56.5		
African American	13	56.5	17	42.5	7	30.4		
Hispanic	8	34.8	17	42.5	3	13.0		
Letter Grade							6.00	.424
A	16	66.7	24	52.2	17	73.9		
B	5	20.8	13	28.3	3	13.0		
C	3	12.5	6	13.0	1	4.3		
F or W	0	0	3	6.5	2	8.7		

Table 5

Means and Standard Deviations of Post-Exam Scores by Section Controlling for Pre-Exam Scores

	n	Mean		SD	D	*F*	*p*
Post-Placement						2.603	.080
Paired Redesign	24	16.92	a	3.83	.95		
Original Redesign	45	16.22	a	2.65	.76		
Traditional Lecture	19	13.32	b	3.80			
Post-Accuplacer Total						1.281	.283
Paired Redesign	24	131.49		30.54	.65		
Original Redesign	43	132.86		32.76	.69		
Traditional Lecture	21	109.30		34.31			
Post-Accuplacer Arith						2.454	.092
Paired Redesign	24	72.94	a	21.72	.44		
Original Redesign	43	77.50	a	20.22	.62		
Traditional Lecture	21	62.06	b	24.96			
Post-Accuplacer Alg						.093	.911
Paired Redesign	24	58.55		17.01	.18		
Original Redesign	43	55.36		17.36	.53		
Traditional Lecture	21	47.24		15.26			

Note- Means with similar superscripts were statistically similar, Tukey's post hoc test, $p < .10$. Cohen's D values were calculated for effect size. D values around .2 signify "small effects," D values of .5 are "medium effects" and D values around .8 are "large effects."

Hypothesis Two

Four separate one-way analyses of variances (ANOVAs) were conducted to test the hypothesis the change in exam scores will be greater for the redesign sections than the traditional lecture section the student was enroll. The change in exam scores was the post

exam score - pre exam score. As shown in Table 6, results failed to reveal any significant effects for differences in placement exam scores, all *F*s, *ns*. Therefore, the hypothesis was not supported.

Table 6

Means and Standard Deviations of Change in Exam Scores by Section

	n	Mean	SD	D	*F*	*p*
Placement Change					1.789	.173
Paired Redesign	24	6.17	3.28	.77		
Original Redesign	45	5.60	4.45	.57		
Traditional Lecture	19	4.00	2.81			
Accuplacer Total Change					.271	.763
Paired Redesign	24	24.43	21.78	.17		
Original Redesign	43	22.77	26.47	.12		
Traditional Lecture	21	18.67	32.93			
Accuplacer Arith Change					1.364	.261
Paired Redesign	24	21.33	16.52	.37		
Original Redesign	43	16.65	21.15	.22		
Traditional Lecture	21	10.67	27.08			
Accuplacer Alg Change					.792	.456
Paired Redesign	24	3.10	15.19	.43		
Original Redesign	43	6.13	13.11	.17		
Traditional Lecture	21	8.00	11.28			

Cohen's D values calculated for effect size, D. D values around .2 signify "small effects," D values of .5 are "medium effects" and D values around .8 are "large effects."

Ethnicity

Hypothesis Three

Since there was a significant relationship between ethnicity and section, it was important to examine the relationship of ethnicity on exam scores. Interactions between ethnicity and section were not possible in the present study due to cells with low sample sizes. Therefore, ANCOVAs, controlling for pre-scores were conducted to test the hypothesis that differences would exist between ethnic groups on post-exam scores. Means and standard deviations are displayed in Table 7. A significant difference was found for the Accuplacer arithmetic exam, $F(2, 79) = 3.29$, $p < .05$. Post-hoc tests showed that Hispanics ($M = 77.97$, $SD = 20.32$) had higher mean scores than both Caucasians ($M = 69.57$, $SD = 28.14$) and African Americans ($M = 68.00$, $SD = 20.63$). The one-way ANCOVA of the placement, Accuplacer total and Accuplacer algebra exams' post-scores, controlling for pre-scores, failed to reveal any significant differences, indicating that there were no differences for the post-exam scores by ethnicity. The hypothesis was partially supported that differences among ethnic group exist for the post-Accuplacer arithmetic score.

Table 7

Means and Standard Deviations for Post-Exam Scores by Ethnicity Controlling for Pre-Exam Scores

	n	Mean	SD	*F*	*p*
Post-Placement				1.330	.266
Caucasian	94	15.86	4.20		
African American	156	15.64	3.95		
Hispanic	110	15.77	3.72		
Post-Accuplacer Total				2.292	.108
Caucasian	18	122.24	39.54		
African American	36	123.11	31.49		
Hispanic	27	132.96	33.62		
Post-Accuplacer Arith				3.285	.043
Caucasian	18	69.57 [a]	28.14		
African American	36	68.00 [a]	20.63		
Hispanic	27	77.97 [b]	20.32		
Post-Accuplacer Alg				.009	.991
Caucasian	18	52.68	16.48		
African American	36	55.11	16.95		
Hispanic	27	54.99	18.88		

Note- Means with similar superscripts were statistically similar, Tukey's post hoc test, $p < .05$.

Hypothesis Four

Four separate one-way analyses of variances (ANOVAs) were conducted to test the hypothesis that differences exist for the change in scores for the placement, Accuplacer total, Accuplacer arithmetic and Accuplacer algebra by ethnic group. As

shown in Table 8, the results failed to reveal significant effects on Accuplacer algebra exam scores, $F(2, 79) = .029$, $p = .971$. However, marginally significant differences were found on the placement exam, $F(2, 358) = 2.980$, $p<.10$ and Accuplacer total exam, $F(2, 79) = 2.575$, $p < .10$. Post hoc tests revealed that Caucasians ($M = 4.37$, $SD = 3.65$) had marginally lower placement change scores than African Americans ($M = 5.17$, $SD = 3.56$) and Hispanics ($M = 5.55$, $SD = 3.28$). African Americans ($M = 14.30$, $SD = 23.85$) had marginally less change on the Accuplacer total than Caucasians ($M = 21.38$, $SD = 20.63$) and Hispanics ($M = 29.57$, $SD = 23.86$). There were significant mean differences on the Accuplacer arithmetic exam, $F(2, 79) = 3.647$, $p< .05$. Post hoc tests showed that Hispanics had significantly greater Accuplacer arithmetic differences ($M = 24.03$, $SD = 20.58$) than both Caucasians ($M = 15.52$, $SD = 25.73$) and African Americans ($M = 9.31$, $SD = 19.65$). The hypothesis was partially supported that differences exist by ethnic group for the change in Accuplacer total exam score and the change in Accuplacer Arithmetic exam score.

Success

The second part of the analysis for this study examined success, which is based on whether the student passed or failed the post-placement exam, developmental mathematics and TSI status (students are TSI complete if they pass both the placement exam and developmental mathematics). A summary of the success variables, including all students from the fall semester of 2007 and the fall semester of 2008, is shown in Table 9. A greater percentage of students passed the placement exam (57.0%) than the

percentage of students who failed (43.0%). A much greater percentage of students passed developmental mathematics (88.9%) than failed (11.1%). However, when it came to examining how students did on both of the success variables, a slight majority failed to become TSI complete (52.2%) than passed (47.8%).

Table 8

Means and Standard Deviations of Differences in Exams by Ethnicity

	n	Mean	SD	*F*	*p*
Placement Change				2.980	.052
Caucasian	94	4.37 [a]	3.65		
African American	156	5.17 [b]	3.56		
Hispanic	110	5.55 [b]	3.28		
Accuplacer Total Change				2.575	.083
Caucasian	18	21.38 [b]	34.17		
African American	36	14.30 [a]	23.85		
Hispanic	27	29.57 [b]	23.86		
Accuplacer Arith Change				3.647	.031
Caucasian	18	15.52 [a]	25.73		
African American	36	9.31 [a]	19.65		
Hispanic	27	24.03 [b]	20.58		
Accuplacer Alg Change				.029	.971
Caucasian	18	5.87	12.04		
African American	36	4.99	14.85		
Hispanic	27	5.54	11.64		

Note- Means with superscripts were significantly different from each other, Tukey's post hoc test, $p < .10$.

Table 9

Frequencies and Percentages of Success Variables: Post-Placement Exam, Letter Grade and TSI Status

	N	%
Post-Placement Exam		
Pass	221	57.0
Fail	167	43.0
Letter Grade		
Pass	361	88.9
Fail	45	11.1
TSI Complete		
Yes	212	47.8
No	194	52.2

Non parametric χ^2 tests of association were conducted to examine the potential relationships between the redesign sections (consisting of paired and original redesign from the fall semester of 2008), fall 2007 traditional sections and fall 2008 traditional sections with the success variables. As shown in Table 10, a significant association was found between section and placement exam $\chi^2(176) = 8.53$, $p < .05$. A greater percentage of students from Fall 2007 developmental mathematics sections passed (63.6%) than those who failed (36.4%). Similar results were found for the redesign sections, where a greater percentage of students passed the placement exam (59.4%) than those who failed (40.6%). The results failed to reveal significant associations among letter grade with section type, all χ^2s, *ns.*

Significant results were also found for letter grades $\chi^2(176) = 6.99, p < .05$ among the developmental mathematics sections. A much greater percentage of students from the redesign developmental mathematics sections developmental mathematics sections passed (95.7 %) than those who failed (4.3%). Similar results were found for the Fall 2007 sections (pass = 90.3%, fail = 9.7%) and for the Fall 2008 sections (pass = 84.4%, fail = 15.6%). As for the success variable, TSI complete status, significant results were also found $\chi^2(176) = 16.05, p < .001$ among the developmental mathematics sections. A greater percentage of students from fall semester of 2007 developmental mathematics sections were TSI complete (61.4%) than those who were not TSI complete (38.6%). Similar results were found for the redesign sections, where a greater percentage of students were TSI complete (57.1%) than those who were not (42.9%). The fall 2008 sections had significant differences. A greater percentage of students were not TSI complete (60.0%) versus those who were TSI complete (40.0%).

Table 10

Frequencies and Percentages of Placement Exam, Grade and TSI Status by Section

	Developmental Mathematics Section							
	Fall 2007		Redesign		Fall 2008			
	n	%	n	%	n	%	χ^2	*p*
Post-Placement Exam							8.53	.014
Pass	112	63.6	41	59.4	68	47.6		
Fail	64	36.4	28	40.6	75	52.4		
Grade							6.99	.030
Pass	159	90.3	67	95.7	135	84.4		
Fail	17	9.7	3	4.3	25	15.6		
TSI Status							16.15	.000
Complete	108	61.4	40	57.1	64	40.0		
Incomplete	68	38.6	30	42.9	96	60.0		

In order to examine the potential differences between ethnicities and success, analyses were conducted to compare placement exam results, letter grades and TSI complete status for the three ethnic groups as shown in Table 11. The results failed to reveal significant differences among ethnicity and the three different success variables.

Table 11

Frequencies and Percentages of Placement Exam, Grade and TSI Status by Ethnicity

	Ethnicity							
	Caucasian		African American		Hispanic			
	n	%	n	%	n	%	χ^2	*p*
Post-Placement Exam							.368	.832
Pass	57	58.8	87	55.4	61	55.0		
Fail	40	41.2	70	44.6	50	45.0		
Letter Grade							2.552	.279
Pass	89	89.9	142	85.5	106	91.4		
Fail	10	10.1	24	14.5	10	116		
TSI Status							1.140	.566
Complete	55	55.6	81	48.8	60	51.7		
Incomplete	44	44.4	85	51.2	56	48.3		

Hypothesis Five

Since there was a significant relationship between section and the success variables, it was important to examine the relationship of section on placement exam scores. Therefore, an ANCOVA, controlling for pre placement scores, was conducted to test the hypothesis that differences exist between sections on post placement scores. Means and standard deviations are displayed in Table 12. A significant difference was found for the post placement exam, $F(2, 381) = 3.22$, $p < .05$. Post hoc tests showed that redesign section ($M = 16.46$, $SD = 4.37$) had greater exam scores than both the fall semester of 2008 ($M = 15.17$, $SD = 3.94$) and the fall semester of 2007 ($M = 16.03$, $SD =$

3.64). Therefore, the hypothesis is supported that differences between the mean post-placement scores exist between fall 2007, redesign section and fall 2008.

Table 12

Means and Standard Deviations of Post-Placement Exams by Section Controlling for Pre-Placement Exams

	n	Mean	SD	*F*	*p*
Post-Placement				3.220	.041
Fall 2007	176	16.03 [a]	3.64		
Redesign	69	16.46 [a]	4.37		
Fall 2008	138	15.17 [b]	3.94		

Note- Means with superscripts were significantly different from each other, Tukey's post hoc test, $p < .05$.

Hypothesis Six

A one-way ANOVA was also conducted to test the hypothesis that differences exists among the sections on changes in placement exam scores. As shown in Table 13, the results revealed a marginally significant difference for sections on change in placement exam scores, $F(2, 381) = 2.51, p < .10$. The hypothesis is supported that differences exist between the change in placement exam scores between fall 2007 scores, redesign scores and fall 2008 scores.

Table 13

Means and Standard Deviations of Change in Placement Exam Scores by Section

	n	Mean	SD	*F*	*p*
Placement Change				2.513	.082
Fall 2007	176	5.26	3.48		
Redesign	69	5.80	4.07		
Fall 2008	138	4.67	3.25		

Hypothesis Seven

A series of multiple regression analyses were conducted to test the hypothesis that students who score greater on the pre-exams for each exam used in this study and are enrolled in the redesigned section will also exhibit greater post-exam scores (see Tables 14-17). Multiple regression analysis is used with continuous dependent variables and categorical or continuous independent variables, because categorical predictor variables cannot be entered directly into a regression model and be meaningfully interpreted. Dummy variables are a way of adding the values of a nominal or ordinal variable to a regression equation. For the four regression analyses, ethnicity and section were dummy-coded.

The overall model in Table 14 was significant, $F(2, 87) = 6.66$, $p < .005$, and accounted for 11.5% of the variance (adjusted $R^2 = .115$). As shown, pre-placement scores significantly predicted post-placement exams ($\beta = .91$, $t = 3.33$, $p < .005$), indicating that while controlling for the other predictors, greater pre-placement scores

predicted greater post-placement scores. In the last regression equation, the redesign section was not a significant predictor of post-placement scores. Therefore, the hypothesis was partially supported that greater pre-exam scores produce greater post-exam scores.

Table 14

Multiple Regression Analyses of Pre-Placement Scores, Ethnicity and Section on Post-Placement Scores (N = 87)

	β	*SE*	*Beta*	*t*	*p*
Constant	9.088	3.92		2.31	.023
Pre-Placement Score	.910	.27	.341	3.33	.001
Redesign Section	-1.026	1.12	-.093	-.91	.364

The overall model in Table 15 was significant, $F(2, 87) = 33.86$, $p < .001$, and accounted for 43.0% of the variance (adjusted $R^2 = .430$). In the first regression equation (Table 15), pre-Accuplacer total scores significantly predicted post-Accuplacer total scores ($\beta = .70$, $t = 7.73$, $p < .001$). However, redesign section was not a significant predictor of post-Accuplacer total scores. Therefore, the hypothesis was partially supported that greater pre-exam scores produce greater post-exam scores.

Table 15

Multiple Regression Analyses of Pre-Accuplacer Total Scores, Ethnicity and Section on Post-Accuplacer Total Scores (N = 87)

	β	*SE*	*Beta*	*t*	*p*
Constant	64.03	13.44		4.77	.000
Pre-Accuplacer Total Score	.698	.09	.636	7.73	.000
Redesign Section	-5.207	3.86	-.111	-1.35	.181

The overall model in Table 16 was significant, $F(2, 87) = 17.13$, $p < .001$, and accounted for 27.1% of the variance (adjusted $R^2 = .271$). In the first regression equation, pre-arithmetic scores significantly predicted post-arithmetic scores ($\beta = .54$, $t = 5.57$, $p < .001$). In the last regression equation, redesign section was not a significant predictor of post-arithmetic scores. Therefore, the hypothesis was partially supported that greater pre-exam scores produce greater post-exam scores.

The overall model in Table 17 was significant, $F(2, 87) = 40.52$, $p < .001$, and accounted for 47.6% of the variance (adjusted $R^2 = .476$). In the first regression equation, pre-algebra scores significantly predicted post-algebra scores ($\beta = .70$, $t = 8.48$, $p < .001$). However, being enrolled the redesign section was not a significant predictor of post-algebra scores. Therefore, the hypothesis was partially supported that greater pre-exam scores produce greater post-exam scores.

Table 16

Multiple Regression Analyses of Pre-Arithmetic Scores, Ethnicity and Section on Post-Arithmetic Scores (N = 87)

	B	*SE*	*Beta*	*t*	*p*
Constant	52.717	8.04		6.56	.000
Pre-Arithmetic Score	.537	.10	.510	5.57	.000
Redesign Section	-5.219	-2.68	-.167	-1.82	.072

Table 17

Multiple Regression Analyses of Pre-Algebra Scores, Ethnicity and Section on Post-Algebra Scores (N = 87)

	B	*SE*	*Beta*	*t*	*P*
Constant	20.166	6.574		3.07	.003
Pre-Algebra Score	.701	.08	.70	8.48	.000
Redesign Section	.06	1.97	.00	.03	.976

Hypothesis Eight

Additionally, a multiple logistic regression analysis was conducted to test the hypothesis that the greater the students scored on each of the pre-exams in this study and

being enrolled in the redesign section, the greater the odds were that they achieve TSI complete Status (0 = incomplete, 1 = complete). The results in Table 18 revealed that the model was significant, $\chi^2(89) = 27.14$, $p < .001$. Pre-Accuplacer total significantly predicted that an increase in pre-placement score scores predicts a greater likelihood that students will be TSI complete after completing developmental mathematics. For every increase in pre-placement score, students are .776 times more likely to be TSI complete (*Odds Ratio* = .776). The remaining predictors, pre-Accuplacer Total, pre-arithmetic and redesign section were not significant predictors of the odds of being TSI complete after completing developmental mathematics, all *ns*.

Table 18

Summary of Multiple Logistic Regression Analysis Predicting TSI Status using Pre-Exam Scores, Ethnicity and Sections as Predictors (N=89)

	β	*SE*	Wald	df	*p*	*Odds Ratio*
Constant	4.277	1.55	7.609	1	.006	72.004
Pre-Placement	-.253	.12	4.682	1	.030	.776
Pre-Accuplacer Total	-.020	.02	1.462	1	.227	.980
Pre-Arithmetic	-.008	.02	.099	1	.753	.992
Redesign Section	.467	.38	1.523	1	.217	1.596

CHAPTER V

DISCUSSION

The purpose of this study was to measure the overall success in students' performances at Texas Woman's University using several different variables in developmental mathematics when comparing a redesign course to traditionally taught lecture and computer developmental mathematics courses.

Texas Woman's University researched and implemented a course redesign similar to a successful model from the University of Alabama, which was effective for their developmental students of mathematics.

Results of this study revealed that the redesign course produced significant and marginal differences in several of the success variables.

Summary of Significant and Marginal Findings

Demographics

Tests were conducted to examine the potential relationships between the experimental and control groups with ethnicity and letter grade. A significant association was found between section type and ethnicity. The traditional lecture section was made up of primarily Caucasians, followed by African Americans, then Hispanics. However, the paired redesign section was primarily made up of African Americans, followed by Hispanics then Caucasians. The majority of students in the original redesign section were split between African Americans and Hispanics, then Caucasians.

By Ethnicity

Since there was a significant relationship between ethnicity and section, it was important to examine the relationship of ethnicity on exam scores. Interactions between ethnicity and section were not possible in the present study due to cells with low sample sizes. Therefore, tests controlling for pre-scores were conducted to test for differences between ethnic groups on post-exam scores. A significant difference was found for the Accuplacer arithmetic exam. Analysis showed that Hispanics had higher mean scores than both Caucasians and African Americans.

Four separate one-way analyses of variances (ANOVAs) were conducted to test for differences on change scores for the placement, Accuplacer total, Accuplacer arithmetic and Accuplacer algebra exam by ethnic group. As shown in Table 8, marginally significant differences were found on the placement exam and Accuplacer total exam. Further testing revealed that Caucasians had marginally lower placement change scores than African Americans and Hispanics. African Americans had marginally less change on the Accuplacer total than Caucasians and Hispanics. There were also significant mean differences on the Accuplacer arithmetic exam. Further testing revealed that Hispanics had significantly greater Accuplacer arithmetic differences than both Caucasians and African Americans.

By Section

The post scores from the placement exam, combined Accuplacer exam, Accuplacer arithmetic exam and the Accuplacer algebra exam were analyzed to

determine whether the section the student enrolled in impacted their post-placement exam scores, controlling for pre-exam scores, which were taken at the beginning of the semester.

Four separate one-way Analyses of Covariance (ANCOVAs) were conducted to test for differences between the sections. Marginally significant differences were found for the placement exam. The paired redesign section and the original redesign had marginally greater placement scores than the traditional lecture section. Marginally significant differences were also found for the Accuplacer arithmetic exam. The original redesign had marginally greater Accuplacer arithmetic scores than the paired redesign section and greater scores than the traditional lecture section. Cohen's D values were calculated to account for effect size and large effects were reported for the post-placement exam for both the paired redesign and the original redesign. Medium effects were reported for the post-Accuplacer Total, post-Accuplacer arithmetic along with the post-Accuplacer algebra for the paired redesign and the original redesign section. Therefore, the paired redesign and the original redesign had greater mean post-exam scores than the traditional lecture section.

Tests were conducted, controlling for pre-placement scores to test for differences between sections on post-placement scores. A significant difference was found for the post-placement exam. Analysis showed that the redesign section had greater exam scores than both the fall semester of 2008 and the fall semester of 2007.

Four separate one-way analyses of variances (ANOVAs) were conducted to test for differences on change scores for the placement, Accuplacer total, Accuplacer arithmetic and Accuplacer algebra exam by section. The results revealed a marginally significant difference for sections on the change in placement exam scores. Cohen's D revealed a large effect on the change in placement score for the paired redesign and the original redesign. This means that the paired redesign and the original redesign had greater means for the change in exam scores. They also had greater means for the change in Accuplacer Total and Accuplacer arithmetic, however, the effect size for Cohen's D was much smaller.

By Success Variables

A greater percentage of students from fall semester of 2007 developmental mathematics sections passed than those who failed. Similar results were found for the redesign sections where a greater percentage of students passed the placement exam than those who failed.

Tests were conducted to examine the potential relationships between the redesign sections (consisting of paired and original redesign from fall semester of 2008), fall semester of 2007 traditional sections and fall semester of 2008 traditional sections with the success variables. A significant association was found between section and the placement exam as shown in Table 10.

Significant results were also found for letter grades among the developmental mathematics sections. A much greater percentage of students from the redesign

developmental mathematics sections passed than those who failed. Similar results were found for the fall semester of 2007 sections and for the fall semester of 2008 sections. As for the TSI complete status success variable, significant results were also found among the developmental mathematics sections. A greater percentage of students from fall semester of 2007 developmental mathematics sections were TSI complete than those who were TSI incomplete. Similar results were found for the redesign sections, a greater percentage of students were TSI complete than were TSI incomplete. Fall semester of 2008 sections also had significant differences, a greater percentage of students were TSI incomplete than students who were TSI complete.

A multiple regression analysis was conducted to predict post-scores for each exam in the study using pre-scores from each exam along with ethnicity and section as predictors. Multiple regression analysis is used with continuous dependent variables and categorical or continuous independent variables, because categorical predictor variables cannot be entered directly into a regression model and be meaningfully interpreted, dummy variables are a way of adding the values of a nominal or ordinal variable to a regression equation. For the four regression analyses, ethnicity and section were dummy-coded.

The overall model in Table 14 was significant. As shown in table 17, pre-placement scores significantly predicted post-placement exam scores. This indicates, while controlling for the other predictors, greater pre-placement scores predicted greater post-placement scores. In the last regression equation, the redesign section significantly

predicted post-placement scores. This indicates, while controlling for the other predictors, being in the redesign section predicted greater post-placement scores.

The overall model in Table 15 was significant. In the first regression equation, pre-Accuplacer total scores significantly predicted post-Accuplacer total scores.

The overall model in Table 16 was significant. In the first regression equation, pre-arithmetic scores significantly predicted post-arithmetic scores. In the last regression equation, the redesign section significantly predicted post-placement scores.

The overall model in Table 17 was significant. In the first regression equation, pre-algebra scores significantly predicted post-algebra scores.

Additionally, a multiple logistic regression analysis was conducted to predict TSI complete Status for developmental mathematics students. The predictors included: pre-scores from the placement, Accuplacer total and Accuplacer arithmetic exams, along with African Americans, Hispanics and redesign sections. The results in Table 18 revealed that the model was significant. Pre-Accuplacer total significantly predicted that an increase in pre-Accuplacer scores predicted a greater likelihood that students will be TSI complete after passing developmental mathematics. For every increase in pre-Accuplacer score, students were more likely to be TSI complete.

Limitations

This study at Texas Woman's University had several limitations. The first limitation was a time restraint. Time was limited to one semester to gather data and support the study, since this was a grant funded project. Unfortunately, graduate students

are not allotted enough time to follow up on studies because they are under deadline to graduate. Further investigation of this study, a follow-up of a few semesters, could have been helpful to evaluate further significant differences.

Future Research

Research on redesign continued after this study ended. The Accuplacer exam proved to be a good measure for students. The basic math placement exam was discontinued and replaced with the Accuplacer exam. Redesign efforts are on-going at Texas Woman's University and continued research is needed to evaluate these efforts.

In conclusion, the results from this study supported the redesign success of the effort. Data supported that students who were enrolled in the redesign or paired redesign courses produced, overall, greater mean scores than students who were enrolled in traditionally taught lecture and computer based courses.

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APPENDIX A
Example of Raw Data

ID	Pre_Score	Post_Score	Section	Differences	Class	Ethnicity
878109	10	7	1113*08	-3	FR	1
831386	16	13	1123*01	-3	FR	1
870498	14	11	1123*03	-3	FR	3
872188	13	10	1123*02	-3	FR	1
761142	18	15	1123*02	-3	FR	2
830254	14	11	1123*03	-3	FR	2
803721	12	10	1113*03	-2	FR	2
863778	12	11	1113*01	-1	FR	2
800231	11	10	1113*02	-1	FR	2
828204	11	10	1113*02	-1	FR	3
872737	13	12	1113*02	-1	FR	1
861004	12	11	1113*04	-1	FR	3
788141	13	12	1113*01	-1	FR	2
879013	16	15	1123*02	-1	FR	2
881975	12	11	1113*02	-1	FR	2
868454	13	13	1113*04	0	FR	3
866517	13	13	1123*03	0	FR	1
879047	24	24	1123*04	0	FR	3
880099	11	11	1113*10	0	FR	2
861208	22	22	1113*08	0	FR	1
879036	12	12	1123*01	0	FR	3