Evaluating Effectiveness of Developmental Mathematics Instruction Based on Faculty Rank

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Abstract

The focus of this study was to investigate the effectiveness of developmental mathematics and core general education mathematics instruction provided by mathematics faculty of different ranks (professor, associate professor, assistant professor, instructor, and graduate teaching assistant) and retention at the institution after completing the developmental mathematics course within a four-year state institution. This study included a quantitative analysis of archival data from a regional four-year institution of higher education in the Midwest. The sample size (n=1312) included students from one four-year institution from the spring semester of 2010 through the fall semester of 2012 who were enrolled in a developmental mathematics course. A chi-square test of independence was conducted to compare faculty rank with the following variables: completion and pass rates of students in developmental mathematics, retention at the institution the semester following completion of a developmental mathematics course, and completion and pass rates of students in one of the core general education mathematics courses. Results from the study revealed the rank of faculty teaching a developmental mathematics course or core general education mathematics course does affect the grade a student received. Students who took a developmental or core mathematics class from an instructor were more likely to successfully pass the course. Instructors for both developmental and core general education mathematics courses had the highest percentage rates of student passing grades than all other ranks. Students who took a course from any other rank (graduate teaching assistant, assistant professor, associate professor, professor) had a higher probability of failing the course.

Dedication

This study is dedicated to my family who provided unending support and encouragement throughout this process and my life. To my husband Shane, I wouldn't have started this program if it weren't for your support, encouragement, and coaching. You were my rock throughout this process. You supported, pushed, and challenged me at the times I needed it the most. Thank You. Your encouraging words often ran through my head when I wasn't motivated or trying to procrastinate, "Mary, just get it DONE!" My hesitation to start a doctoral program was because I didn't want to miss out on our children's lives. I thought their only memory of this experience would be me doing homework. However, I quickly learned that the Monday nights I was in class were "Daddy Fun Night" for the kids. What a truly unique bonding experience you created for Alexa and Maddox. Every Tuesday morning, I looked forward to the exciting stories they had to tell about whose turn it was to select the restaurant, who got to sit by dad, and what thrilling adventure you created for them. Words cannot express my gratitude. Thank you for walking the talk and role modeling what it means to be an outstanding husband, best friend, and truly amazing father. I love you, and I am honored to experience our life's journey together!

Alexa and Maddox, I can't tell you how much I appreciated the little notes you wrote, the many high fives, the special bookmarks you made and left in my textbooks, and the encouraging words you would say to keep me moving. You never complained about all the hours I spent doing homework or writing.

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I hope this journey we have experience together has taught you hard work, dedication, and perseverance are the keys to obtaining your dreams.   Alexa and Maddox, dream BIG! Your father and I support you 100%! I love you to the moon and back a million times x 1 million!

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Chapter One

Introduction

Living in a world of ever-changing needs, challenges, and technology advances, we need a highly educated and skilled workforce to move the United States forward (McCabe, 2000). In the world of work, there are few unskilled jobs. The majority of jobs, especially well-paying ones, require a post-secondary education (Quint, Jaggars, Magazinnik, & Byndloss, 2013). Yet, students are experiencing huge roadblocks in gaining a post-secondary education when they are not ready to take college-level courses in mathematics, writing, and reading. Underprepared college students are spending time and money taking non-credit bearing courses trying to gain the necessary skills and knowledge needed to complete college-level courses.

One of the top 10 political issues higher education has been facing over the last decade is college readiness and developmental education (Hurley, Harnisch, & Parker, 2014). Finding effective solutions to a systematic issue is a challenge. Grubb (2001) acknowledged the lively and heated debates over the effectiveness of developmental education. He stated "relatively few evaluations of remedial programs have been conducted, and many existing evaluations are useless" (p. 1).

There are many students who are not prepared for college-level mathematics. Thiel, Peterman, and Brown (2008) cited a 2005 report of the Business HE Forum that indicated "22% of college freshmen must take remedial math courses" (p. 45). Almost 60% of the students enrolling at a community college needed to take some type of developmental mathematics course before they were ready to take a college-level course (Bailey, 2009; Schwartz, 2007). The U.S. Department of Education (2016) reported that nationally 40% of first- or second-year students enrolled in a developmental course at a 2-year college and 30% of first- or second-year students enrolled in a developmental course at a 4-year college.

In a published report from the Kansas Board of Regents (2015), 30.9% of first-year, degree seeking students enrolled in a developmental mathematics course at a community college in Kansas in 2014 and 12.6% of first-year, degree seeking students enrolled in a developmental course from a four year Kansas institution. In the California State University system, 30% of first-year freshman needed to take a developmental mathematics course (California State University System, 2012). Another study completed in 2006-2007 in Nevada found that more than one-third of students entering a community college or university needed a developmental mathematics course to help them gain the skills and knowledge to be ready for a college-level course (Fong, Huang, & Goel, 2008).

There is a knowledge gap growing in the overall educational system in America. “The ambitious effort to develop Common Core State Standards in K–12 schools is in danger of falling short of its promise because the nation’s higher education system is not currently lining up” to these college and career readiness standards (Tepe, 2014, p. 2). There is a division in knowledge of students who enroll in higher education and those who are actually ready to take college-level courses (Bachman, 2013).

Students feel they have the knowledge, skills, and ability to be successful at an institution of higher education, yet their test scores, placement rates, and college grades indicated otherwise (Bachman, 2013). Students believe that if they earn a high school diploma they are ready and prepared to be successful in college. However, this is not always the case. There are many students who graduate from high school who are not ready to complete college-level work. One of the biggest areas of deficiency for students is the inability to perform at college level in mathematics (Hagedorn, Lester, & Cypers, 2010).

There have been many different attempts and programs aimed at reducing the achievement gap between high school and college using developmental courses in college and university settings (Arendale, 2011). Developmental coursework aims to help students gain the skills and knowledge they lack so they will be able to successfully move into and complete college-level reading, writing, and mathematics courses. Many students report mathematics courses are the most challenging to complete. In addition to lacking basic mathematics knowledge and skills, many students describe high levels of anxiety in conjunction with taking or considering taking mathematics courses (Hopko, 2003; Perry, 2004).

There is a great debate over whether developmental education should occur in institutions of higher education. Some critics say community colleges should be the only place developmental education should be offered, therefore prohibiting these courses at any four-year institution (Bastedo & Gumport, 2003; Bettinger & Long, 2005; Boylan, Bonham, & White, 1999; Breneman and Haarlow, 1998; Day & McCabe, 1997; Jenkins & Boswell, 2002; Phipps, 1998; Trombley, 1998). On the other hand, some critics argue developmental education should not happen at all in higher education systems and blame the K-12 system for not preparing students for college ready material (Roueche & Roueche, 1999).

State legislators are becoming more vocal about the topic of remediation. Many are asking the question of why they should help fund developmental education when they have already done so at the high school level (McCabe, 2000). State supported funding and resources are in limited supply in the changing landscape of funding for higher education. Legislators are making choices about developmental education for higher education institutions. Many states are limiting the availability or the funding of developmental education (Kozeracki, 2002).

Shifting the blame and avoiding identification of root causes for lack of college academic readiness fail to address the issue of underprepared students in the United States. A knowledge gap exists for underprepared students. This study sought to determine the extent to which the rank of faculty who taught developmental mathematics education courses at a four-year university impacted student success in developmental and college-level mathematics courses, and student retention at the institution.

Background

> Developmental education is a core function of higher education. There has never been a golden age in American educational history when all students who enrolled in college were adequately prepared, all courses offered at a higher education institution were “college-level,” and the transition for students between high school and college was smooth. (Merisotis & Phipps, 2000, p. III)

An extensive review of the literature found few studies examining the effectiveness of developmental education. Research conducted during the last 20 years has not conclusively identified whether or not developmental education is helping students be successful in passing the general education mathematics requirement, frequently college algebra. Merisotis and Phipps (2000) stated that research investigating the effects of developmental education programs had been “sporadic, underfunded, and inconclusive” (p. 75). Assessments of developmental mathematics concluded these courses are neither helping nor hindering student performance in entry-level mathematics courses (Hagerty, Smith, & Goodwin, 2010; Knowlton, 2011; Trenholm, 2009).

This study was conducted using archival data housed at a Midwest, four-year public institution with a Masters L Carnegie classification. The institution requires successful completion of one of the following courses to satisfy the mathematics general education core: MA 110 College Algebra (three credit hours), MA 156 Principles of Mathematics (three credit hours), MA 160 Functions of Calculus (three credit hours), MA 161 Calculus I (three credit hours), or MA 165 Basic Calculus (three credit hours).

Academic advisors recommend that students who did not meet the criteria to enroll in a general education mathematics course enroll in a developmental mathematics course. The institution offered a developmental, non-credit bearing mathematics course for students who earned a score of 21 or below on their American College Testing (ACT) or 69% or below on the institution design algebra placement exam. The course to prepare students for one of the credit-bearing courses was MA 098 Intermediate Algebra for three non-credit bearing hours (Midwest University Catalog 2010, 2011, 2012). The course was offered under the same title and same prerequisite in 2010 through 2012.

Statement of the Problem

The focus of this study was to investigate the effectiveness of developmental mathematics instruction provided by mathematics faculty of different ranks (professor, associate professor, assistant professor, instructor, adjunct faculty, and graduate teaching assistant) and retention at the institution after completing the developmental mathematics course within a four-year state institution. Another focus of the study was to examine student success rates in terms of completion and final grade in a core general education mathematics course MA 098 Intermediate Algebra.

This study expanded the current knowledge base about developmental education by examining the extent to which faculty rank impacts student success in terms of completion and pass rate in a developmental mathematics course, and completion and pass rate in a college-level mathematics course. Studies have examined beliefs and attitudes of faculty toward teaching developmental education (Hadden, 2000; Parker & Bustillos, 2007; Pitts, White, & Harrison, 1999, Trombley, 1998). However, little research has focused on faculty academic rank and the effect on student success outcomes.

Purpose Statement

The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of developmental mathematics courses. The third purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following completion of a developmental mathematics course. A fourth purpose of this study was to determine the impact of faculty rank on the number of students who completed a core mathematics general education course after enrollment in a developmental mathematics course. The final purpose of this study was to determine the impact of faculty rank of instructor in a developmental mathematics course on the final grade in core mathematics courses.

Significance of the Study

The results of this study will contribute to the research focusing on developmental mathematics instruction in a four-year college setting. The rank of faculty teaching developmental mathematics education could have an impact on successful completion of the developmental mathematics course. Since successful completion of the developmental mathematics course is a prerequisite for enrollment in a general education mathematics course for students who do not meet the criteria for enrollment in a core mathematics course, faculty rank may also impact enrollment and successful completion of a general education mathematics course and retention at the institution.

The results of this study may have implications for selecting faculty members to teach developmental education courses. Results of the study will add to the research on developmental mathematics education and the faculty who are recruited to teach underprepared students. Another positive outcome of this study could be to provide legislators with additional information regarding factors that influence successful completion of developmental mathematics courses and general education mathematics courses. This study will expand on previous research by focusing on the rank of faculty teaching the developmental mathematics courses.

Delimitations

This study was completed using archival data from one institution of higher education in the Midwest. Other delimitations are the type of the institution, the size of the institution, and the purposes of the university. Another delimitation of this study was the archival data represented only eight semesters of coursework and only from fall and spring semesters. No summer data were included in this study. The scope of the study was limited to archival data collected from the four-year institution from spring semester of 2010 to fall semester of 2012.

Assumptions

"Assumptions are postulates, premises, and propositions that are accepted as operational for purposes of the research" (Lunenburg & Irby, 2008, p. 135). The researcher assumed the curriculum (e.g., common textbook) taught by the faculty of different ranks was relatively the same for each developmental course.

Research Questions

The following research questions guided this study:

RQ1. To what extent does faculty rank impact student completion of developmental mathematics courses?

RQ2. To what extent does faculty rank impact the assignment of a pass or fail grade in developmental mathematics courses?

RQ3. To what extent does faculty rank impact student retention at the institution the semester immediately following enrollment in a developmental mathematics course?

RQ4. To what extent does faculty rank impact student completion of one of the core general education mathematics courses after successfully completing a developmental mathematics course?

RQ5. To what extent does faculty rank in a developmental mathematics course impact course grade (pass/fail) in one of the core mathematics courses?

Definition of Terms

Developmental education. *Developmental education* is an umbrella term used for a whole host of opportunities, experiences, tutoring, mentoring, and courses designed to support and develop underprepared students to be successful in college-level courses (Kozeracki, 2002). The National Association for Developmental Education [NADE] (2011) defined developmental education as "a field of practice and research within higher education with a theoretical foundation in developmental psychology and learning theory…[that] promotes the cognitive and affective growth of all post-secondary learners" (para. 3).

Completion. In this study, successful completion of a course includes all students who were enrolled in the course on the 20th day of class and finished the course with a pass or fail grade.

Overview of the Methodology

This study included a quantitative analysis of archival data from a regional four-year institution of higher education in the Midwest. The methodology used in this study investigated the effectiveness of developmental mathematics education when taught by faculty of different ranks. Completion and pass rates in one of the core general education mathematics courses were also compared with faculty of different ranks. The sample size (n=1,312) included students from one four-year institution from the spring semester of 2010 through the fall semester of 2012 who were enrolled in a developmental mathematics course. All independent and dependent data collected for the study were nominal scale (yes/no). Therefore, following the advice of Creswell (2014), chi-square analysis was deemed appropriate to respond to each of the five research questions. A chi-square test of independence was conducted to compare the pass rate of students in developmental mathematics, faculty of different ranks, completion and pass rate into one of the core general education mathematics courses, and retention at the institution the semester following completion of a developmental mathematics course.

Organization of the Study

This study has five chapters. The first chapter included an overview and rationale of the need for developmental education. It also included the statement of the problem, purpose of the study, significance of the study, delimitations, assumptions, research questions, and definition of terms.

Chapter two provides a literature review summarizing the lack of college readiness, need for developmental education, the history of developmental education, research findings related to students who enroll initially in developmental education courses and the likelihood of college graduation, and the attitudes and perceptions of faculty teaching developmental education courses. Chapter three describes the methodology for this study and includes the research design, population and sample, sampling procedures, data collection procedures, data analysis and hypothesis testing, and limitations.

Chapter four presents analysis of the data and research findings, including descriptive statistics, results, and hypothesis testing. The fifth chapter provides major findings of the study, findings related to the literature, and conclusions, including implications for action and recommendations for future research.

Chapter Two

Review of Literature

Introduction

"Mathematics is used in today's real world problems" (Hagerty et al., 2010, p. 425). It is used on simple tasks like estimating the total savings on a discount sale at a clothing store, figuring square footage to paint a room, and to figure miles per gallon on a vehicle. Mathematical skills can also be beneficial to manage personal or professional budgets, to calculate return on investments, and to determine what insurance premiums and deductibles are the most beneficial to an employee. It is important to have basic mathematical abilities to thrive in today's world.

Developmental education in simple terms is "designed to provide students who enter college with weak academic skills the opportunity to strengthen those skills enough to prepare them for college-level coursework" (Bailey, Jeong, & Cho, 2010, p. 255). Previously, remedial education was used to describe the education that helped students learn the skills and knowledge to be college ready. However, the term *remedial education* was often associated with the "curative connotation" (Clowes, 1980, p. 8). In educational circles, the term *remedial* implies that if a remedy (e.g., a course of study) is applied to a student, the exhibited problem (weak academic skills) will be fixed (Boylan, Bonham, & Rodriguez, 2000; Casazza, 1999; Gordon, Hartigan, & Muttalib, 1996; Roueche & Roueche, 1999;). *Developmental education* is the more holistic term that is used in higher education today.

A growing problem in the United States is lack of college readiness in mathematics. College readiness is the "level of preparation a student needs in order to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program" (Conley, 2007, p. 5). In order for students to succeed in a college-level course, they have to be able to learn the core skills and knowledge that are presented in the class. They have to be able to digest cognitively and master the information, so they are prepared to move on to the next course in the subject matter sequence and continue to build on the knowledge base (Conley, 2007).

One of the reasons students may struggle with college-level courses is they find there is a gap from what they have experienced in the high school classroom to what college professors expect of them in a college-level course. There are fundamental differences for students in high school coursework compared to college courses (Conley, Aspengren, Stout, & Veach, 2006). Students are expected to own the knowledge they learn in college courses. They are expected to analyze, research, manipulate and think deeply about material from a variety of perspectives in college-level courses (National Research Council, 2002).

The publishers of the American College Testing (ACT) college readiness assessment stated that 43% of high school graduates who took the ACT test met the math benchmark for college readiness. Fifty percent of Kansas high school graduates who were tested met the benchmark for math college-readiness (2014). Varied assessments are used to test the mathematics knowledge of Kansas high school students including ACT, SAT (formerly known as the Scholastic Assessment Test), National Assessment of Educational Progress (NAEP), and institutionally developed tests. The total of Kansas high school graduates who meet all four ACT college readiness benchmarks has increased by five percent since 2011 (Kahlar, 2015).

Since 2011, there has been a steady increase in the number of high school graduates who have met the benchmarks in the ACT college and career standard. Even with this positive growth, almost 30% of those students who will go on to college will still need developmental education to gain the skills and knowledge to be successful in college (American College Testing, 2014).

> The term '*college-level*' suggests that agreed upon standards exist or, at least, enjoy a consensus by educators. A reasonable assumption would be that the academic community has identified specific knowledge and skills that are required of students to be successful in a college or university. (Merisotis & Phipps, 2000)

Conley (2007) suggested there are currently several but often limiting ways colleges and universities determine if students are ready for a college-level course. They look at high school course titles and overall grade point average (GPA), national test scores, such as ACT, SAT, and NAEP, or how they score on placement assessments such as ACT Compass or ACCUPLACER.

At many higher education institutions, these placement exams are the sole indicator of the mathematics course a new student should enroll, a developmental mathematics or a college level course. Scott-Clayton (2012) suggested that this one assessment should not be the only factor considered when determining which mathematics course placement.

Developmental Mathematics Faculty and Instructional Strategies

There is limited research on the type of instructors who teach developmental mathematics courses. Chingos (2016) completed a study at one community college in California and found on average, full-time instructors outperformed part-time instructors in the developmental educational classroom. He concluded that instructors with master's degrees outperformed those instructors with doctorate degrees (Chingos, 2016).

Reynolds (2015) studied the perceptions and attitudes of faculty of different academic ranks. The rank that had the most positive belief about developmental education was part-time, non-tenured faculty. The rank that had the most negative view of developmental education was full-time, tenured faculty.

Research on instructional strategies is more developed. A landmark study on teaching and learning in developmental education classrooms was conducted by Kulik and Kulik (1991). Their meta-analysis of the literature and findings of the suggested models are still being used in developmental education. The effective models of teaching and learning were based on Bloom's Mastery for Learning (1968), Keller's Personalized System of Instruction (1968), and instruction through technology (Kulik and Kulik, 1991).

Bloom's Mastery for Learning described a process of learning in six stages. Students have to recall a new concept before they can perform higher levels of thinking with the concept. The six stages are recall, grasp, apply, analyze, synthesize, and judge (Bloom, 1968).

Keller's Personalized System of Instruction was originally created by Keller (1968) and later adapted by Burton, Moore and Magliaro (1996). The system is preidentified with learning objectives and is in self-paced modules. The learner must master the content at the first level before going to the next (higher thinking) level of the content. Learners are tested often and provided immediate feedback.

Kulik and Kulik (1991) suggested using these learning strategies through technology applied to instruction. While technology allows many opportunities for a student to master a skill and be assessed on the content, Jaggars and Xu (2010) suggested using caution when applying a program completely through technology.

There are practitioners using these learning models in the classroom. The Community College of Baltimore County (2014) created the Accelerated Learning Program for students who needed extra help to gain the skills and knowledge to be successful in two courses (e.g., developmental and college level). The college level course had 20 students; 10 were also enrolled in the developmental course at the same time. North Carolina Community College (2012) used the learning mastery model in modularized programs based on the individualized needs of each student. Part of the instruction was taught using technology. These learning models are helping students be successful in developmental courses.

Authors Zientek, Ozel, Fong, and Griffin (2013) identified other instructional strategies to help students be successful in the classroom. Some of these strategies were attendance policies, mandatory academic support, and giving students regularly scheduled tests or quizzes to assess their skills and knowledge. Having support services for students while in the classroom and outside of the class period is another effective instructional strategy (Boylan and Saxon, 2006; Jenkins, 2006). Boylan (2002) claimed lecture-style instructions for developmental education classrooms are not effective.

Instead, Boylan (2002) suggested active learning methods, self-paced and individualized instruction, collaborative learning and peer review, and mastery learning.

The History of and Need for Developmental Education

One of the reasons for the lack of college readiness is that high school and college curricula are not aligned with each other. The expectations for performance in entry level college-level mathematics courses are far greater than the expectations of high school graduation requirements for mathematics (Center for Community College Student Engagement, 2016; Creech, 1997; Kraman, D'Amico, & Williams, 2006). In order for high school courses to help prepare students for college-level mathematics, courses need to set higher standards, learning objectives, and outcomes (Adelman, 2006; Gamoran, Porter, Smithson, & White, 1997). Perin (2011) noted some educators are stressing the importance of conceptualizing curricula based on best practices.

Benken, Ramirez, Li, and Wetendorf (2015) advocated for student outcomes to focus on the content and the attitude of developmental mathematics students. Another factor to consider is age of the student entering into college. Some students enter college many years after high school graduation and need help to rebuild or refresh their skills in certain areas (McCabe, 2000; Merisotis & Phipps, 2000).

Higher education institutions have been offering remedial education to underprepared students since early colonial days (Boylan et al., 1999; Merisotis & Phipps, 2000). Harvard College had tutors available to students who needed help in Greek and Latin in the seventeenth century. Land-grant colleges were being established in the mid-eighteenth century. At these institutions, preparatory programs were created to help those students who were not ready for the college curriculum in reading, writing, and math (Payne & Lyman, 1996). The University of Wisconsin was the first university to offer developmental education programs, more than just a course in remediation, in reading, writing, and arithmetic to students who needed to gain additional skills to be successful in college in 1849 (Breneman & Haarlow, 1998).

In the twentieth century, institutions were admitting many underprepared students to help grow enrollment numbers. There was a huge flux of World War II veterans that were flocking to universities under the G.I. Bill. This also created a great need in developmental education to help prepare veterans to be successful in college. The Civil Rights Act of 1964 and the Higher Education Act of 1965 brought about another surge of underprepared students to higher education with open admissions policies (Payne & Lyman, 1996). Students of any educational background were now being admitted into colleges across the nation. Some students lacked the skills and knowledge to be successful in college level courses.

Remediation or developmental education has been a part of higher education for more than 150 years. Throughout the history of higher education, students for a variety of reasons have needed to gain additional skills and knowledge to be successful in college level courses. Developmental education has been an important link to success for students in college.

Effectiveness of Developmental Education

Although several nonprofit foundations have helped fund and research teaching practices and creative and innovative developmental education approaches, few studies have investigated the effectiveness of developmental education for students (Alstadt, 2012; Center for Community College Student Engagement, 2016; Clancy & Collins, 2013; Silva & White, 2013). A report published in 2008 stated that due to the lack of effectiveness "college remediation is one of the most serious education issues facing our country, and policymakers must address it immediately" (Ashendorf, 2008, p. 6).

In Texas, Martorell and McFarlin (2007) studied remediation and concluded that "aside from weak evidence that remediation improves the grades received in college-level mathematics courses, we find little indication that students benefit from remediation" (Martorell & McFarlin, 2007, p. 1). They also found a small negative effect on number of courses students attempted/enrolled in and the likelihood those students would complete their first year of college.

Greene and Winters (2005) studied graduation rates of all graduating seniors nationally as well as by state from 1991-2002. They found that even though students graduated from a high school, not all of these students were qualified academically to attend college. The high school graduation requirements are lower than the admission policies of colleges.

> Nationally, the percentage of all students who left high school with the skills and qualifications necessary to attend college increased from 25% in 1991 to 34% in 2002. The finding of flat high school graduation rates and increasing college readiness rates is likely the result of the increased standards and accountability programs over the last decade, which have required students to take more challenging courses required for admission to college without pushing those students to drop out of high school. (Greene & Winters, 2005, p. Executive Summary)

There are also studies that have controlled for entering academic skills and demographic characteristics. These studies found that community college students who are in need of developmental education, but do not participate in developmental education, do just as well as those students who do participate in developmental education (Adelman, 1998; Attewell, Lavin, Domina, & Levey, 2006). It is not about how many developmental courses a student takes that leads to college graduation; it is the amount of skills a student lacks when s/he leaves high school that has a greater impact on graduation rates (Attewell et al., 2006).

Adelman (1998) examined how developmental education affected a cohort of students who graduated in 1982 from high school and went on to college. He found that the more developmental courses completed the less likely a student was to graduate with a bachelor's or associate's degree. Fifty-five percent of students who completed one course, 45% of students who completed two developmental courses, and 35% of students who completed five or more courses earned a college degree. He replicated this study with a cohort that graduated from high school in 1992. Results were very similar to the earlier findings. The more developmental courses a student completed decreased the likelihood of college graduation (Adelman, 2004).

A new report from Complete College America (2016) reported on how some states redesigned developmental education to benefit students. Georgia, West Virginia, Tennessee, Indiana, and Colorado now have co-requisites for developmental education not prerequisites. Co-requisite remediation allows students to enroll in a college level course and at the same time receive additional support to be successful in the course. These additional mandatory classes and specific tutoring during lab hours help develop students' skills and knowledge. The co-requisites are paired with customized instruction for the student as well as support services.

Cost of Developmental Education and the Effects It Has on Financial Aid for Students

"When students attend college but never leave the developmental sequence, it is costly both for them and for the state" (Perry & Rosin, 2010, p. 23). The annual cost of remediation at community colleges across America is estimated to be $1.9 to $2.3 billion a year and an additional $500 million a year at four-year colleges (Ashendorf, 2008).

Students carry the burden of the cost of remediation. They spend extra time, money, and resources in developmental courses to try to acquire the skills and knowledge necessary to advance to college-level work. Students do not earn college credit for developmental courses. These courses could actually be using up students' financial aid eligibility yet may not move them closer to graduation (Horn & Carroll, 1996; Horn & Nevill, 2006).

College-Level Mathematics Courses: The Gate Keeper Courses in Higher Education

There are many factors that contribute to the success of a student in a college mathematics course: student motivation to work hard in order to grasp the knowledge and content, self-regulation, and assertiveness (Zientek, Ozel, Fong, and Griffin, 2013). Zientek, Ozel, Fong, and Griffin found that 41% of grade variance was predicted by non-cognitive, affective variables. They concluded that affective variables need to be addressed when considering placement into developmental or college level course work.

There are even more affective variables that play a role in the success of nontraditional students (Sedlacek, 2004; Van Horne, 2009). Sedlacek (2004) described how the following variables could help or hinder a student's academic success; student self-concept, self-appraisal, goal setting, community involvement, leadership experience, mentor presence, and the ability to deal with systemic bureaucracy and racism. Van Horne (2009) completed qualitative research with nontraditional students and their transition to college. The research showed cultural differences and perspective of non-traditional students adversely affected them because of their unwillingness to ask for support. Therefore these students did not receive the level of support they needed to be successful academically.

"Introductory courses, including many that satisfy general-education requirements, often pose a particular problem for students who are not interested in the subject or fear failure based on their high school experiences" (Thiel, et. al., 2008 pp. 45-46). These introductory level courses are sometimes referred to as gateway keeper courses. Students must have basic proficiency levels of mathematics to be enrolled in a college level course (Goudas & Boylan, 2012). "Students' low success rates nationally in mathematics courses are particularly damaging because these courses are a gateway to many majors and hence a major stumbling block to students' achievement" (Thiel, et. al., 2008, p. 46).

Retention

A survey published in 2008 stated that most college students believed that they were academically prepared for college (Ashendorf, 2008). Many students become discouraged when they realize they are not prepared for college and earn low test results on entrance exams. This adds to a student's frustration and often leads a student to drop out of college (Deil-Amen & Rosenbaum, 2002).

Retention of students can suffer when students are mandatorily placed into remedial or developmental courses at an institution. Boylan, Bonham, and Bliss (1994) found a statistically significant negative impact on mandatory placement.

Bettinger and Long (2004) found that if a student stays in a developmental course and passes the course s/he is slightly less likely to drop out of college compared to underprepared peers who didn't complete or did not take a developmental course. The authors concluded that there was a positive effect on persistence at the institution. They found that students took longer to complete their degrees because of the extra time spent on developmental courses.

Criticism of Developmental Education

Critics have argued that the existence of remedial or developmental courses on a college campus is proof that students are not prepared for college-level work (Marcus, 2000; Trombley, 1998). Some believe having developmental mathematics courses on a college campus lowers the standards of college admissions. This allows students to pass an easier or "dumbed down" version of a course (Mac Donald, 1997, 1998, 1999). These views suggest that only students who can successfully pass a college level course should be admitted into college.

Others argue that students spend a great deal of time taking non-credit bearing courses just to prepare them for entry into college-level mathematics courses. Students who are placed into a developmental course spend a semester or more taking courses that will not earn them credit toward graduation. Taking additional courses outside of the number required for graduation adds to the workload of the underprepared students and does not help them progress closer to graduation (Deil-Amen & Rosenbaum, 2002; Rosenbaum, 2001).

Faculty Attitudes and Perceptions on Developmental Education

Advisors and faculty often help students navigate around developmental courses. They work with and point out policies and procedures that don't necessarily require (only strongly suggest) students to take developmental courses (Perin, 2004).

"The real problem here is that we value being smart much more than we value developing smartness" (Astin, 1998, para. 20). Faculty feel they are good teachers when they teach "smart" students who learn material quickly and master concepts taught in class. However, when teachers instruct students who struggle and do not comprehend the content easily or at all, they fear they have failed as a teacher. "Much of our fear of remedial students and much of our unwillingness to get involved in educating them can be traced to our uncritical acceptance of this belief and to the fact that most of us are not even consciously aware of the power and scope of its influence" (Astin, 1998, para. 18).

Credentials and Training of Developmental Education Faculty

The mathematics developmental education field relies heavily upon adjunct instructors to teach developmental courses. Shults (2001) reported that 65% of faculty in the field were adjunct instructors. Zientek, Ozel, Fong, and Griffin (2013) found students earned lower grades when taught by adjunct faculty compared to the students who earned higher grades when taught by faculty of higher rank. Datray, Saxon, and Martirosyan (2014) noted the significant challenges adjunct instructors have stacked against them. Adjunct faculty often are not as connected with campus and the resources available. This lack of campus engagement hinders the student's ability to ask questions or meet with the instructor outside of class (Datray et al., 2014). These challenges can be detrimental to the student's holistic learning experience.

A survey by the California Community Colleges Chancellor's Office (2009) identified that mathematics faculty who taught developmental mathematics education were not hired to teach these courses based on their prior knowledge or experiences in developmental mathematics education nor did they receive training in this area once they were hired. They were hired based on mathematics credentials, not their ability to teach or their effectiveness with developmental mathematics students and their needs (Boylan, 2009).

"Faculty familiarity with a rich menu of research-based options for effective practice in developmental education is a first step on the road to improving student outcomes on a campus" (Perry & Rosin, 2010). However, Datray, Saxon, and Martirosyan (2014) noted that adjunct faculty are paid less and receive little if any professional developmental dollars to improve their knowledge and skills.

Commitment of College Administration

The overall success of developmental mathematics education can benefit from institutional commitment. Boroch, Hope, Smith, Gabriner, Mery, Johnstone, and Asera (2010) concluded that "changes in institutional conditions… also result in fundamental shifts of organizational focus that may have an impact on the delivery of developmental education" (pp. 15-16). An important aspect of successful developmental education is committed higher educational leadership (Roueche & Roueche, 1999).

Bracco, Austin, Bugler, and Finkelstein (2015) encouraged practitioners to get buy-in from faculty on the curricula that will be used in developmental courses. They also stressed the importance of having administration understand and support developmental education.

Summary

Research on developmental education for students who lack the proficiencies needed to be successful in college level mathematics courses suggests that developmental education is needed to help these students be successful in college. However, some research does not support the use of developmental mathematics education. Few studies have investigated the impact of faculty rank on student success in developmental mathematics courses, core mathematics courses enrolled in after a developmental mathematics course, or retention at the institution. This study focused on how the rank of faculty who taught developmental mathematics courses affected student success in terms of completion and pass rates in developmental mathematics courses as well as retention at the institution, completion of a college-level mathematics course, and final grade in the college-level mathematics course. This chapter outlined literature on developmental mathematics education. It focused on developmental education faculty and their attitudes, perceptions, and credentials. Instructional strategies used in the classroom, historical perspectives, need, effectiveness, and criticism of developmental education were also addressed. This chapter also covered the cost of developmental education for states, colleges, and students. Chapter three will detail the methodology for this study.

Chapter Three

Methods

The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of students enrolled in developmental mathematics courses. The third purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following completion of a developmental mathematics course. A fourth purpose of this study was to determine the impact of faculty rank on the number of students who completed a core mathematics general education course after successful completion of a developmental mathematics course. The final purpose of this study was to determine the impact of faculty rank of the individual teaching a developmental mathematics course on the final grade in a core mathematics course.

Research Design

This study used a non-experimental, comparative design to examine the impact of faculty rank on the success of students in developmental mathematics courses. This study included a quantitative analysis of archival data from a regional Midwest, Master L Carnegie classification, four-year institution of higher education. The study focused on how faculty rank impacted student success in terms of completion of a developmental mathematics course and pass rate, as well as retention at the institution, completion of a college-level mathematics course, and final grade in a college-level mathematics course.

The dependent variables were completion of a developmental mathematics course, course grade (pass or fail) in a developmental mathematics course, student retention at the institution the semester immediately following enrollment in a developmental mathematics course, and student completion and pass rates in a core general education mathematics course. The independent variable was faculty rank (e.g., professor, associate professor, assistant professor, instructor, and graduate teaching assistant).

Population and Sample

The population for this study was all developmental mathematics education students at one institution. A non-probability, purposive sampling technique was used for this total population sample. The data set included all students enrolled in a MA 098 Intermediate Algebra developmental education course fall or spring semesters at a Midwestern state institution between spring semester 2010 to the fall of 2012. Students were placed in a developmental mathematics course if they earned an ACT score of 21 or below or earned a 69% or below on the college algebra placement exam designed by faculty within the institution.

Sampling Procedures

There was no sampling procedure since archival data for the total population were included in the study. Archival data were used for this research study from a mid-sized, Midwest regional, Master L Carnegie classification, four-year institution. All students who were enrolled in MA 098 Intermediate Algebra, a developmental mathematics course, from the spring of 2010 to the fall semester of 2012 were included in the database. There were 1,312 students enrolled in this course during a fall or spring semester 2010 through 2012. No summer semesters were included in this data set.

Data Collection Procedures

A request to conduct research was submitted to the Baker University Institutional Review Board (IRB) on January 15, 2016 (see Appendix A). Permission was granted from the Baker University IRB to conduct this study on January 21, 2016 (see Appendix B). After receiving permission from Baker University, the researcher submitted a request to conduct research at the Midwest, mid-sized regional institution IRB on February 4, 2016 (see Appendix C). Approval to conduct research at the Midwest institution was obtained on February 23, 2016 (see Appendix D).

Archival data were collected from the Midwest, mid-sized regional institution's office of Institutional Research and Assessment for eight academic semesters from spring 2010 through fall 2012. The archival data were requested and received from the assistant provost for Institutional Research and Assessment at the Midwest, mid-sized regional institution on February 23, 2016. The data included student identification number, status, term, course; academic rank of the faculty member teaching the developmental course; pass rate of students in developmental mathematics courses; retention at the institution the semester immediately following enrollment in a developmental mathematics course; and completion and the final grade received in a college-level mathematics course.

Data Analysis and Hypothesis Testing

The research questions, hypotheses, and data analyses summarized below guided this quantitative study. A significant difference in proportionality suggested that one or more faculty ranks may be superior to other ranks.

RQ1. To what extent does faculty rank impact student completion of developmental mathematics courses?

H1. There is a difference in faculty rank and the completion of developmental mathematics courses.

A chi-square test of independence was conducted to test H1. The proportional differences of the percent of course completion or non-course completion will be compared between the faculty ranks. A significant difference in proportionality will suggest that one or more faculty ranks may be superior to other ranks. The level of significance was set at .05.

RQ2. To what extent does faculty rank impact the assignment of a pass or fail grade in developmental mathematics courses?

H2. There is a difference in faculty rank and the assignment of a pass or fail grade in developmental mathematics courses.

A chi-square test of independence was conducted to test H2. The proportional differences of the percent of course grade (pass/fail) will be compared between the faculty ranks. A significant difference in proportionality will suggest that one or more faculty ranks may be superior to other ranks. The level of significance was set at .05.

RQ3. To what extent does faculty rank impact student retention at the institution the semester immediately following enrollment in a developmental mathematics course?

H3**.** There is a difference in faculty rank and student retention at the institution the semester immediately following enrollment in a developmental mathematics course.

A chi-square test of independence was conducted to test H4. The proportional differences of the percent of student retention will be compared between the faculty ranks. A significant difference in proportionality will suggest that one or more faculty ranks may be superior to other ranks. The level of significance was set at .05.

RQ4. To what extent does faculty rank impact student completion of one of the core general education mathematics courses after successfully completing a developmental course?

H4. There is a difference in faculty rank and the student completion of one of the core general education mathematics courses after successfully completing a developmental mathematics course.

A chi-square test of independence was conducted to test H5. The proportional differences of the percent of course completion or not of a core general education mathematics course will be compared between the faculty ranks. A significant difference in proportionality will suggest that one or more faculty ranks may be superior to other ranks. The level of significance was set at .05.

RQ5. To what extent does faculty rank in a developmental mathematics course impact course grade (pass/fail) in one of the core general education mathematics courses?

H5. There is a difference in faculty rank in a developmental course and the course grade (pass/fail) in one of the core general education mathematics courses.

A chi-square test of independence was conducted to test H6. The proportional differences of the percent of course grade (pass/fail) will be compared between the faculty ranks. A significant difference in proportionality will suggest that one or more faculty ranks may be superior to other ranks. The level of significance was set at .05.

Limitations

The study had the following limitations:

1. The data in this study were from one state institution in the Midwest; therefore the results might not be generalized to other institutions.

2. There are many variables outside the researchers control that affect student retention (e.g., social and cultural integration, economic factors, family support).
3. Faculty members' past experiences with developmental mathematics education as well as instructional quality were not controlled in this study.
4. The syllabus including student learning outcomes, course delivery (e.g., face-to-face, online, or hybrid) was not controlled in this study.

Summary

This study focused on how the rank of faculty who taught developmental mathematics courses affected student success in terms of completion and pass rates of a developmental mathematics course, as well as retention at the institution, completion of a college-level mathematics course, and final grade in the college-level mathematics course. This chapter outlined the methodology of this study. It also described the research design, population and sample, data collection procedure, research questions, hypotheses, data analyzes, and limitations. Chapter four will define the results of the study.

Chapter Four

Results

The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of students enrolled in developmental mathematics courses. The third purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following a developmental mathematics course. The fourth purpose of this study was to determine the impact of faculty rank on course competition. The final purpose of the study was to determine final grade in a core mathematics course. Presented in this chapter are the results of the data analysis for each hypothesis associated with the research questions posed for this study.

Descriptive Statistics

Table 1 describes frequency and percentages for the number of students taught by each rank of faculty (graduate teaching assistant, instructor, assistant professor, associate professor, and professor). There were 1,312 students who enrolled in MA 098 Intermediate Algebra, a developmental mathematics course, from the spring of 2010 to the fall semester of 2012. Only fall and spring semesters during 2010 through 2012 were included in the data set. No summer semesters were included in the data set.

Table 1

Descriptive Frequencies and Percentages for the Number of Students Taught by Faculty Rank.

Faculty Rank	Number of Students Taught	Percentage
Graduate Teaching Assistant	333	25.4%
Instructor	786	59.9%
Assistant Professor	28	2.1%
Associate Professor	88	6.7%
Professor	77	5.9%
Total	1312	100.0%

Table 2 describes the frequencies and the percentages for the number of students who completed or withdrew from MA 098 Intermediate Algebra. For a student to "complete" a course the student had to enroll in the course and continue in the course through the final exam. By completing the course, the student received a grade of satisfactory (S) or unsatisfactory (U). A student who did not remain enrolled throughout the duration of the course received a course code for withdraw (W). There were 155 students who withdrew from the developmental mathematics course and 1,157 students who completed the course.

Table 2

Descriptive Frequencies and Percentages of Students Who Completed or Withdrew from the Developmental Mathematics Course

Completion	Frequency	Percent
Withdrew	155	11.8%
Completed	1157	88.2%
Total	1312	100.0%

Table 3 illustrates the descriptive frequencies and percentages of the number of students who withdrew (W) from MA 098 Intermediate Algebra, failed with an unsatisfactory (U) grade code, or passed with a satisfactory (S) grade code. The total number of students enrolled in the course was 1,312. Of those students 155 withdrew, 538 failed the course with an unsatisfactory (U) grade, and 619 students successful pass the course with a satisfactory (S) grade.

Table 3

Descriptive Frequencies and Percentages of Students Who Successfully Passed, Failed, or Withdrew from MA 098 Intermediate Algebra

Grade	Frequency	Percent
Withdrew (W)	155	11.8%
Unsatisfactory (U)	538	41.0%
Satisfactory (S)	619	47.2%
Total	1312	100.0%

The descriptive frequencies and percentages of the number of students who were retained at the institution are described in Table 4. Students who enrolled in any course at the university the semester immediately following completion of MA 098 Intermediate Algebra were considered to be retained. There were 1,312 students who took a developmental mathematics course. 803 students were retained the semester following the developmental mathematics course and 509 students left the institution.

Table 4

Descriptive Frequencies and Percentages of Students Retained at the Institution the Semester Immediately After Completion of MA 098 Intermediate Algebra

Retained	Frequency	Percent
Not Retained	509	38.8%
Retained	803	61.2%
Total	1312	100.0%

Table 5 illustrates the number of students who enrolled in a core general education mathematics course taught by faculty of different rank after taking a developmental mathematics course. There were 633 students that enrolled in a core general education mathematics course. Graduate teaching assistants taught 189 students while 53 students were taught by full professors.

Table 5

Descriptive Frequencies and Percentages of Students Who Enrolled in a Core General Education Mathematics Course Taught by Faculty Rank

Faculty Rank	Number of Students Taught	Percentage
Graduate Teaching Assistant	189	29.8%
Instructor	96	15.1%
Assistant Professor	119	18.8%
Associate Professor	177	27.9%
Professor	53	8.4%
Total	634	100.0%

Table 6 describes the frequencies and the percentages for the number of students who completed or withdrew from a core general education mathematics course. ‘Completion’ of a course meant the student stayed enrolled through the final exam. By completing the course, the student received a grade letter of A, B, C, D, or F. A student who didn’t remain enrolled throughout the duration of the course received a course code for withdraw (W). Of the 643 students enrolled in one of the core general education mathematics courses, 496 students completed the course and 138 students withdrew before the end of the semester.

Table 6

Descriptive Frequencies and Percentages of Students Who Completed a Core General Education Mathematics Course

Completion	Frequency	Percent
Did Not Complete	138	21.8%
Complete	496	78.2%
Total	634	100.0%

Table 7 illustrates the descriptive frequencies and percentages of the number of students who passed a core general education mathematics course (e.g., received a grade of A, B, or C), failed (e.g., received a grade of D or F), or withdrew (W) before the end of a core mathematics course. Of the 634 students who enrolled in a core general education mathematics course, 251 students failed and 138 withdrew from the course. Only 245 of the 634 students enrolled in the course passed with a grade of A, B, or C.

Table 7

Descriptive Frequencies and Percentages of Students Who Passed or Failed a Core General Education Mathematics Course

Grade	Frequency	Percent
Withdrew	138	21.8%
Failed	251	39.6%
Passed	245	38.6%
Total	634	100.0%

Hypothesis Testing

Presented next are the research questions, hypotheses formulated, and the results from the analysis for each question.

RQ1. To what extent does faculty rank impact student completion of developmental mathematics courses?

H1. There is a difference in faculty rank and the completion of developmental mathematics courses.

A chi-square test of independence was conducted to test H1. The proportional differences of the percent of course completion or non-course completion were compared between the faculty ranks. As shown in Table 8, there was not a significant difference $\chi^2 = 3.97$, $df = 4$, $p = .41$ in faculty rank and the completion of developmental mathematics courses, when Alpha was set at the 0.05 confidence level.

The hypothesis was not supported. More than 80% of students completed the course regardless of faculty rank.

Table 8

A Chi-square Test of Independence: Proportional Differences of Developmental Mathematics Course Completion or Non-course Completion (Withdrew) Between Faculty Ranks

Completion		Rank				
		Graduate Teaching Assistant	Instructor	Assistant Professor	Associate Professor	Professor
Withdrew	Count	33	92	4	13	13
	Total %	9.9 %	11.7 %	14.3 %	14.8 %	16.9 %
Complete	Count	300	694	24	75	64
	Total %	90.1 %	88.3 %	85.7 %	85.2 %	83.1 %

Chi-square Test

	Value	*df*	*p*
X^2	3.971	4	0.41
n	1312		

Note: Alpha=<.05

RQ2. To what extent does faculty rank impact the assignment of a pass or fail grade in developmental mathematics courses?

H2. There is a difference in faculty rank and the assignment of a pass or fail grade in developmental mathematics courses.

A chi-square test of independence was conducted to test H2. The proportional differences of the percent of course grade (pass/fail) were compared between the faculty ranks. As shown in Table 9, there was a significant difference $\chi^2 = 18.71$, $df = 8$, $p = .016$ in faculty rank and the course grade in developmental mathematics courses, when Alpha was set at the 0.05 confidence level.

The hypothesis was supported. Students were more likely to receive an unsatisfactory grade (64.3%) if taught by assistant professors and were more likely to receive a satisfactory grade (50.4%) if taught by instructors.

Table 9

A Chi-square Test of Independence: Proportional Differences of Developmental Mathematics Course Grade Between Faculty Ranks

Grade		Rank				
		Graduate Teaching Assistant	Instructor	Assistant Professor	Associate Professor	Professor
Withdrew	Count	33	92	4	13	13
	Total %	9.9 %	11.7 %	14.3 %	14.8 %	16.9 %
Unsatisfactory	Count	155	298	18	35	32
	Total %	46.5 %	37.9 %	64.3 %	39.8 %	41.6 %
Satisfactory	Count	145	396	6	40	32
	Total %	43.5 %	50.4 %	21.4 %	45.5 %	41.6 %

Chi-square Test

	Value	*df*	*p*
X^2	18.71	8	0.016
n	1312		

Note: Alpha=<.05

RQ3. To what extent does faculty rank impact student retention at the institution the semester immediately following enrollment in a developmental mathematics course?

H3. There is a difference in faculty rank and student retention at the institution the semester immediately following enrollment in a developmental mathematics course.

A chi-square test of independence was conducted to test H3. The proportional differences of the percent of student retention were compared between the faculty ranks.

As shown in Table 10, there was a significant difference $\chi^2 = 11.36$, $df = 4$, $p = .023$ in faculty rank and student retention at the institution the semester immediately following enrollment in a developmental mathematics course, when Alpha was set at the 0.05 confidence level.

The hypothesis was supported. Students taught by assistant professors (53.6%) and associate professors (52.3%) were more likely to not be retained at the institution the semester immediately following completion of a developmental mathematics course. Conversely, students taught by professors (64.0%) and graduate teaching assistants (64.6%) were more likely to be retained at the institution the semester immediately following completion of a developmental mathematics course.

Table 10

A Chi-square Test of Independence: Proportional Differences of Student Retention at the Institution Between Faculty Ranks

Retained		Rank				
		Graduate Teaching Assistant	Instructor	Assistant Professor	Associate Professor	Professor
Not Retained	Count	118	303	15	46	27
	Total %	35.4 %	38.5 %	53.6 %	52.3 %	35.1 %
Retained	Count	215	483	13	42	50
	Total %	64.6 %	61.5 %	46.4 %	47.7 %	64.9 %

Chi-square Test

	Value	*df*	*p*
X^2	11.36	4	0.023
n	1312		

Note: Alpha=<.05

RQ4. To what extent does faculty rank impact student completion of one of the core general education mathematics courses after successfully completing a developmental mathematics course?

H4. There is a difference in faculty rank and student completion of one of the core general education mathematics courses after successfully completing a developmental course.

A chi-square test of independence was conducted to test H4. The proportional differences of the percent of course completion or non-completion of a core general education mathematics course was compared between the faculty ranks. As shown in Table 11, there was not a significant difference $\chi^2 = 7.195$, $df = 4$, $p = .126$ in faculty rank and the completion of a core general education mathematics courses, when Alpha was set at the 0.05 confidence level.

The hypothesis was not supported. More than 70% of students completed a core general education course regardless of the faculty rank of the instructor teaching the developmental mathematics course.

Table 11

A Chi-square Test of Independence: Proportional Differences of Student Completion in a Core General Education Mathematics Course Between Faculty Ranks

Completion		Rank				
		Graduate Teaching Assistant	Instructor	Assistant Professor	Associate Professor	Professor
Not Completed	Count	43	22	19	47	7
	Total %	22.8 %	22.9 %	16.0 %	26.6 %	13.2 %
Completed	Count	146	74	100	130	46
	Total %	77.2 %	77.1 %	84.0 %	73.4 %	86.8 %

Chi-square Test

	Value	*df*	*p*
X^2	7.195	4	0.126
n	634		

Note: Alpha=<.05

RQ5. To what extent does faculty rank in a developmental mathematics course impact course grade (pass/fail) in one of the core general education mathematics courses?

H5. There is a difference in faculty rank in a developmental course and the course grade (pass/fail) in one of the core general education mathematics courses.

A chi-square test of independence was conducted to test H5. The proportional differences of the percent of course grade (pass/fail) was compared between the faculty ranks. As shown in Table 12, there was a significant difference $\chi^2 = 36.8$, $df = 8$, $p < .001$ in faculty rank and the final course grade (pass/fail) in a core general education mathematics courses, when Alpha was set at the 0.05 confidence level.

The hypothesis was supported. Students taught by assistant professors in a developmental mathematics course (54.6%) had the highest likelihood of failing the core general education mathematics course. On the other hand, students were also more likely to receive failing grades in a core mathematics course when the developmental mathematics course was taught by a professor (43.4%), graduate teaching assistant (39.7%), or associate professor (39.5%).

Table 12

A Chi-square Test of Independence: Proportional Differences of Student Grade (Pass/Fail) in a Core General Education Mathematics Course Between Faculty Ranks

Grade		Rank				
		Graduate Teaching Assistant	Instructor	Assistant Professor	Associate Professor	Professor
Withdrew	Count	43	22	19	47	7
	Total %	22.8 %	22.9 %	16.0 %	26.6 %	13.2 %
Failed	Count	75	18	65	70	23
	Total %	39.7 %	18.8 %	54.6 %	39.5 %	43.4 %
Passed	Count	71	56	35	60	23
	Total %	37.6 %	58.3 %	29.4 %	33.9 %	43.4 %

Chi-square Test

	Value	*df*	*p*
X^2	36.8	8	< .001
n	634		

Note: Alpha=<.05

Summary

Chapter four reviewed the research questions and outcomes of hypothesis testing related to differences in faculty rank when compared to overall student success. Chi-square tests of independence were completed to analyze each hypothesis. Chapter five presents interpretation of the results, implications for higher education institution leaders, and recommendations for future research.

Chapter Five

Interpretation and Recommendations

Chapter one of this study focused on the background and purpose of the study, the statement of the problem, significance, delimitations, assumptions, and the research questions. Chapter two provided an extensive literature review covering mathematics faculty and instructional strategies, as well as the need, effectiveness, and cost of developmental education. It also provided overviews of developmental education as it relates to student retention, faculty attitudes, perceptions, credentials, and training. Chapter three summarized the methodology of this study. The research design, population, and data analysis and hypothesis testing were described. Chapter four presented descriptive statistics for dependent and independent variables, and provided the results of the hypothesis testing. Chapter five will review the study, identify major findings, implications for actions, and recommendations for future research.

Study Summary

Overview of the problem. There are many underprepared students who enter college. These students do not have the knowledge or skills to be successful in college level mathematics courses (Hagedorn et al., 2010). To gain the necessary mathematics skills to be successful in a core general education mathematics course, some students enroll in a non-credit bearing developmental mathematics course. Students spend a great deal of time and money in developmental sequenced coursework and may or may not complete the course or receive a passing grade. This study examined how faculty rank affects student success factors such as completion and pass rates for developmental mathematics courses, retention at the institution, and completion and pass rates for core general education mathematics courses.

Purpose statement and research questions. The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of students enrolled in a developmental mathematics course. The third purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following completion of a developmental mathematics course. A fourth purpose of this study was to determine the impact of faculty rank on the number of students who completed a core mathematics general education course after completing a developmental mathematics course. The final purpose of this study was to determine the impact of faculty rank of the individual teaching a developmental mathematics course on a student's final grade in a core mathematics course. Five research questions guided this study.

Review of the methodology. The study focused on how faculty rank impacts student success in terms of completion of a developmental mathematics course, pass rates in a developmental mathematics course, retention at the institution the semester immediately following completion of a developmental mathematics course, completion of a college-level mathematics course after completion of a developmental mathematics course, and final grade in a college-level mathematics course. This study used a non-experimental, comparative design to examine the impact of faculty rank on the success of students in developmental mathematics courses. The study used archival data from a Midwest, mid-sized institution. The dependent variables were grade (satisfactory/unsatisfactory) in a developmental mathematics course, completion of a developmental mathematics course, student retention at the university the semester immediately following completion of a developmental mathematics course, and student completion and pass rates (pass or fail) in a core general education mathematics course. The independent variable was faculty rank (professor, associate professor, assistant professor, instructor, adjunct faculty, and graduate teaching assistant). Chi-square tests of independence were used to compare the variables in each research question.

Major findings. Multiple chi-square tests of independence were conducted to determine to what extent faculty rank impacted student success: course completion and final grade in a developmental mathematics course, course completion and final grade in a core general education mathematics course, and retention at an institution. The detailed results of the chi-square analyses of the five research questions and hypotheses can be found in chapter four. Table 13 provides a summary table highlighting the chi-square analyses for all five hypothesis questions.

Table 13

Summary Chi-square Analysis Results for H1 Through H5

Course	H_A	Between	Performance	Chi SQ	*df*	*p*	*sig*
Developmental Mathematics	H1	Faculty Ranks	Completion	3.97	4	0.41	No
	H2	Faculty Ranks	Pass or fail	18.71	8	0.02	Yes
	H3	Faculty Ranks	Retention	11.36	4	0.02	Yes
Core General Education Mathematics	H4	Faculty Ranks	Completion	7.19	4	0.13	No
	H5	Faculty Ranks	Pass or fail	36.8	8	<.001	Yes

Several conclusions emerged from the data analyses. There was a not a statistically significant result indicating faculty rank had an impact on student completion of developmental mathematics courses. However, regardless of the faculty rank, students had an 86% chance of completing the developmental mathematics course. The hypothesis was not supported. There was no proportional difference in student final grades between faculty rank.

There was a statistically significant result indicating faculty rank had an impact on final grade (satisfactory/unsatisfactory) in developmental mathematics courses. Assistant professors had the lowest percentage of students successfully passing developmental mathematics courses. Students enrolled in a course taught by an assistant professor were 64.3% more likely to fail the course with an unsatisfactory grade. Students who enrolled in a developmental course taught by a full professor had a 41.6% chance of passing the course.

Another statistically significant result indicated faculty rank had a negative impact on student retention at the institution the semester immediately following enrollment in a developmental mathematics course. Retention from one semester to the next is an important factor for the entire institution. Students who enrolled in a developmental course taught by an assistant professor or associate professor had a higher likelihood of not coming back to the institution the next semester. However, the students who took the course from a full professor or graduate student had a much higher probability of being retained at the institution the following semester.

There was not a statistically significant result indicating faculty rank impacted student completion of one of the core general education mathematics courses after successfully completing a developmental course. Regardless of the rank of the faculty, there was a 75% chance a student would complete the core general education mathematics course.

There was a statistically significant result indicating faculty rank had an impact on course grade (pass or fail) in one of the core general education mathematics courses. Students who completed a core mathematics course taught by an instructor had a higher rate (58%) of passing the course than students who completed a core mathematics course taught by faculty representing other ranks. Students who were taught by graduate teaching assistants, assistant professors, or associate professors were more likely to fail than pass the course.

The rank of faculty teaching a developmental mathematics course or core general education mathematics course does affect the grade a student received. Students who took a developmental or core mathematics class from an instructor were more likely to successfully pass the course. Instructors for both developmental and core general education mathematics courses had the highest percentage rates of student passing grades than all other ranks. Students who took a course from any other rank (graduate teaching assistant, assistant professor associate professor, professor) had a higher probability of failing the course.

While none of the hypothesis related to overall retention and success in higher education, one of the findings that can be inferred is only 38.6% of the 634 students who enrolled in a core general education course completed the course with a passing grade. That is 61.4% of the students who enrolled failed or withdrew from the core general education course. This has serious implications for success of college completion and retention.

Findings Related to the Literature

Currently 30% of students who attend college need some kind of developmental education. To be successful in college, developmental education is a must in higher education (ACT, 2014). Helping students to be successful once they are enrolled in developmental courses is critical. This study focused on the effect faculty rank has on student success, completion and pass rates in developmental mathematics and core mathematics courses, and retention at the institution.

Many students enter college lacking ACT scores or high school grades documenting sufficient mathematics competence to be successful in a college level core mathematics course. These students are often either encouraged or required to enroll in a development mathematics course. While several recent studies have focused on specific types of instructional strategies of developmental mathematics (Boylan, 2002; Kulik and Kulik,1991; Zientek et al., 2013) additional research is needed to investigate how faculty rank plays a role in these instructional strategies.

Chingos (2016) found that the level of education of the faculty made a difference on student success rates in developmental algebra courses at a large community college. He stated that faculty with a master's degree were more successful teaching students in the classroom than the faculty who held a doctorate degree. This study confirmed Chingos' research. Students enrolled in developmental and core mathematics courses taught by instructors had a higher percentage of passing the course than all other rank of faculty.

Conley (2007) stated students need to be able to master information so they can continue on to the next course in the sequence. This study supported Conley's research. In this study, there were very high rates of failure and withdrawals from developmental courses and core general education courses. Without successful completion of these courses, it is highly unlikely students will complete college.

Perry and Rosin (2010) found that it can cost students a great deal of money if they do not pass developmental courses and move on to credit bearing courses. Students do not receive college course credit for developmental courses. Students who are enrolled in these courses are paying college tuition for the course, but cannot count the course credit toward degree complete or graduation requirements. Horn and Nevill (2006) and Horn and Carroll (1996) found that developmental courses can use a student's financial aid eligibility but these courses are not counting toward graduation requirements. This study supported Horn and Nevill's and Horn and Carrol's findings. Students who took a developmental course from an assistant professor had a 64.3% chance of failing the developmental mathematics course.

Thiel, Peterman, and Brown (2008) found that students who can't pass gateway courses such as core general education mathematics courses are blocked from continuing on to their majors of choice. This study supported Thiel, Peterman, and Brown's research. There was a high rate of failure (54.6%) of students who enrolled in and completed a core general education mathematics course after successfully completing a developmental mathematics course. Failure in the core mathematics course will block students from completing their academic major and will ultimately impact completion of a college degree.

Zientek, Ozel, Fong, and Griffin (2013) found that students taught by adjunct faculty received lower grades than those taught by faculty of higher rank. This study does not support Zientek, Ozel, Fong, and Griffin's findings. In this current study, students had better pass rates in both developmental and core general education mathematics courses when taught by instructors and graduate teaching assistants than when taught by assistant and associate professors.

Conclusions

Faculty rank does matter in developmental mathematics courses as well as core general education mathematics courses.

- Developmental mathematics course completion rates are not determined by faculty rank. Eighty percent of students completed the course regardless of faculty rank.
- Final grade in a developmental mathematics course is determined by faculty rank. Surprisingly, instructors have the highest percentage of student pass rates of all faculty.
- Students who were taught by a professor or graduate student had an increased chance of being retained at the institution the semester immediately following completion of a developmental mathematics course. In this study, professors and graduate teaching assistants out-performed assistant and associate professors.
- Core general education mathematics course completion rates were not determined by faculty rank. No matter the faculty rank, 70% of students completed the core general education mathematics course.
- Final grade in a core general education mathematics course is determined by faculty rank. Once again, professors and graduate teaching assistants outperformed assistant professors in terms of pass rates of students in the core.

In the following section, implications for action are provided, followed by recommendations for future research and concluding remarks.

Implications for action. Results from this study could help administrators in higher education make informed decisions about the rank of faculty members who have a likelihood of producing the best outcomes in terms of completion and course grades in developmental mathematics courses as well as core general education mathematics courses completed after a student has successfully passed a developmental mathematics course. If administrators do not monitor faculty rank in developmental mathematics courses, students will fail at a higher rate.

In this study instructors outperformed all other ranks. This is an area that merits additional investigation to determine common variables contributing to the success of this faculty rank. Students may not gain the skills to be successful if students and college officials don't pay attention to faculty rank. A student should consider all opportunities to help them be successful in a developmental sequence and core general education mathematics courses and faculty rank is one factor of student success.

Recommendations for future research. The following recommendations are offered for consideration.

Faculty rank had an effect on student success outcomes (e.g., course grades in developmental and core mathematics courses) and retention at the institution. College chairs and deans should further investigate why these differences were found. Future studies should focus on collaborative design of developmental courses taught by faculty of varied ranks, specific curriculum elements that lead to successful course completion and grades of C or higher, the impact of course delivery (e.g., face to face, online, hybrid), co-requisites, and instructional quality.

Examining the type of instruction methods used as well as the specific training a faculty member has received prior to teaching a developmental education course could also provide additional insights into factors that lead to greater success for students in developmental mathematics courses. Focusing on the type of appointment an instructor has (e.g., part-time or full-time) or whether the instructor is on tenure track or non-tenure track could help identify instructors who will be the most effective at teaching developmental education. University chairs and deans need to further investigate why instructors have the highest pass rates in developmental mathematics classes. Academic advisors who are enrolling students into developmental education courses and core general mathematics course should strongly consider the rank of the faculty member teaching the developmental or core mathematics course before enrolling underprepared students in a certain section.

An additional topic potentially related to student success and retention in developmental mathematics courses is the attitudes and perceptions of faculty of different rank who teach developmental education courses. Additional research on this topic could potentially identify faculty attitudes and perceptions that would help students grow and develop knowledge and skills in the developmental education mathematics classroom.

This study focused on one small to middle sized institution in the Midwest. Additional research is needed on a variety of institutional sizes as well geographical locations. Additional studies should look at the rank of faculty and student success in states that have successfully adopted the common core standards. While this study focused on mathematics developmental education, additional research should be conducted with the effects of faculty rank on writing and reading developmental education.

Concluding remarks. Student success in courses and retention at an institution are major priorities in higher education and at the institution where this study conducted. Helping the underprepared student achieve academic success is a major hurdle at many institutions. The rank of faculty teaching a developmental mathematics course or core general education mathematics course appears to determine or affect the grade a student received. Students are more likely to pass a developmental or core mathematics class from an instructor. Instructors for both developmental and core general education mathematics courses had the highest percentage rates of passing grades than all other ranks. Students who took a course from a faculty member of any other rank (graduate teaching assistant, assistant professor associate professor, professor) had a higher probability of failing the course.

Administrators have the power to help students be successful in developmental and core general education mathematics courses by assigning the most successful faculty to teach these courses. Higher education administrators have a responsibility to insure that faculty assigned to teach developmental and core mathematics courses have the necessary knowledge and teaching skills that will produce student success.

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Appendices

Appendix A: Baker University IRB Form

BAKER UNIVERSITY

Date: January 21, 2016

SCHOOL OF EDUCATION
GRADUATE DEPARTMENT

IRB PROTOCOL NUMBER _______________
(IRB USE ONLY)

IRB REQUEST

Proposal for Research
Submitted to the Baker University Institutional Review Board

I. Research Investigator(s) (Students must list faculty sponsor first)

Department(s) **School of Education Graduate Department**

Name Signature

1. Tes Mehring ____________________________, Major Advisor
2. Phil Messner ____________________________, Research Analyst
3. University Committee Member
4. External Committee Member

Principal Investigator: Mary Shivley ___________________
Phone: 620-481-1790
Email: maryashivley@stu.bakeru.edu
Mailing address: Midwest University

Faculty sponsor: Tes Mehring
Phone: 913-344-1236
Email: tmehring@bakeru.edu

Expected Category of Review: _X_Exempt ___ Expedited _ __Full

II: Protocol: (Type the title of your study)

Evaluating the Effectiveness of Developmental Mathematics Education based on Faculty Rank

Summary

In a sentence or two, please describe the background and purpose of the research.

The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of developmental mathematics courses. The third purpose of this study was to determine the impact of faculty rank on the number of students who matriculated to a core, college-level mathematics course the immediate semester following the developmental mathematics course. A fourth purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following completion of a developmental mathematics course. A fifth purpose of this study was to determine the impact of faculty rank on the number of students who complete a core mathematics general education course after a developmental mathematics courses. The final purpose of this study was to determine the impact of faculty rank of the developmental mathematics course on the final grade in core mathematics courses. Archival data will be retrieved from a regional Midwest 4-year institution of higher education.

Briefly describe each condition or manipulation to be included within the study.
There are no conditions or manipulations in this study.

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.
Will the subjects encounter the risk of psychological, social, physical or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

Since archival data is being used in this study, there will be no psychological, social, physical or legal risk.

Will any stress to subjects be involved? If so, please describe.

Archival data will be used, there will be no stress involved in this study.

Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

Since archival data will be used, there will be no deception or misleading behavior.

Will there be a request for information which subjects might consider to be personal or sensitive? If so, please include a description.

Archival data will be used, so no personal or sensitive information will be gathered.

Will the subjects be presented with materials which might be considered to be offensive, threatening, or degrading? If so, please describe.

Archival data will be used, so there will not be any materials presented.

Approximately how much time will be demanded of each subject?

No time commitment will be required, since this study will be using archival data.

Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.

There won't be subjects in this study, archival data will be used.

What steps will be taken to insure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?

Archival data will be used. I will not be seeking participant participation and will not be offering any inducements.

How will you insure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.

Written consent will not be necessary because archival data will be used.

Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.

The data that I will receive will be unidentifiable. All personal information will be removed by the university prior to be obtaining the data.

Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher or employer? If so, explain.

Archival data will be used, so the data that I will receive will be unidentifiable. All personal information will be removed by the university prior to obtaining the data and nothing will be noted on a permanent record.

What steps will be taken to insure the confidentiality of the data? Where will it be stored? How long will it be stored? What will be done with it after the study is completed?

1. What steps will be taken to insure the confidentiality?
    a. University official will remove the names and assign numbers to each record.
2. Where will you stored the data?
    a. I will store the information on my personal/professional Y Drive. This drive is only accessible by secure password login.
3. How long will it be stored?
    a. I will keep the data for three years after the study is completed.
4. What will be done with the data after the study.
    a. It will be destroyed.

If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?

No risks will be involved in this study.

Will any data from files or archival data be used? If so, please describe.

This study will include a quantitative analysis of archival data from a regional Midwest 4-year institution of higher education. A database will be created that includes all students enrolled in a developmental mathematics course each fall and spring semester during the fall 2010 through spring 2013 semesters. Developmental mathematics course grade (pass or fail), enrollment status the semester immediately following enrollment in a developmental mathematics course, enrollment in a college level mathematics course and grade received in a college level mathematics course will be recorded for each subject in the study. A university official at the institution from which the archival data are being retrieved will remove any personally identifying information from the database prior to providing the file to the researcher. The academic rank of the faculty member teaching the developmental mathematics course will be linked (without the name of the faculty member) to the subject database.

After the IRB is approved at Baker University, I will seek approval from the regional Midwest 4-year institution of higher education.

Appendix B: Baker University IRB Approval Form

BAKER UNIVERSITY
Own Confidence

Baker University Institutional Review Board

February 4, 2016

Dear Mary Shivley and Dr. Dr. Mehring,

The Baker University IRB has reviewed your research project application and approved this project under Exempt Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.

Please inform this Committee or myself when this project is terminated or completed. As noted above, you must also provide IRB with an annual status report and receive approval for maintaining your status. If you have any questions, please contact me at CTodden@BakerU.edu or 785.594.8440.

Sincerely,

Chris Todden EdD
Chair, Baker University IRB

Baker University IRB Committee
Verneda Edwards EdD
Sara Crump PhD
Erin Morris PhD
Scott Crenshaw

Appendix C: Midwest University IRB Form

APPLICATION FOR APPROVAL TO USE HUMAN PARTICIPANTS

For R&G Use Only	Date approved:	___________	Approved by: ____________
Protocol No. _________	Full Review _____	Expedited Review _____	

This application should be submitted, along with the Informed Consent Document and supplemental material, to the Institutional Review Board for Treatment of Human Participants, Research and Grants Center, Plumb Hall 313F, Campus Box 4003.

Before approval can be given to use human subjects, you must register with the CITI Program and successfully complete the Human Subject Research Course applicable to your discipline. Information and instructions are available at http://www.midwestuniversity.edu/research/irb.html.

Human Subjects Research course was completed on: Date ___2/15/16________________

1. Name of Principal Investigator(s) (Individual(s) administering the procedures):
Mary Shivley

2. Departmental Affiliation:
   Doctoral work with Baker University, Major advisor-Dr. Tes Mehring
   Baker University IRB has approved this study (attached).

3. Person to whom notification should be sent:_ Mary Shivley
   Mailing Address: Midwest University

   Telephone: 620-481-1790 Email address: mshivley@midwestuniversity.edu

4. Title of Project: ______Evaluating Effectiveness of Developmental Mathematics Instruction Based on Faculty Rank
5. Funding Agency (if applicable):

6. This is a: X dissertation _____thesis _____class project _____other research study

7. Time period for which you are requesting approval (maximum one year): from Feb. 8, 2016__________ to May 15, 2016__________. *If the research project extends past the end date requested, you will need to submit a request for a time extension or an annual update. This form is available at www.midwestuniversity.edu/research/docs/irbmod.doc*.
8. Project Purpose *(please be specific)*:

The purpose of this study was to determine the impact of faculty rank on student completion of a developmental mathematics course. A second purpose of this study was to determine the impact of faculty rank on the pass or fail grade of developmental mathematics courses. The third purpose of this study was to determine the impact of faculty rank on the number of students who matriculated to a core, college-level mathematics course the immediate semester following the developmental mathematics course. A fourth purpose of this study was to determine the impact of faculty rank on student retention at the institution the semester immediately following completion of a developmental mathematics course. A fifth purpose of this study was to determine the impact of faculty rank on the number of students who complete a core mathematics general education course after a developmental mathematics courses. The final purpose of this study was to determine the impact of faculty rank of the developmental mathematics course on the final grade in core mathematics courses.

9. Describe the proposed participants: (*age, sex, race, expected number of participants, or other special characteristics, such as students in a specific class, etc.*)

Since archival data will be used, there will be no participants for this study.

10. Describe how the participants are to be selected. *If you are using archival information, you must submit documentation of authorization from applicable organization or entity.*

I collaborated with the Assistant Provost for Institutional Research and Assessment, Jo Kord to inquire about the use of archival data of students who enrolled in developmental mathematics education courses spring 2010 through the fall of 2013. A request to conduct research was submitted to the Baker University Institutional Review Board (IRB) on February 1, 2016. Permission was granted from the Baker University IRB to conduct this study on February 4, 2016.

Archival data will be collected for eight academic semesters from spring 2010 through fall 2013. The data will include random selected identification number, status, term, course, academic rank of the faculty member teaching the developmental course, pass rate of students in developmental mathematics courses, retention at the institution the semester immediately following enrollment in a developmental mathematics course, matriculation into a college-level mathematics course, and the final grade received in college-level mathematics course. Personal identification of the individual students will in no way shape or form be given as part of the archival data.

11. Describe **in detail** the proposed procedures and benefit(s) of the project. This must be clear and detailed enough so that the IRB can assure that the University policy relative to research with human participants is appropriately implemented. Any proposed experimental activities that are included in evaluation, research, development, demonstration, instruction, study, treatments, debriefing, questionnaires, and similar projects must be described here. **Copies of questionnaires, survey instruments, or tests should be attached.** (*Use additional page if necessary*.)

This study will use a non-experimental, comparative design to examine the impact of faculty rank on the success of students in developmental mathematics courses. This study will include a quantitative analysis of archival data from a regional Midwest, Master L Carnegie classification, four-year institution of higher education. The study will focus on how faculty rank impacts student success in terms of completion of a developmental mathematics course and pass rates, as well as retention at the institution, completion of a college-level mathematics course, and final grade in the college-level mathematics course.

There will be no sampling procedure since archival data will be used for the total population. Archival data will be used for this research study from a mid-sized, Midwest regional, Master L Carnegie classification four-year institution. The total population includes all students who were enrolled in MA 098 Intermediate Algebra, a developmental mathematics course, from the spring of 2010 to the fall semester of 2013. There are 1,841 students who enrolled in this course during a fall or spring semester during 2010 through 2013. No summer semesters will be included in this data set. The total population sample size is 1,841 students.

12. Will questionnaires, tests, or related research instruments not explained in question #11 be used?
Yes __x____ No (*If yes, attach a copy to this application*.)

13. Will electrical or mechanical devices be applied to the subjects? _____Yes ___x___ No
(*If yes, attach a detailed description of the device(s) used and precautions and safeguards that will be taken.*)

14. Do the benefits of the research outweigh the risks to human participants?
_____ Yes _____ No (*If no, this information should be outlined here*.)

There is no risk to human participants since the study involves archival data and no participants are involved.

15. Are there any possible emergencies which might arise in utilization of human participants in this project?
_____ Yes _____ No (*If yes, details of these emergencies should be provided here*.)

There will be no emergencies that will arise to human participants since the study involves archival data and no participants are involved.

16. What provisions will you take for keeping research data private/secure? (*Be specific – refer to the section* ***Safeguarding Information*** *in the IRB Policies.)*

To insure confidentiality of the data, the university official, Dr. Jo Kord, will remove the names and all personal identifying information and assign numbers to each record. No personal information will be included in the data set. I will store the information on my personal/professional Y Drive at Midwest University. This drive is only accessible by secure password login. I will keep the data for three years after the study is completed and then I will destroy it.

17. **Attach a copy of the informed consent document, as it will be used for your participants**.

There will not be an informed consent document since there will not be participants, only archival data will be used.

INVESTIGATOR'S ASSURANCE: I certify that the information provided in this request is complete and accurate. I understand that as Principal Investigator I have ultimate responsibility for the protection of the rights and welfare of human participants and the ethical conduct of this research protocol. I agree to comply with all of Midwest University policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human participants in research, including, but not limited to, the following:

- The project will be performed by qualified personnel according to the research protocol,
- I will maintain a copy of all questionnaires, survey instruments, interview questions, data collection instruments, and information sheets for human participants,
- I will promptly request approval from Midwest University IRB if any changes are made to the research protocol,
- I will report any adverse events that occur during the course of conducting the research to the IRB within 10 working days of the date of occurrence.

______________________________________ 2/8/16______________________
Signature of Principal Investigator Date

Appendix D: Midwest University IRB Approval Form

GRADUATE SCHOOL AND DISTANCE EDUCATION

February 23, 2016

Mary Shivley
Baker University

Dear Ms. Shivley:

Your application for approval to use human subjects has been reviewed. I am pleased to inform you that your application was approved and you may begin your research as outlined in your application materials. Please reference the protocol number below when corresponding about this research study.

Title:	Evaluating Effectiveness of Developmental Math Instruction Based on Faculty Rank
Protocol ID Number:	16045
Type of Review:	Exempted
Time Period:	February 8, 2016 to May 15, 2016

If it is necessary to conduct research with subjects past this expiration date, it will be necessary to submit a request for a time extension. If the time period is longer than one year, you must submit an annual update. If there are any modifications to the original approved protocol, such as changes in survey instruments, changes in procedures, or changes to possible risks to subjects, you must submit a request for approval for modifications. The above requests should be submitted on the form Request for Time Extension, Annual Update, or Modification to Research Protocol. This form is available at www.emporia.edu/research/irb.html.

Requests for extensions should be submitted at least 30 days before the expiration date. Annual updates should be submitted within 30 days after each 12-month period. Modifications should be submitted as soon as it becomes evident that changes have occurred or will need to be made.

On behalf of the Institutional Review Board, I wish you success with your research project. If I can help you in any way, do not hesitate to contact me.

Sincerely,

John Barnett pf

Dr. John Barnett
Chair, Institutional Review Board

pf

cc: Tes Mehring

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