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A Correlation of Community College Math Readiness and Student Success

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COLLEGE OF EDUCATION

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Jayna Nicole Brown

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Walden University
2015

Abstract

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MA, Antioch University Midwest, 2006

BS, Central State University, 1997

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Although traditional college students are more prepared for college-level math based on college admissions tests, little data have been collected on nontraditional adult learners. The purpose of this study was to investigate relationships between math placement tests and community college students' success in math courses and persistence to degree or certificate completion. Guided by Tinto's theory of departure and student retention, the research questions addressed relationships and predictability of math Computer-adaptive Placement Assessment and Support System (COMPASS) test scores and students' performance in math courses, persistence in college, and degree completion. After conducting correlation and regression analyses, no significant relationships were identified between COMPASS Math test scores and students' performance ($n = 234$) in math courses, persistence in college, or degree completion. However, independent t test and chi-squared analyses of the achievements of college students who tested into Basic Math ($n = 138$) vs. Introduction to Algebra ($n = 96$) yielded statistically significant differences in persistence ($p = .039$), degree completion ($p < .001$), performance ($p = .008$), and progress ($p = .001$), indicating students who tested into Introduction to Algebra were more successful and persisted more often to degree completion. In order to improve instructional methods for Basic Math courses, a 3-day professional development workshop was developed for math faculty focusing on current, best practices in remedial math instruction. Implications for social change include providing math faculty with the knowledge and skills to develop new instructional methods for remedial math courses. A change in instructional methods may improve community college students' math competencies and degree achievement.

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Dedication

I would like to first give honor to my Lord and Savior Jesus Christ, who has appointed me a team of family, faculty, and employers who supported my professional vision. I dedicate this study to my family. I am grateful to my children, who at the ages of 5 and 7 understood the importance of giving Mommy space when she was doing her homework, and to my husband, Ernest C. Brown, Jr., who has always had confidence in my capabilities. I wish to show my greatest appreciation to my parents, James Chilton, Jr. and Pamela Chilton, who have always encouraged me to be the best that I can be regardless of my professional field.

Higher education professionals, especially those in student affairs, have an abiding desire to see students achieve. Each educator has his or her own reasons that have cultivated this desire. This study is also dedicated to all the student affairs professionals who love math enough to refuse to abandon those students who experience math anxieties, aversions, or deficiencies.

Acknowledgements

I would like to acknowledge and give thanks to my Chair and committee members for all their support. Dr. Wendy Edson, thank you for your unwavering encouragement. I hope you know how appreciative I am that you took my success personally and refused to accept anything less than my best. I also appreciate that you recognized my potential and held me accountable throughout my journey. Dr. Linda Swanson, I want to thank you for your expertise and for always being available and timely with your advice. I could not have done any of this without the both of you.

To the administration, staff, and faculty of the participating college, I extend my ultimate gratitude. You all contributed numerous hours outside of your contracts to help me complete this project. I will be forever grateful for your commitment to student achievement. I would like to especially thank the president of the college, the director of Student Success, the director of Institutional Research, and the math faculty for listening to my concerns and being transparent with providing data and insight about the college policies and procedures. Thanks also to Dr. Michael Lopez and Jerome Murray for their statistical advice and direction. Lastly, I want to acknowledge my colleagues who supported me through classroom discussions. Your updates and support motivated me to persist through completion.

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Introduction

The challenges of returning to school for adult learners who have been out of school for five years or more can begin immediately with the admissions process. Demonstrating basic competencies in reading, writing, and math is one of the first obstacles faced by a new student. This task is difficult for underprepared students, especially in the area of mathematics. It is perceived that underprepared adult learners are drawn to community colleges by their commonly known traits such as accessibility, convenience, and cost effectiveness (Shulock & Moore, 2007). However, Shulock and Moore argued that the increased educational opportunities provided by community colleges are negligible because community college students are not meeting academic requirements needed to complete a degree. The challenges adult learners face are related to how community colleges assess readiness skills. The reliability of college admission tests as a placement tool has been questioned, especially in the area of mathematics (Hughes & Scott-Clayton, 2011). It is imperative to know if students' math skills are being properly assessed so that students' are appropriately placed into courses that will help them develop the skills needed to be successful in college math.

To determine if math preparedness has any relation to persistence and degree completion, I conducted an assessment of math readiness skills among adult learners at a community college in Ohio. The protocol at the community college is to assess each new student's math readiness based on their performance on the COMPASS test. Specifically, I measured the relationships between the COMPASS test scores of students who tested into lower-level remedial math courses and their success and persistence in those courses.

I then evaluated variations of persistence and success based on COMPASS and ACT scores and examined the predictive nature of COMPASS Math test scores on student performance and persistence to degree completion.

The Local Problem

In this study I examined factors related to the academic performance of students at a community college in Ohio, known hereafter by the pseudonym Local Community College (LCC), who were struggling with math readiness and academic success. I specifically examined adult learners new to the college who tested into lower-level remedial math courses, their success in these courses, and their persistence to degree completion. LCC is a state-funded institution that serves a population of students in west central Ohio and has students throughout the Midwest via online learning.

The mission of the LCC is to provide accessible, high-quality, and learner-centered educational opportunities to its students (LCC, 2013). The institution has an open-admission policy and is committed to preparing students for success. The college offers approximately 90 certificates and associate degree programs, of both transfer and technical nature, and supports an average of 3,200 credit-seeking students each quarter. Of the student population, approximately 69% are female, and 14% are minorities. The average student age is 28, and more than half of the students attend part-time. There is no on-campus housing, so 100% of the student population commute to and from campus.

The community college of this study is one of 23 two-year institutions in Ohio that have historically reported low graduation rates. However, enrollment for this institution continues to increase. LCC experienced a 64% increase in enrollment from 2007 to 2011, peaking at a count of 8,564 (LCC, 2011a). Such growth has been beneficial to the college’s reputation although retention has been a topic of discussion. The college has been tracking student retention and has noticed some trends. For instance, in 2009, 385 first-time, full-time students were enrolled for the fall quarter, and of those, 70.4% returned for the winter quarter and 61% returned for spring (LCC, 2011b). This quarter-to-quarter retention data, however, does not lead to high annual retention rates.

LCC (2011b) found that of the 385 students who enrolled in fall of 2009, only 181 returned the following fall (47%). According to data from the Ohio Board of Regents (2010a), this rate is significantly lower than the 53% average first-year to second-year retention rate of similar institutions in the State of Ohio. Also, these data indicated that despite the enrollment of 334 full-time, first-year degree-seeking students in 2002, only 11% graduated within three years, which is considerably lower than the 17–20% seen in other Ohio institutions with similar enrollments. The lack of institutional research explaining these data has created an interest among the college’s administration in the subject of mathematics and student success. Approximately 57% of the students enrolled at the college required math remediation in the 2010 academic year, leading to substantial effort being devoted to investigating any potential evidence of a relationship between math readiness and student success (OBR, 2010b).

A potential means of addressing student success is the national organization Achieving the Dream, which was developed to help community college students, particularly minority and low-income students, persist and complete their educational goals (Asera, 2012). Administrators at LCC have been attentive to the efforts of this organization. Through research and evidence-based initiatives, the organization is helping to close the achievement gap by encouraging institutional change, influencing public policy, and inspiring knowledge development. Asera reported that the organization's participating colleges have conducted studies in such areas as remedial education prior to college admission, guiding the remedial math student to student services, and exploring interventions for remedial education.

Researchers who have studied a variety of interventions have reported findings that positively impact educational outcomes like persistence. Visher, Butcher, Cerna, Cullinan, and Schneider (2010) found that structured mentoring for students needing low-level remedial math improved the persistence of students in those courses; however, it had no bearing on their success in those courses. Roksa, Jenkins, Jaggars, Zeidenberg, and Cho (2009) found that students who require lower-level remedial education in any subject have less favorable educational outcomes than those who require upper-level remedial courses or none at all. Still, little research has been done to specifically explore a potential relationship between success in remedial math and student success in the form of persistence or degree completion.

The pledge of LCC to provide access to a quality educational experience to learners of all educational backgrounds, even those who may be considered at risk, makes evident its priorities and is reflected in its admission procedures. Admission for students without a high school diploma or a General Educational Development (GED) credential is accommodated by the requirement of the COMPASS placement test. Students can major in any of 43 terminal or technical degrees; however, they must all demonstrate a minimum basic math requirement or competency for degree completion and financial aid eligibility (LCC, 2012a). The admissions policy set by the college administrators supports accessibility for students; however, access alone does not ensure a quality educational experience. In addition, LCC's lower than average graduation rate (11–14%) raises concerns. In 2010, 65% of its first-year students enrolled in at least one remedial course, and the basic math remedial course also had the lowest completion rates (44.02%) of all subjects (LCC, 2010).

The State of Ohio is transitioning into new success-driven funding policies and procedures (Dougherty & Natow, 2009). If the college's concerns about student degree completion continue to be unaddressed, this problem has a strong potential to jeopardize the funding of the institution and decrease the resources available to students in the future. This will negatively affect the community members' pursuit of higher education. The LCC has devoted much time and effort to providing an educational opportunity equally accessible to both prepared and underprepared students. During my involvement with the college, I recognized that math could potentially be a barrier for students as they pursue that opportunity.

In 2009, the Ohio Board of Regents, which oversees colleges and universities in the state, began implementation of a new funding formula for Ohio institutions of higher education. This new formula, designed to promote student achievement, has three components: enrollment, student success, and instructional-specific goals and metrics (Moltz, 2009). Moltz suggested that the student success component of this formula include a persistence element to account for community colleges. The performance-based funding model of Ohio includes a persistence component that focuses on the number of credit hours students complete. Conversations with administrators at the college have indicated that this funding model has made them more determined than ever to be better stewards of the academic success of enrolled students (A. Sues, personal communication, November 10, 2014). However, there could be external elements, such as the college readiness skills (specifically math skills) of students prior to enrollment that are of concern for the institution.

In 2010, 460 first-time/first-year students over the age of 20 were admitted to LCC, and of those students, 57% needed math remediation (Ohio Board of Regents, 2010b). However, there are no data showing the retention, persistence, or success of those students in the subsequent remedial math courses. LCC's institutional research, however, shows that students are more successful in the intermediate remedial math course (CPE 101) than in the basic remedial math course (CPE 091). In 2010, 30-47% of the students enrolled in sections of CPE 091 successfully completed the course, compared to 55-63% of those enrolled in CPE 101 (LCC, 2010). The institutional data, however, do not indicate why this is so. Also, there are no data that track students in both the CPE 091 or CPE 101 courses and their progression to degree completion (LCC, 2010).

The need for research related to the persistence and success in remedial math courses at the college used in this study is also reinforced by a lack of evidence showing that the assessment of developmental math is a valid method for assigning students to remediation. Hughes and Scott-Clayton (2011) stated that no placement rule is without error. The misplacement of students in remedial math courses or even college math courses is inevitable. It is these gaps in research that provide an opportunity to improve both the student success rate in these courses and possibly ensure or even increase the funding of the institution.

Rationale

George (2010) described how community colleges have the potential to remedy college readiness disparities within their communities. An investigation into the relationship between COMPASS Math test scores and the success of community college students could prompt such intercession to address these disparities. The purpose of this correlation study was threefold. First, it was designed to assess relationships between the COMPASS test scores of students who test into lower-level remedial math courses and their success and persistence in those courses. Second, it evaluated variations of persistence and success based on COMPASS and ACT scores. Finally, it examined the predictive nature of COMPASS Math test scores on student performance and their persistence to degree completion.

These factors contributed to the creation of a study design with four overall research objectives. First, an assessment of a potential relationship between students' COMPASS Math test scores and their persistence in math courses was conducted. Second, possible relationships between students' COMPASS Math test scores and their success in math courses were examined. Third, a comparison of success and persistence among students using COMPASS cut scores, as defined by LCC and those suggested by ACT, was performed. Lastly, the predictive nature of COMPASS Math test scores for students' performance in math courses and their persistence to degree completion was evaluated.

Wang (2012) confirmed that math is one of the most recurrent forms of remediation at the college level. Reports also indicate the most prevalent area of weakness in Ohio schools is math, with 30% of the students needing remediation in 2004

(Ohio Board of Regents, 2006). Roksa, Jaggars, Zeidenberg, and Cho (2009) observed in their study of successful completion of gatekeeper courses at a Virginia community college that 43% of first-time students needed math remediation. Such data are an indication of an issue with postsecondary math deficiencies. While the lack of math readiness is apparent, research on how math readiness affects academic success at the college level is sparse. Most math-related studies have focused on college readiness upon exiting secondary education systems. Long, Iatarola, and Conger (2009) found that traditional students who completed a minimum of Algebra II in high school were significantly more prepared for college math than those who completed courses below Algebra II. Such findings are necessary for ensuring readiness for traditional age students; however, they are not applicable to the nontraditional college students, who may have been out of high school for five years or more.

Research and federal funding have been designated for the many facets of developmental education, from increasing course completion rates by providing tutoring interventions to the implementation of a national project, The Developmental Education Initiative (Gallard, Albritton, & Morgan, 2010). The aim of this initiative is to foster the success of students in the postsecondary system by developing remedial education programs that will increase college completion rates (Asera, 2010). Students in many states, including Ohio, show a clear need for remedial or developmental education, with 35 to 40% of first-time students testing into remedial courses on college entry tests (Calcagno & Long, 2009). Open admissions and nonselective institutions are significantly more likely to receive and be required to accommodate these underprepared students. Benefits to such institutions include increased enrollment and the ability to regulate student enrollment in more expensive upper-level courses (George, 2010). In addition, students receive the intervention needed to gain entry into college-level courses at much lower tuition rates than at most four-year colleges.

The process of remediation is burdensome to both the institution and student. A significant amount of money is spent teaching remedial courses. The Ohio Board of Regents reported that 3.6% of the state's undergraduate instructional support was allotted to remedial education in Ohio (Ohio Board of Regents, 2006). Also, remedial courses are typically considered institutional credit and do not apply toward graduation requirements; taking remedial courses increases time to graduation and degree cost (Veenstra, 2008).

Despite the expense of remedial education and its impact on time in college, research in Ohio supports the use of remediation to mitigate academic insufficiencies (Bettinger, 2009). In contrast, Martorell and McFarlin (2010) studied the effect of remediation in Texas and found that remediation had neither a positive nor negative impact on student achievement. Conflicting conclusions are indicative of how subjective remedial education research is.

Brock's (2010) review of the barriers that underprepared college students face revealed a need to continuously improve upon remediation programs. Brock argued for the importance of proven practices that enhance the outcomes of remedial programs and the need to test new ideas that do the same. Assessing the math readiness skills among adult learners who test into lower-level math courses, their success in those math courses, and their persistence to degree completion will provide evidence that can encourage new ideas. Choosing an appropriate assessment tool is the responsibility of the individual institution.

Foley-Peres and Poirier (2008) conducted a study that showed that college math placement tests are better indicators of college readiness than the Standardized Admissions Test (SAT) administered in high school. The assessment tool used by LCC in this study is the COMPASS placement test. The COMPASS test is used to gauge college readiness prior to admission in the college. Based on the students' assessment results, they are placed in either remedial or college-level math. Findings from this study may be used to more accurately identify students with the greatest need for remediation at the community college level. Such information could lead to program improvements or changes to college policies and procedures that could increase persistence and success for remedial students.

Definitions

Age Group: This study uses the age groups defined in the National Center for Education Statistics Integrated Postsecondary Education Data System (IPEDS) Fall Enrollment Survey. These are:

- under 18 (high school age) = IPEDS under 18;
- 18-21 (traditional age) = IPEDS 18-19 and 20-21;
- 22-34 (early-career) = IPEDS 22-24 and 25-29 and 30-34;
- 35-49 (mid-career) = IPEDS 35-49;
- 50-64 (late-career) = IPEDS 50-64;
- 65+ (seniors) = IPEDS 65+ (Phillippe, 2013).

Andragogy: The art, science, or profession of teaching adults (Merriam et al., 2007).

College-level Credits: Credits earned in classes that are either transferable to a baccalaureate-granting institution or specialized within a technical area (NCES, 2012).

College Readiness: The measure of students who are prepared for college level work (Phillippe, 2013).

Community College: A college that provides programs to prepare students with relevant job related skills based on the needs of employers and the economy.(AACC, n.d.). See Technical or Vocational College.

COMPASS: Computer-adaptive Placement Assessment and Support System, developed to address the need for accurate course placement in order to support student services (ACT, 2007).

Concordant Score: The percentile ranking of the two score distributions of COMPASS scores and ACT scores of a population. The percentile rank is defined as "the percent below that score plus one half the percent at that score" (ACT, 2010b, p. 3).

Course Completion: Percentage of students who do not withdraw from class and who receive a valid grade (grades ranged from A to F, with A being the highest and F being the lowest; LCC, 2011d).

Credits Earned: The total number of credits received over a given period of time (Phillippe, 2013).

Cut Scores: The minimum test score needed to be prepared to succeed in a course. (ACT, 2007).

Developmental Education Progress. The measure of students referred to remedial math .who completed all developmental education math courses (Phillippe, 2013).

Dual Enrollment: An enrollment status that requires a partnership between a school or district and a local institution of higher education. Courses offered can be academic or career/technical and students earn college credit by passing the course (Cassidy, Keating, & Young, n.d.).

First-time Student: A student with no previous postsecondary experience attending any college for the first time (NCES, 2012).

Full-time Student: A student who is registered for 12 credit hours or more for all terms of the standard academic year. These credits may include developmental level credits (American Association of Community Colleges, 2013).

General Education Development: High school credentials that equate to a high school diploma (Ohio Department of Education, 2013).

Math Sequence Progression. The math progress of students measured at critical points. The chronological measurements of course retention and successful completion of remedial math courses in a given year (La Manque, 2009).

Nontraditional Student: A student age 24 or above has been the defining characteristic for this population. Age acts as a surrogate variable that captures a large, heterogeneous population of adult students who often have family and work responsibilities as well as other life circumstances that can interfere with successful completion of educational objectives. Other variables typically used to characterize nontraditional students are associated with their background (race and gender), residence (i.e., not on campus), level of employment (especially working full time), and being enrolled in nondegree occupational programs (NCES, 2013a.).

Part-time Student: A student registered for fewer than 12 credit hours during a regular academic term (NCES, 2013b).

Pedagogy: The art, science, or profession of teaching (Dictionary.com).

Persistence: Persistence is a term applied to students who continuously pursue their educational goal, enrolling term after term without a break in enrollment (Keck, 2007; Tinto, 1975). Persistence was defined as the number of terms completed for this study.

Placement Test: A test used to assess a student's academic (reading, writing, mathematics) aptitude in order to place them in courses appropriate to their abilities (AACC, n.d.).

Postsecondary Education: An instructional program whose curriculum is designed primarily for students who are beyond the compulsory age for high school. This includes programs whose purpose is academic, vocational, and continuing professional education, and excludes vocational and adult basic education programs (NCES, 2013b).

Prerequisite: Preparatory course or courses required before being permitted to enroll in a more advanced program or course (AACC, n.d.).

Progress: The measure of students who reach the credit threshold by end of year two (24 credits = part time; 42 credits = full time) (Phillippe, 2013).

Remedial Course: A course designed to address the academic deficiencies of students wanting to take postsecondary level courses. (Phillippe, 2013).

Student Development: Learning that happens as a product of students being exposed to higher education environments designed to enhance academic, intellectual, psychosocial, psychomotor, moral, and, for some institutions, spiritual development. The concept is based on applying human development theories within the context of higher education. (Council for the Advancement of Standards in Higher Education, 2009).

Success: The measure of students that earn an associate degree or certificate without transfer (Phillippe, 2013).

Time to Degree: Institutional time to degree is the median length of time per student used for degree completion, in calendar years, measured by institution (Crawmer, 2011).

Significance

This project study was designed to add to the knowledge base of student success and persistence as it relates to math readiness, specifically for community college students. Administrators at community colleges have recognized a gap in college readiness among their student population and speculate on its relation to persistence rates. Hoag and Benedict (2010) found that student success in college math courses appeared to be positively influenced by their exposure to math in high school. In addition, Kurlaender, Howell, and Horn (2009) stated, “research on college persistence has consistently demonstrated that students with better academic preparation in high school are more likely to complete college” (p. 22). Community college policies of open access have led to the enrollment of students who may not have completed their high school education and are admitted into the college academically disadvantaged. The findings and conclusions provide guidance for the planning of academic interventions for students who are underprepared for college-level math at LCC. Information on issues of common populations and academic concerns may be helpful to other community colleges. Secondary audiences may include state legislators and four-year institutions; however, an attempt will not be made to make assumptions that could apply to a larger population other than the group to be studied.

Research Questions

The purpose of this study was to assess the relationship between math readiness skills among adult learners who test into remedial math courses, their success in those math courses, and their persistence to degree completion, in an effort to provide insight that could positively affect persistence. Previous research on the topic suggested an unexplored relationship between math readiness assessment and student performance in remedial courses. Also, some program-specific research suggested that students who are better prepared in the area of mathematics are more likely to be successful within that program. Furthermore, a review of literature revealed evidence that increasing student persistence must be an initiative that is institution-specific, suggesting that any effort to intervene must be considered within the local organization's context and with the local student population in mind. Past institution-specific research has revealed weak evidence that students who complete two developmental math classes instead of one are more likely to be successfully in college-level math classes.

This study was guided by four main research questions:

1. What is the relationship between a student's COMPASS Math test scores and their persistence in math courses?
2. What is the relationship between a student's COMPASS Math test scores and their success in math courses?
3. What is the difference in success and persistence among students using COMPASS cut scores as defined by LCC in comparison to those suggested by ACT?
4. How predictive are COMPASS Math test scores of a student's performance in math courses and their persistence to degree completion?

Review of Literature

Introduction

The literature review for this study examined research on student performance on the COMPASS Math test, student success and persistence in the mandatory remedial course, and degree completion. Sources were identified via an online search conducted through EBSCO databases. The Walden University Library website was used to access the Academic ProQuest, Academic Search Complete, Education Research Complete, and ERIC databases. Search terms included the following: *community college*, *higher education*, *performance-based funding*, *academic success*, *student success*, *student persistence*, *developmental education*, and *remedial education*.

Conceptual Framework

Tinto's Student Departure Theory was used as the conceptual framework for this project study to focus on the external elements of the student's postsecondary academic ability and undergraduate student development and its impact on persistence and degree completion. Tinto's theory suggests that student retention is a product of the individual student's disposition upon entering college and connects retention to the social and academic integration of students into the college (Tinto, 1975). When describing a student's disposition, Tinto (1993) explained it as experiences that happen within the institution following admission, which include external forces that influence their educational or occupational intentions, behavior, and commitment. Integration (academic and social) includes the characteristics of precollege abilities and goals, relationships with peers and faculty, and outside classroom interactions, which will eventually lead to persistence and degree completion (Tinto, 1975).

Braxton, Sullivan, and Johnson (1997) conducted an assessment of Tinto's theory and were able to provide support to 5 of the 13 propositions within the foundational theory. Four of the five propositions supported were interconnected with characteristics of initial commitment and motivation to return to college, family background, and individual attributes and abilities (Braxton, Milem, & Sullivan, 2000). However, Tinto's theoretical perspective of social integration has not been supported by empirical studies. The foundation of Tinto's theory relied highly on data from a single, traditional, non-commuter institution and lacks explanatory power for nontraditional institutions and adult learners (Berger & Braxton, 1998). In addition, Berger and Braxton speculated that the lack of evidence supporting the concept of social integration has resulted in the formation of a subsequent theory of student departure. Although the student departure theory has not been a prominent theoretical foundation in the research of community colleges, the concept of academic integration will be utilized to assist in explaining the registration activity of students requiring remedial math.

Seidman (2005) theorized that student retention requires that institutions provide programs that include direct interaction with students, interactive assessments and evaluations to identify needs, and then the accommodation of those needs with appropriate skill development. It has also been suggested that retention is dependent upon the student's personal ability to assimilate to the institution (Credé & Niehorster, 2012). These authors found substantial relationships between college matriculation and grades and retention based on results from a Student Adaptation to College Questionnaire.

In addition, other factors, such as student development measured by grade point averages, have also proven to have some relevance to retention. An established importance of such factors as the relationship between college matriculation and retention has been assessed given the rate of students who either do not complete or drop out of college (Lynch & Engle, 2010). Students who do not pass math assessments and are assigned remedial math courses could find it hard to adjust to college and meet the institution's math requirements for completion. Adult learners who may have unique challenges of their own could find it difficult to matriculate, especially if they are mathematically underprepared.

Adult Learning

Gvaramadze (2007) referred to one's choice to participate in "societal institutionalized activities" for one's own motives as a "mutual process of learning from and contributing to society" (p. 130), and stated that a result of engaging in lifelong learning could be the realization of an individual's potential. It is the understanding of how learning in adulthood contributes to individual goals that can positively affect society as a whole (Saar, Ure, & Desjardins, 2013).

The science of assisting adults as learners has been a topic of research for decades. Henschke (2011) provided a summary of the development of the field of *andragogy*. He described how a German high school teacher, Alexander Kapp, introduced the term to the field of education in 1833, and then Henschke quoted Reischmann (2005) to show how the concept was ignored for many years. Henschke went on to describe how other educators revived the term, citing the account of Rosenstock-Huessy (1925) of the way andragogy was used in an effort to revitalize the German people and country after World War I, and how, in 1926, Lindeman applied the concept to adult learning in American society. Henschke quoted Sopher (2003) in his account of how the most prominent American researcher of andragogy, Malcolm Knowles, acquired the term from yet another educator, Dusan Savicevic, in 1966. Henschke cited the work of Knowles (1970) to show how Knowles was able to use his broad background and knowledge of adult learning to infuse the earlier principles of andragogy into his own practices. Henschke stated that Knowles viewed the adult learner as self-directed and the instructor as more a facilitator of learning rather than a presenter and showed how Knowles was able to expand his concepts into every setting where adults engage in learning, from the workplace to religious contexts. Henschke asserted that Knowles' concept of andragogy argues the need to address learning for adults differently from the learning of children (Henschke, 2011).

In addition, adult learning systems have gained popularity as being the essential factor in generating high levels of skilled employees necessary to be economically competitive (Rees, 2013). Based on six assumptions thought to be foundational to designing adult programs, Knowles' model helped to distinguish adult education from other fields (Merriam et al., 2007). The "model of assumption" assumes that as a person matures, their self-confidence moves from a personality of dependency toward one of self-reliance, that adults gain an increasing pool of experience that they use as a resource for learning, that an adult's readiness to learn is closely related to the evolving mission of their social role, that as adults mature from future to immediate application of knowledge there is a change in the time perspective, that internal motivation is more potent than external motivation among adult learners, and that adults respond better to educational experiences when they know why they need to learn something (Carpenter-Aeby & Aeby, 2013). Critiques of andragogy argue that the assumption that education is valueless and has no political relevance (Sandlin, 2005). Sandlin summarized that critique as wrong and that andragogy was derived from the adult learners with white middle-class values, that it discounts any connection between self and society, and is generative of discriminations.

Knowles (1987) cautioned researchers that his "model of assumptions" should be utilized as a conceptual framework for developing theories. From these assumptions, educators can draw implications regarding the design, implementation, and evaluation of learning activities (Carpenter-Aeby & Aeby, 2013). Henschke (2011) developed an assessment tool, the Instructional Perspectives Inventory (IPI), designed to measure the andragogical core of teacher-trust learning, which was later used by Stanton in 2005 to assess readiness for self-directed learning. Henschke surmised that Stanton's research "validated the IPI as an almost perfect bell-shaped measurement of andragogical facilitator" (p. 35). Carpenter-Aeby and Aeby (2013) noted that Knowles' concept of andragogy has been perceived as valid and acknowledged its contribution to advancements in adult learning theory, while also seeing the need to advance beyond andragogy. The population for this study was adult learners, and it is important to understand Knowles' theory to assess their learning activities. Knowles' "model of assumptions" will assist in defining variables, identifying the limitations to generalizations, identifying variable influence on a phenomenon, and examining how those key variables might differ under specific circumstances directly related to community colleges.

History of Community Colleges

Community colleges in the United States continue to grow in popularity and purpose among students wanting to attend school on a part-time basis and save money on their education (Crawford & Jervis, 2011). In 2008, the U.S. Department of Education released a study that found there were 1,045 community colleges in the United States in 2006 to 2007 that enrolled 35% of the postsecondary students for that year (Provasnik & Planty, 2008). In addition, the authors noted the average annual tuition at a community college was less than half of the public four-year institutions, attracting a larger number of nontraditional, low income, and minority students, many of whom are first-time students. The concept of accessible education is historically found among community colleges.

The idea of a community college grew from the need to make the American educational system "more rational, efficient, and accommodating" to high school graduates (Beach, 2011, p. 4). Jurgens (2010) wrote that during the mid-1800s, "proposals were made to create junior colleges in order to lessen the responsibility of universities to provide general education to qualified high school graduates" (p. 1).

Beach wrote that their purpose was to serve as two-year institutions of preparation housed near or on university campuses and that evidence of the existence of junior colleges can be found as far back as 1835, on the campus of Monticello College. Jurgens (2010) wrote that the growth of junior colleges was supported by the passage of the Morrill Act of 1890, which advanced educational opportunities for all students, including women and minorities, and required each state to provide evidence that conditions for admission in public higher education did not include race. Beach (2011) noted that by 1927, there were approximately 300 junior colleges in 39 states. As the number of junior colleges grew, their purpose began evolving into serving the population of high school students who were not academically prepared to attend traditional colleges, and simultaneously addressed economic concerns (Beach, 2011; Jurgens, 2011). These authors noted that during the Great Depression of 1930, the concept of junior colleges offering full trade and semiprofessional terminal programs was devised to meet local labor demands. The focus on job training at the community college-level continued through the mid-1900s in an effort to address periods of widespread unemployment.

Jurgens reported that in 1957 a national committee was formed to study the attributes and transferability of two-year college graduates, and that this early research led to a set of transfer guidelines and plans to improve articulation services. From the 1960s through the present, the number of community colleges and their enrollment continued to increase along with the growth of relationships between community colleges, local businesses, and high schools (Jurgens, 2011). Recently the community college has become a major vehicle for high school students wanting an early start to their higher education journey. In 2010, 53% of all colleges reported high school students taking college credit courses through or outside of dual enrollment programs (NCES, 2012).

Community colleges continue to strive to meet the needs of today's society. In addition to providing associate degrees, community colleges offer students the opportunity to achieve educational goals through a variety of short-term and long-term certificate programs. Community colleges award more than 800,000 associate degrees and certificates annually (NACC, 2008). Although community colleges have flourished, such growth has not come without challenges. New demands of accountability have compelled community colleges to rethink their missions so they can measure their success appropriately (Jurgens, 2011). Today's community colleges continue to provide flexible quality programming with the understanding that their students may have nontraditional motives for attending college.

First-Time Community College Students

A review of why students attend community colleges for the first time can reveal even more diversity, considering what motivates them to attend. One consideration is that in community colleges with open-admission policies, many first-time students are underprepared (Purdie & Rosser, 2011). These authors discovered that first-time community college student persistence could be improved when faculty members and student affairs experts shaped programs around the curriculum and campus experience and encouraged student interaction with peers and faculty of similar academic interest.

Using a cluster analytic method, Bahr (2010) was able to develop six classifications for first-time community college students based on their registration and behaviors. The six major clusters include drop-in, experimental, noncredit, vocational, transfer, and exploratory. Each cluster generally defines the motivation and intentions of the student. The first classification, the drop-in cluster, is made up of students who remain in school for a few semesters, take a few occupational courses, and are successful at a high rate (95%). The experimental cluster defines students who remain in school for a shorter period of time, like the drop-in student, but complete their courses at a lower rate (23%). The vocational and noncredit cluster comprises students who enroll in school for a fairly lengthy period of time, mainly enrolling in courses that are nontransferable or noncredit. They successfully complete those courses at a high rate (79%). The transfer cluster is students who also remain in school for long periods of time and are generally successful (77%), but they tend to enroll in transferable courses. The last cluster is the exploratory cluster, which consists of students who are extremely similar to those in the transfer cluster, with the exception that they spend about half the amount of time in school as transfer students. Bahr's clusters help define the enrollment behavior of community college students and informed the interpretation of the study's data.

Persistence and Performance-Based Funding

Historically, federal policies have supported the efforts of higher education, especially at public institutions. Such support was based on the principle that higher education is essential to supporting the economic growth of individuals and society as a whole (Kallison & Cohen, 2010). The single most important source of support for higher education institutions is financial. Early funding methods developed by the government, many of which are still followed today, such as need-based and merit-based grant and loan programs and grants for students in underrepresented fields, have been successful but lack accountability (Sanford & Hunter, 2011).

Prior to 1973, states adhered to low-tuition funding policies to promote equal access to higher education. The Committee for Economic Development saw the need for a shift toward a cost-sharing model and recommended states move to a needs-based model (Committee for Economic Development, 1973). The federal Pell Grant program was able to equalize opportunities for the poor through 1978. However, the Middle Income Student Assistance Act changed the dynamics of those assisted by the Pell Grant when it allowed more middle-class students to utilize the funds (Chen & St. John, 2011). They noted that by the 1980s, policies began to lean away from needs-based and toward individual responsibility by contributing less to the Pell Grant and more to subsidized loans in an effort to insure fair accessibility. Several states follow this model today, one which awards funding at the enrollment stage of the educational process.

Obtaining financial assistance from the government requires students to meet many criteria, as described by the U.S. Department of Education (2013, para. 1). They must demonstrate financial need (for most programs). In addition the Department requires students to have established U.S. citizenship or eligibility for non-citizenship, a valid Social Security number, and Selective Service registration (for males between the ages of 18 and 25). Students must also enroll "as a regular student in an eligible certificate program" and have an enrollment status of "at least half-time to be eligible for Direct Loan Program funds." Even further, students must maintain satisfactory academic progress, have signed "statements on the Free Application for Federal Student Aid (FAFSA)" certifying good standing on federal student loans, and agree that federal student aid will only be used for educational purposes. Students must also "have a high school diploma or a General Educational Development (GED) certificate” or completion of a “high school education in a home school setting approved under state law.”

Additionally, students enrolled in a college can establish eligibility by passing a placement test or self-paying for six credit hours toward a degree (U.S. Department of Education, 2013). Many community colleges in the United States generate revenue from state and federal funding which includes tuition (i.e., Pell Grant and federal student loans). The Ohio Board of Regents (2010e) reported that in 2009, 80% of first-time, full-time students attending a community college received financial aid. The largest source of financial aid funding was federal grants (59%), while 2% received state-level grants, and 52% received loans (Ohio Board of Regents, 2010d). This access to state and federal funding has sustained institutions of higher education even when the academic performance of their students falls short of the national standards.

Across the country, community colleges have experienced an increase in enrollment since 2008. In 2008, on a national level, two-year institutions saw 27% of 18-to-24 year olds enroll, and 32% of them were high school graduates (National Center of Education Statistics, 2012). As of 2010, the NCES (2012) reported an 8% increase in the enrollment of 18-to-24-year-olds and a 9% increase in those who were high school completers. It could be assumed that a comparable increase would be seen in the degree completion rate. However, with the influx in enrollment, NCES reported that only 29.9% of first-time, full-time students who attended a two-year institution beginning in 2007 completed their degree or certificate within 150% of the credit hours required for their degree (NCES, 2011). These data suggest that the majority of students are exceeding the required amount of credit hours per program by more than 50% and still are not completing a degree. This reflects a slight increase from those who began in 2004, where 27.8% of first-time full-time students completed within 150% of their program hours. It is not clear how institutions can continue to receive funding based on their input versus their output, according to these data.

As state-level governing bodies sought to insure that educational funding was being allocated responsibly, performance-based funding began to increase in popularity. Dougherty and Natow (2009) found that, politically, the establishment of performance accountability was favored because of the pressure on elected officials to control revenue/cost, demands from businesses for efficient governing and lower cost, and the increased Republican presence in state legislatures. A number of authors have written on the value and purpose of performance measures established cooperatively by educational institutions and the state (performance-based funding) to determine the kind and level of state support for education (Burke & Minnassians, 2003; McLendon, Hearn, & Deaton, 2006; Sanford & Hunter, 2011), and Burke and Minassians, 2007 and McLendon et al., 2006 agreed that this method is the best one to optimize the role of the state in education funding.

The practice of using performance-based funding measures is not new to the field of higher education, although decision makers in various states are rethinking the practice to fit today's challenges. Two major goals have been identified for institutions considering implementing performance-based funding. Serban and Burke (1998) suggested that funding practices could increase accountability and improve institutional performance. Several institutions have adopted the practice and have become models of successful and unsuccessful implementation. Tennessee's Higher Education Commission successfully piloted the funding policy in 1974 and by 1981 was receiving 2% of its state appropriations by meeting goals within five performance indicators (Doughtery, Natow, Hare, & Vega, 2010). However, Sanford and Hunter (2011) reported that Tennessee institutions had yet to establish a significant impact on retention.

Specifically, community college students are not meeting the expectations of some of the commonly used metrics of success measures. Such challenges encourage state legislators to adjust the performance indicators for these institutions. For instance, some adjustments made by the Ohio Board of Regents (2010c) included the ability for schools to earn "success points" for the number of student who earn their first 15 credit hours or 30 semester hours of college-level coursework, complete developmental math and English within a year of enrollment, successfully complete an associate degree, and complete 15 credit hours and then transfer to a 4-year institution for the first time.

Clearly, the expectations of the funding policy are to promote persistence and degree completion and attempt to fairly address the circumstances of the community college environment. However, the effects of the new funding formulas are questionable and uncertain. Initially, it was perceived that performance-based funding policies would motivate institutions to improve their performance (Shin, 2010). Research on South Dakota's funding policies has shown favorable results. For example, Martinez and Nilson's case study (2006) found that institutional performance could be strongly influenced by state policy goals. On the other hand, more recent studies have indicated that performance-based accountability policies from the state have had no influence on institutional performance (Shin, 2010).

As college administrators accept the inevitability of meeting performance outcomes, they are inspired to take on the challenge through practices that will optimize their funding allocations. Individual institutions have explored creative strategies to accomplish this goal. Vasko, Ache, McGhee, and Snow (2009) conducted a study to investigate the usage of a mathematical optimization model to target criteria within the performance indicators that would increase their funding at University of Pennsylvania, Kutztown. Other scholars within the field, such as Campbell (2011), suggested that institutions should clearly understand the expectations of the performance indicators and possibly follow cohorts of students to help target special populations that would increase the success of meeting those expectations. My investigation of the relationship between math readiness and degree completion could assist LCC in exploring strategies that will improve their funding ability in the near future.

Assessment of Math Readiness

Assessing the math abilities of students is typically done by the use of placement testing. In general, the goal of most math placement tests is to determine how prepared a student may be for college-level mathematics. The accuracy of placement testing is relative to the creators of the test. COMPASS (ACT, 2007) described an accuracy rate of 63-68% when the success criterion equates to a grade of C or higher. A variety of factors could influence the accuracy of math placement testing. For example, sources point to evidence of a lack of preparedness upon high school completion (Shelton & Brown, 2010).

One major factor that may contribute to underpreparedness is the lack of content alignment of standardized tests at the high school level with college admissions or placement tests. Shelton & Brown (2010) found discrepancies in the content alignment of higher level mathematics in their examination of the California Standards Test (high school level) and the community college placement test. Their findings suggest that the creation of partnerships between local colleges and high schools in an effort to compare and analyze their content could begin to close the gap in college readiness. Regardless of where students begin to show signs of underpreparedness, evidence shows students are completing high school with low levels of competency and entering college lacking necessary skills. Some commonalities among those students who are mathematically underprepared at LCC may be identified, which could strengthen early college programs at the high school level and affect overall student success.

Math Readiness and Student Success

A connection between student success and college readiness has been established through previous research. For example, Radunzel & Noble (2012) conducted a study that revealed students who were on target based on the benchmarks of ACT in grades 11–12 were more successful in college than those who were not. Research on math readiness and student success is not as abundant; however, some studies have shown significant correlations between the two. Many studies have produced results that contradict one another. Hoag and Benedict (2010) conducted a study that revealed students with mathematical backgrounds that qualified them for high level college math courses were more likely to earn As or Bs in college-level economics courses than those who qualified for elementary or intermediate algebra courses. The authors were able to establish a similar correlation between ACT scores and course completion in economics; however, their results shed little light on how successful a student would be in the college economics course. Researchers at the Virginia Community College System conducted a study (2011) on students who tested into developmental math and found no significant relationship between their scores and the success rate. Varsavsky (2010) found similar results in the college math success rates of students with weak mathematics skills coming out of high school. Variance between the Virginia Community College and Hoag and Benedict studies illustrates how subjective the results can be when studying students who take developmental math courses, therefore strengthening the need for institution-specific research regarding the topic.

Implications

Valuable information derived from the results of this study could be used to advise college administrators, state legislators, and local policy makers about the assessment of college math readiness and student success (degree completion) at the community college level. Most importantly, the data may support the development of efficient math remediation programs that will foster the educational achievement of remedial math students. Early identifiers shed light on those who are more apt to persist; therefore, procedures can be put in place to optimize this outcome. Innovative programming established as a result of this study could improve the LCC graduation rate, increase student interest in STEM-related programs, and sustain or even increase state funding to the college.

Implications of this study could affect the success of the local economy. Research has suggested those students who complete college-level math courses are better prepared for the workforce (Weinstein & Laverghetta, 2009) and are more likely to pursue degrees related to science, technology, engineering, and mathematics (STEM). The current underpreparedness not only indicates significant academic challenges but also could imply that students may find themselves unable to compete academically for today's fastest-growing career sectors, specifically STEM-related careers (Smith & Turner, 2013). As more students gain math literacy and college graduation rates increase, local industries will have a sufficient pool of highly qualified candidates for STEM-related job opportunities.

Summary

The ultimate role of higher education is to assist students in meeting their personal, educational, and career goals. I have outlined some of the challenges of this role in this section. College students are expected to have fundamental skills needed to accomplish their goals. Postsecondary assessment results provide evidence of the lack of math skills among high school graduates, but these data do not eliminate the responsibility of colleges (specifically community colleges) to accommodate underprepared students and support their persistence through degree completion. As community colleges attempt to develop remedial programs that adequately prepare remedial math students for college math, external pressures increase the challenges. New state performance-based funding policies increase the pressure for colleges to address the less-achieving student population. Institutional funding will eventually rely solely on the successful completion of remedial education, retention, and degree completion. While previous research has clearly identified evidence of a relationship between math readiness and academic success in specific college subjects (i.e., economics) overall there is a gap in research connecting persistence and success to math assessment, math readiness, and degree completion.

In Section 1, I defined the problem; briefly described the research questions and the nature of the study; provided a comprehensive literature review of community colleges, first-time students, persistence, math readiness, and student success; and explained how significant the results are and how they could affect the local community. In the next section I will describe the research design and approach, sampling methods, instrumentation, data collection procedures, assumptions and limitations, scope, and delimitations of the study.

Section 2: Research Methodology

Introduction

In this study I employed a correlation design using a secondary data analysis with a threefold purpose: (1) to assess relationships between the COMPASS Math test scores of students who test into lower-level remedial math courses and their success and persistence in those courses; (2) to evaluate variations of persistence and success based on COMPASS and ACT scores; and (3) to examine the predictive nature of COMPASS Math test scores on student performance and persistence to degree completion. Previously published research on math skills and retention rates has primarily used quantitative designs to explain behaviors or compare groups of adult learners. Suskie (2009) suggested that structured and predetermined outcomes, such as test scores, can be summarized into meaningful data and analyzed statistically. Trochim (2006) explained how nonexperimental quantitative designs that include secondary analysis of data intended for one purpose can be used to answer new inquiries. In this study, I analyzed data to investigate the contribution of students' level of math preparedness to academic success and persistence.

Research Design and Approach

Limited institutional data are available to describe the behaviors of adult learners with math deficiencies as they develop academically at LCC. I used several sources to settle on a research design for this unexplored area. Creswell (2012) explained how correlations can be used to effectively examine the extent to which two or more variables are associated and "whether one can predict another" (p. 21). Peng & Milburn (2011) conducted a correlation study that was able to establish a positive relationship between basic math skills test scores and students' final program Grade Point Average (GPA) among business majors.

To inform future curriculum changes and interventions for remedial math students at LCC, I therefore chose a correlational design to explore relationships between COMPASS Math test scores and student progress, persistence, and success in college, including performance in remedial math courses. A Pearson's correlation coefficient and an ANOVA were used to assess the differences between the success and persistence of students whose math readiness was determined by COMPASS testing compared to those whose readiness was established by ACT scores. A multivariate multiple regression analysis was used to predict the success rate of students using COMPASS cut scores.

Setting and Sample

A population of 2,450 students who attended LCC in the fall of 2008 was the focus of this investigation. According to the Ohio Board of Regents (2010d), 81% of the college's students in this term were Caucasian, 11% were African American, 6% were of an unknown ethnicity, and 1% were Hispanic, Asian, Hawaiian, or Pacific Islanders. In order to maintain confidentiality, all participant identifiers (name, Social Security number, mailing address, student number, etc.) were removed and an alternatively numbered list of the students was presented for research.

All students in this study had completed their first year of college by the fall of 2008 and were selected for the study sample based on their completion of the COMPASS test, submission of ACT/SAT scores, and their placement into remedial math courses. The sampling frame excluded students who transferred in math credit from another institution, did not take the COMPASS Math test, or did not submit ACT/SAT test results.

Students with disabilities were included in the sample population but were not identified in the dataset because public institutions are prohibited from preadmission inquiry of individual handicaps (U.S. Department of Justice, 2011). Students majoring in any health-related programs were also excluded on the grounds that these programs at the study site have waiting lists that lengthen the time to degree. In addition, students who had participated in early college programs were excluded because these students are typically minors. The sample for this study was representative of the larger student population at LCC as all students are required to establish math competency through COMPASS testing, the submission of ACT/SAT scores, or transfer credits.

A stratified random sample of a secondary dataset was used for the analysis. Retrospective data were collected from the college's student information system (DataTel), consisting of data for first-year students enrolled at the college in the fall of 2008, with the sample stratified on the registration of the first math course (Basic Math, Introduction to Algebra, or College Math). The initial dataset produced a population of 786 students. However, several exclusions were made to ensure the accuracy of the sample size. Students who were missing key variables (such as COMPASS scores and grades) were removed from the sample set. In addition, the College Math sample set was eliminated because only 17 students who completed the Algebra COMPASS test registered and completed a college-level math course, and the group size was too small for the planned analyses. The final sample set included 237 students.

I conducted a power analysis, using G*3 Power software, to determine the appropriate sample size for the study. The results of the analysis for a correlation test determined a recommended sample size of 111, based on a medium effect size of .3, a power of .95, and alpha of .05 (Citea, 2014). For an independent samples *t* test, the recommended sample size was 176, based on a medium effect size of .5, a power of .95, and alpha of .05 (Citea, 2014). The final sample size of 237 exceeded the recommended sample sizes for both of these statistical tests. In addition to the scores from the ACT, SAT, and COMPASS tests, grades, grade point averages, academic majors, and age ranges were obtained from the student information system (DataTel) used by the college .

Instrumentation

Data for this study were provided by the LCC Office of Institutional Research and collected from the college's student information management system, DataTel. All entries into DataTel are manually input by college departments such as Admissions, Success Center, and Records and Registration, and by faculty. Queries were performed by the institutional research department of LCC in DataTel to identify students who were enrolled in fall of 2008 and met the sample criteria.

The primary study instrument was COMPASS, the designated college entry test at LCC at the time of the study. This test has two primary uses: it measures the skills and knowledge of entering college students, and supports students and college administrators in making course placement decisions (ACT, 2012). Math competency skills can also be established by ACT or SAT preadmissions tests. Each instrument, including COMPASS, has a math component that is aligned to the Common Core Standards for Mathematics as established by the Ohio Department of Education.

The Common Core Standards for Mathematics define a student's comprehension of mathematics at specific grade levels. Benchmarks in the subject areas for each test are set to assure the "highest probability of success in credit-bearing college-level courses" based on empirical data by ACT (ACT, 2012, p. 24) Earning the appropriate score for the set benchmarks for both the ACT and COMPASS approximates a “50% chance of earning a grade of B or better in a corresponding college-level course and a 75% chance of earning a C or better at a typical college” (ACT, 2012, p. 24).

Data collected by ACT helped to establish the effectiveness of student placement and retention in mathematics as measured by COMPASS cut scores. ACT defines the COMPASS math cut-off score as “the minimum score for which it is estimated that a student has a 50% chance of earning a grade of B or higher (or C or higher) in a particular type of course” (ACT, 2012, p. 24). Performance on the test is measured in five placement domains and 15 diagnostic tests. The COMPASS Mathematics Placement Test offers five subjects: Pre-algebra, Algebra, College Algebra, Geometry, and Trigonometry (ACT, 2007, p. 4). The COMPASS Mathematics Diagnostics Test assesses the competency of students in up to 16 subareas in Pre-algebra and Algebra, which are characterized as Numerical Skills/Pre-algebra Diagnostic Scores, sorted into these categories:

1. Operations with Integers;
2. Operations with Fractions;
3. Operations with Decimals;
4. Exponents, Square Roots, Scientific Notation;
5. Ratios and Proportions;
6. Percentages;
7. Averages (means, medians, and modes);
8. Algebra Diagnostic Scores;

9. Substituting Values;
10. Setting up Equations;
11. Basic Operations with Polynomials;
12. Factoring Polynomials;
13. Linear Equations with One Variable;
14. Exponents and Radicals;
15. Rational Expressions; and
16. Linear Equations in Two Variables (ACT, 2007, p. 4).

Pre-established test packages come with software comprising “routing rules” that direct the customization of the test based on student performance (ACT, 2007). ACT suggested that institutions establish their cut scores in two stages. Stage 1 would be the initial cut score as recommended by ACT based on national data, which may not be appropriate for all institutions. Stage 2 cut scores would be established after the institution has had the opportunity to research students’ success rates in specific courses as established by the Stage 1 cut scores. Stage 2 cut scores would be more refined and suitable to the institution’s needs.

ACT defines success rate as “the percentage of students placed into a course who received a grade of C or higher” (ACT, 2007, p. 4). Institutions can adjust the cut scores if a success rate is higher or lower than the established expectations. ACT research conducted a correlation study to establish a relationship between COMPASS and ACT scores and reported using a concordance method. Correlations between the two tests in the subject of math ranged from .64 to .73 (Table 1), suggesting that many of the same skills are being measured (ACT, 2010b).

Table 1

Weighted Descriptive Statistics for Concordance Samples

Sample	Tests	*n*	*M*	*SD*	Correlation
1	COMPASS Pre-Algebra	152,675	54.7	21.7	.71
	ACT Mathematics		18.8	3.9	
2	COMPASS Algebra	175,039	37.9	20.2	.73
	ACT Mathematics		18.8	4.0	
3	COMPASS College Algebra	42,478	39.1	17.5	.64
	ACT Mathematics		18.9	3.9	

Note. From *Concordant ACT, COMPASS, and ASSET scores*. Iowa City, IA: ACT National Office, p. 8. Retrieved from http://www.act.org/compass/pdf/Concordance.pdf. Reprinted with permission.

The concordance method established comparable levels of performance among the two tests to assist with the placement of students who have taken either the ACT or COMPASS test, or both. ACT (2010b) reported that a percentile rank was established for each of the two score distributions, and then the concordance score was chosen based on its proximity to the percentile rank (see Table 6). Given the differences in the two tests, the most appropriate usage of the concordance method would be to adhere to the decision zone rule. This two-stage rule instructs institutions to give the students with ACT scores below the concorded score the COMPASS test and place those at or above the concorded score in standard courses. Table 2 shows how COMPASS Pre-Algebra and Algebra scores were concorded to ACT math scores.

Table 2

COMPASS Pre-Algebra & Algebra to ACT Math Concordance

COMPASS Test	COMPASS Score	Concorded Score
COMPASS Pre-Algebra	31	15
	36	16
	40	16
	62	19
COMPASS Algebra	28	17
	48	21
	71	25

Note. From *Concordant ACT, COMPASS, and ASSET scores*. Iowa City, IA: ACT National Office. Retrieved from http://www.act.org/compass/pdf/Concordance.pdf, p. 10 -11. Reprinted with permission.

The COMPASS test is a computer-adaptive test that has been created to ensure a strong match between test and college course content, optimizing the content validity of the test (ACT, 2012). The validity of COMPASS has been evaluated in the past using two methods, correlation coefficients and placement validity indices (a method established by ACT). The disadvantage of the use of correlations alone is that they provide "little direct information about how effective the test scores were at placing students" in the appropriate course (p. 19). In addition, correlations can establish the test score and course grade strength of association, but require some potentially unjustifiable assumptions, such as the assumption that the distribution of grades is normal. The use of placement validity reveals the strength of relationships between test scores and course grades and is predictive of the probability of success in college-level courses (p. 20).

Suggested cut scores based on the validity indices that would reflect a probability of appropriately placing students into courses is shown in Table 3. For example, 16 colleges that administered the Numerical Skills/Pre-algebra test, each offering an arithmetic course (Basic Math course), tested at least 40 students and had an optimal median cutoff score of 31. When the "optimal median cutoff score was used, the median percentage of students placed in the standard-level course was 63%" (ACT, 2012, p. 24). The median accuracy rate, based on "the percent of students appropriately placed in either the standard level" or remedial math, was 72% (ACT, 2012, p. 24). (See Table 3.) This reflects a 4% "increase in appropriate placement over using no placement test" (ACT, 2012, p. 24).

Table 3

COMPASS Cutoff Scores and Validity Statistics for Placement in First-year Courses in College With a C or Higher Course Grade

Course type	COMPASS test	No. of colleges	Cutoff score statistics		Validity statistics	
			Median cutoff score	% ready for course	Median accuracy rate	Median increase in accuracy rate
Arithmetic	Numerical Skills/ Pre-algebra	16	31	63	72	4
Elementary algebra	Numerical Skills/ Pre-algebra	24	40	47	63	6
Intermediate algebra	Algebra	17	28	50	68	5
College algebra	Algebra	19	48	19	67	20

Note. From *COMPASS: Internet Version Reference Manual*, 2012. Iowa City, IA: ACT National Office, p. 23. Retrieved from http://www.act.org/compass/secure/InternetManual.pdf. Reprinted with permission.

When the expectation was raised to a grade of B or better, the median increase in accuracy rate was 16% for the Numerical/Pre-algebra test. Table 4 indicates which COMPASS cutoff scores for placement had the highest probability of students earning a grade of B or higher and a C or higher within specific courses (ACT, 2012). Thus, for example, of the 15 colleges that administered the Numerical Skills/Pre-algebra test, a score of 36 was needed for a 50% chance of students earning a grade of B or better, and a score of 31 was needed for a grade of C or better (ACT, 2012).

Table 4

COMPASS Cutoff Scores and Validity Statistics for Placement in First-year Courses in College With a B or Higher Course Grade

Course type	COMPASS test	# of colleges	Cutoff score statistics		Validity statistics	
			Median cutoff score	% ready for course	Median accuracy rate	Median increase in accuracy rate
Arithmetic	Numerical Skills/ Pre-algebra	26	36	54	70	16
Elementary algebra	Numerical Skills/ Pre-algebra	38	62	19	67	25
Intermediate algebra	Algebra	29	48	19	71	25
College algebra	Algebra	23	71	6	72	43

Note. From *COMPASS: Internet Version Reference Manual*, 2012. Iowa City, IA: ACT National Office, p. 22. Retrieved from http://www.act.org/compass/secure/InternetManual.pdf. Reprinted with permission.

In summary, Table 5 details the optimum COMPASS Math cutoff score that would give students a 50% chance of earning a grade of B or better or C or better. These data serve as a temporary guide for institutions. ACT (2012) encourages institutions to re-evaluate the validity of their choice scores to determine their effectiveness (p. 7).

Table 5
COMPASS Cutoff Score Guide for Placement in First-year College Courses

Course type (# of colleges)	COMPASS test scored	Score needed for 50% chance of: B or higher	C or higher
Arithmetic (15)	Numerical Skills/Pre-algebra	36	31
Elementary algebra (23)	Numerical Skills/Pre-algebra	62	40
Intermediate algebra (19)	Algebra	48	28
College algebra (18)	Algebra	71	48

Note. From *COMPASS: Internet Version Reference Manual*, 2012. Iowa City, IA: ACT National Office, p. 24. Retrieved from http://www.act.org/compass/secure/InternetManual.pdf. Reprinted with permission.

Administration in the local setting selected cutoff scores with the ACT suggested cutoff scores in mind. Table 6 summarizes the COMPASS Math cutoff scores for the 2008 academic year. The scores set by the local college determine which remedial math course is required for the student. For example, a score of 35 on the Arithmetic test or a score of 15 on the ACT would place a student into the CPE 091 math course.

Table 6
Local Setting Community College COMPASS Cutoff Scores for 2008

Remedial Course ID #	COMPASS Test	COMPASS Score	ACT Equivalent	SAT Equivalent
CPE 091	Arithmetic	0-37	At least 19	At least 510
CPE 101	Elementary Algebra	0-27	At least 22	At least 560
CPE 102	Intermediate Algebra	29-40	At least 22	At least 560
CPE 103	Intermediate Algebra	41-50	At least 22	At least 560
No CPE math	Intermediate Algebra	51-99	At least 22	At least 560

Note. From *COMPASS Cut Scores,* LCC, 2008.

Data Collection

Data for this study included demographic data, including age, ethnicity, and gender. Data also included college-related data, including academic programs, COMPASS Math and ACT math test results, and remedial math course grades, number of terms enrolled, number of credits earned, and degree/certificate completion date. The college's institutional research department utilized the student information system to collect the archival data from Fall 2008 to Summer 2012. The institutional research department provided two datasets in Microsoft Excel format. One dataset included individual student records of age band, academic program, gender, and zip code; COMPASS, ACT, and SAT scores; test dates; enrollment dates; enrolled math course; and math course grades. The second dataset contained individual student records of age band, academic program, gender, zip code, terms enrolled, total terms enrolled, and graduation status. The institutional research department assigned a formula to the student identification number to protect the identity of the dataset. The formula used to scramble the identification numbers did not extend to decimal points, which created repeat identification numbers. This oversight resulted in the duplication of numbers. Therefore several student numbers were assigned a decimal number in order to provide distinction among student numbers in the dataset. This distinction was determined based on demographic data (i.e., age band, gender, academic program, and zip code). Information from both datasets was consolidated manually into one master Excel spreadsheet of 786 students.

Several exclusions were made to insure data analysis accuracy. Students who were in postsecondary education, health-related academic programs, and students pursuing departmental certificates with less than a year of curriculum were excluded from the master spreadsheet, bringing the total dataset count to 548 students. Students who neither attempted to test nor enrolled in a remedial math course were removed from the dataset (20 students). Students who never attempted the COMPASS test but who enrolled in a remedial math course were also removed from the dataset (five students). Also students who submitted only ACT or SAT scores for the purpose of admissions but never enrolled in a remedial math course, or those who submitted ACT/SAT scores and took a remedial math course based on their results, were also removed from the dataset (10 students). In addition, students who took the COMPASS test but never registered for class and students who registered for class but never took the COMPASS test were also excluded from the dataset (269 students). Finally, students who completed the COMPASS test and enrolled in only one remedial math course but received a grade other than A, B, C, D, or F were excluded from the dataset (7 students). The total number of appropriate subjects in the final dataset for this study was 237 students.

Data Analysis

I determined the degree of relationship between variables using a correlation study. The independent variables for this study were age, gender, ethnicity, COMPASS and ACT scores, time in college, and academic program. Dependent variables included persistence, success, progress, and performance in a first remedial math course. This study included nominal scales of several variables. Creswell (2012) stated that nominal scales quantify variables that have no order or numerical meaning. Nominal scales 1 and 2 were used to quantify male and female gender. Also a nominal scale, 1, 2, 3, 4, 5, and 6, was used to quantify remedial courses, respectively CPE 091, CPE 101, CPE 102, CPE 103, MTH 106, and MTH 108. Academic divisions were transformed to nominal scales 1 through 7, and a nominal scale was used to quantify the COMPASS Math test type.

The purpose of this study was to explore correlations between a student's math readiness, as established by COMPASS or ACT test scores, their academic success, and their persistence. The following hypotheses were developed to assess these correlations:

Ho_1: There is no statistically significant correlation between a student's COMPASS Math test score and his/her persistence in math courses.

Ho_2: There is no statistically significant correlation between a student's COMPASS Math test score and his/her success in math courses.

Ho_3: There is no statistical difference in the success and persistence of students whose math readiness was established by COMPASS cut scores defined by LCC and students whose math readiness was established by the suggested ACT cut score.

Ho_4: COMPASS Math test scores cannot statistically predict a student's performance in math courses and his/her persistence toward degree completion.

Results

In this quantitative study I examined relationships between the COMPASS test results of first-time students as they related to persistence, progress, and success. Walden University's IRB provided permission to collect archival data from LCC for analysis. First, I will report descriptive statistics in frequency tables that operationalized both independent and dependent variables (Table 7 and Table 25). Next, I will present the results of the independent sample *t* test, correlations, and linear regression utilized to assess the hypotheses.

The independent sample *t* test required a statistical significance of $a = .05$ to reject the null hypothesis. The correlation and linear regression results provided additional context to support the *t* test results. I applied the following interpretation of correlation coefficients and Pearson's *r*: a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation (Lodico, 2006).

Descriptive Statistics

Table 7 presents descriptive statistics for the sample. The students were grouped by the COMPASS test and test scores that determined which first math course they were enrolled in (Basic Math or Introduction to College Algebra). There were 138 students who tested into Basic Math and 96 students who tested into the Introduction to College Algebra class. Table 7 presents descriptive analyses of the independent variables by group (Basic Math or Introduction to College Algebra). The mean for each group was calculated for the variable, COMPASS score. An independent sample *t* test was conducted to compare the COMPASS score (t [234] = 1.66, p = 0.097), and was not significantly different between the two groups.

A frequency distribution table was run in SPSS for each group to yield percentages for age, gender, ethnicity, and program of study for the sample population. A chi square analysis performed on age, ethnicity and program of study showed no significant difference; however, the chi square analysis of gender, ($\chi^2 = 6.979, p = 0.008$) was significant. There were more males in the group testing into Introduction to College Algebra. (See Table 7)

Table 7

List of Independent Variables by Groups

List of All Independent Variables	Operationalized	Group 1 Basic Math	Group 2 Intro to Algebra	Total	Test statistic Sig level
Age *n* = 234	21 – 25 26 – 30 31 – 40 41 – 50 51+	60.9% 14.5% 15.2% 5.1% 4.3%	58.3% 24.0% 9.4% 5.2% 3.1%	59.8% 18.4% 12.8% 5.1% 3.8%	$\chi^2 = 6.913$ $p = 0.329$
Gender *n* = 233	Male Female	36.2% 63.7%	53.68% 46.32%	43.35% 56.65%	$\chi^2 = 6.979$ $p = 0.008$
Ethnicity *n* = 234	Black, White, Asian, Multiple, Other	22.3% 72.3% 0.75% 1.49% 2.99%	18.28% 78.49% 0.00% 0.00% 3.23%	20.70% 74.89% .044% 0.88% 3.08%	$\chi^2 = 2.813$ $p = 0.590$
COMPASS Score *n* = 234	Numerical	38.51	35.43	37.2479	$t = 1.66$ $p = .097$
Program of Study *n* = 234	Arts & Science	34.0%	51.04%	41.03%	$\chi^2 = 8.209$ $p = 0.004$
	Business & App Tech	39.1%	34.38%	37.18%	
	Health & Human Service	26.8%	14.58%	21.79%	

I conducted 10 unique statistical analyses on the entire sample. Most tests yielded statistically non-significant results, demonstrating that the COMPASS test scores of students who took remedial level math courses did not affect their performance, persistence, or success at LCC. Hypothesis testing of each subgroup and assessment follows.

Inferential Analyses by Research Question and Hypotheses

I determined the degree of relationship between variables by using a correlation study. The independent variables for this study were age, gender, ethnicity, COMPASS scores, time in college, and academic program. Dependent variables included persistence, success, progress, and performance in math courses. The overarching research question asked whether statistically significant differences existed in student performance, success, and persistence among students who tested into lower-level remedial math based on their COMPASS test score. A total of four research questions resulted in four null hypotheses. The following analysis of the four null hypotheses determined the effect of COMPASS test scores on student performance, success, and persistence.

Research Question 1

1. What is the relationship between a student's COMPASS Math test scores and his/her persistence in math courses?

Ho_1: There is no statistically significant correlation between a student's COMPASS Math test score and his/her persistence in math courses.

Ha_1: There is a statistically significant correlation between a student's COMPASS Math test score and his/her persistence in math courses.

Research Question 2

2. What is the relationship between a student's COMPASS Math test scores and his/her performance in math courses?

Ho_2: There is no statistically significant correlation between a student's COMPASS Math test score and his/her performance in math courses.

Ha_2: There is a statistically significant correlation between a student's COMPASS Math test score and his/her performance in math courses.

Correlation between COMPASS test scores, performance, persistence, and success. An analysis was done to determine whether a student's COMPASS test score correlated with his/her performance in math courses and persistence and progress while in college. Performance was operationalized as the student's GPA in completed math course, persistence was operationalized as number of terms attended, and progress was operationalized as number of credits earned while in school for this study. The entire sample was used for the analysis (n = 234). It was hypothesized that there was no significant relationship between a student's COMPASS test score and his/her persistence or in school or performance in math courses. In order to test these hypotheses, Pearson's correlation test was used to conduct the analysis on two groups of students, those who took the math test and those who took the algebra test, and four variables (test scores, performance, persistence, and progress). The Pearson's test revealed no significant relationship between COMPASS test scores and persistence of those who took the math test ($r = 0.139$, $p = 0.103$) or their performance ($r = 0.12$, $p = 0.160$). See Table 8.

Table 8

Correlations among COMPASS Math Test Scores, Performance, Persistence, and Progress

Student (*n* = 234)	Test Score	Performance	Persistence	Progress
Test Score	_____	0.12	0.139	0.133
Performance		_____	0.335**	0.108
Persistence			_____	0.179*
Progress				_____

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The Pearson's test also revealed that there was no significant relationship between the COMPASS test scores of those who took the algebra test and persistence (r = 0.024, p = 0.820) or their performance (r = 0.136, p = 0.185). See Table 9.

Table 9

Correlations among COMPASS Algebra Test Scores, Performance, Persistence, and Progress

Student (*n* = 234)	Test Score	Performance	Persistence	Progress
Test Score	_____	0.136	0.024	-0.272**
Performance		_____	0.77	-0.075
Persistence			_____	-0.076
Progress				_____

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

Hypothesis 3

3. What is the difference in success and persistence among students using COMPASS cut scores as defined by LCC in comparison to those suggested by ACT?

Ho_3: There is no statistical difference in the success and persistence of students whose math readiness was established by COMPASS cut scores defined by LCC and students whose math readiness was established by the suggested ACT cut score.

Ha_3: There is a statistical difference in the success and persistence of students whose math readiness was established by COMPASS cut scores defined by LCC and students whose math readiness was established by the suggested ACT cut score.

Difference in success. Success was measured by whether or not the student graduated or received a certificate. The same students who had taken the COMPASS Math test were categorized into low or high groups based on the LCC cut score, and then the same students were categorized into low or high based on the ACT recommended cut score. Those students who were grouped into the low category were required to take the remedial course in that subject. For the COMPASS Math test, of the group of students who tested into the low group, 5.7% graduated when the local cut score was used and 5.0% graduated when the ACT cutoff score was used. Students who tested into the high group took college-level math courses. For the COMPASS Math test, of the group of students who tested into the high group, 6.3% graduated when the local cut score was used and 5.7% graduated when the ACT cut score was used (see Tables 10 and 11).

Table 10

Difference in Success by LCC Math Cut Score

		Graduate?	No	Yes	Total
LLC Cut Math Score	Low (>37)	*n*	116	7	123
		% within LLC Cut Math Score	94.3%	5.7%	100.0%
	High (<37)	*n*	74	5	79
		% within LLC Cut Math Score	93.7%	6.3%	100.0%
Total		*n*	190	12	202
		% within LLC Cut Math Score	94.1%	5.9%	100.0%

Table 11

Difference in Success by ACT Math Cut Score

		Graduate?	No	Yes	Total
ACT cut score Math	Low (>31)	*n*	76	4	80
		% within ACT cut score Math	95.0%	5.0%	100.0%
	High (<31)	*n*	116	7	123
		% within ACT cut score Math	94.3%	5.7%	100.0%
Total		*n*	192	11	203
		% within ACT cut score Math	94.6%	5.4%	100.0%

Of the students who tested into the low category of the COMPASS Algebra test, 2.7% graduated when the LCC cut score was used and 3.6% graduated when the ACT cut score was used. Of those students who tested into the high category, 6.4% graduated when the LCC cut score was used and 6.9% graduated when the ACT cut score was used (see Tables 12 and 13).

Table 12

Difference in Success Based on LCC Algebra Cut Score

Variable	Cut Score		Graduate No	Graduate Yes	Total
LLC Algebra cut score	Low (>27)	*n*	36	1	37
		% within LLC Cut Algebra Score	97.3%	2.7%	100.0%
	High (<27)	*n*	146	10	156
		% within LLC Cut Algebra Score	93.6%	6.4%	100.0%
Total		*n*	182	11	193
		% within LLC Cut Algebra Score	94.3%	5.7%	100.0%

Table 13

Difference in Success Based on ACT Algebra Cut Score

Variable	Cut Score		Graduate No	Graduate Yes	Total
ACT cut score Algebra	Low (>28)	*n*	53	2	55
		% within ACT cut score Algebra	96.4%	3.6%	100.0%
	High (<28)	*n*	135	10	145
		% within ACT cut score Algebra	93.1%	6.9%	100.0%
Total		*n*	188	12	200
		% within ACT cut score Algebra	94.0%	6.0%	100.0%

Based on these data, there does not appear to be a difference in success among students when using the LCC cut score versus the ACT cut score.

Difference in persistence. Persistence was measured by the number of terms completed. The same students who had taken the COMPASS Math test were categorized into low or high groups based on the LCC cut score, and then the same students were categorized into low or high based on the ACT recommended cut score. Those students who were grouped into the low category were required to take the remedial course in that subject.

Students in the low group, as determined by the LCC math test cut score, had a similar number of terms completed (*M* = 4.93, *SD* = 3.63) compared to those in the high group (*M* = 4.99, *SD* = 3.34, *F* (1, 201) = .011, p = .918). See Tables 14 and 15.

Table 14

Difference in Persistence Based on LCC Math Test Score

Terms Attended LLC Cut Math Score	*M*	*n*	*SD*
Low (>37)	4.93	123	3.630
High (<37)	4.99	79	3.342
Total	4.96	202	3.512

Table 15

Difference in Persistence Based on ACT Math Test Cut Scores
ANOVA TABLE

Variable		*SS*	*df*	*MS*	*F*	Sig.
Terms Attended LLC Cut Math Score	Between Groups (Combined)	.132	1	.132	.011	.918
	Within Groups	2478.467	200	12.392		
	Total	2478.599	201			

When the ACT cut score was used for the COMPASS Math test, students in the low group had a similar mean (*M* = 4.86, *SD* = 3.73) when compared to students in the high group (*M* = 4.93, *SD* = 3.31, *F* (1, 202) = .021, *p* = .885). See Tables 16 and 17.

Table 16

Difference in Persistence Based on LCC Algebra Test

Terms Attended ACT cut score Math	*M*	*n*	*SD*
Low (>31)	4.86	80	3.734
High (<31)	4.93	123	3.309
Total	4.91	203	3.474

Table 17

Difference in Persistence Based on ACT Math Test

Variable		*SS*	*df*	*MS*	*F*	Sig.
Terms Attended ACT cut score Math	Between Groups (Combined)	.255	1	.255	.021	.885
	Within Groups	2436.967	201	12.124		
	Total	2437.222	202			

When the LCC cut score was used for the COMPASS Algebra test, students in the low group had a similar mean (*M* = 4.16, *SD* = 3.184) when compared to students in the high group (*M* = 5.16, *SD* = 3.573, *F* (1, 192) = 2.428, *p* = .121). See Tables 18 and 19.

Table 18

Difference in Persistence Based on LCC Algebra Test

Terms Attended LLC Cut Algebra Score	*M*	*n*	*SD*
Low (>27)	4.16	37	3.184
High (<27)	5.16	156	3.573
Total	4.97	193	3.516

Table 19

Difference in Persistence Based on LCC Algebra Test ANOVA

Variables		*SS*	*df*	*MS*	*F*	Sig.
Terms Attended LLC Cut Algebra Score	Between Groups (Combined)	29.793	1	29.793	2.428	.121
	Within Groups	2344.021	191	12.272		
	Total	2373.813	192			

When the ACT cut score was used for the COMPASS Algebra test, students in the low group had a similar mean (*M* = 4.09, *SD* = 3.087) when compared to students in the high group (*M* = 5.05, *SD* = 3.412, *F* (1, 198) = 3.302, *p* = .071). See Tables 20 and 21.

Table 20

Difference in Persistence Based on ACT Algebra Test

Terms Attended

ACT cut score Algebra	*M*	*n*	*SD*
Low (>28)	4.09	55	3.087
High (<28)	5.05	145	3.412
Total	4.78	200	3.346

Table 21

Difference in Persistence Based on ACT Algebra Test ANOVA

Variables		*SS*	*df*	*MS*	*F*	Sig.
Terms Attended ACT cut score Algebra	Between Groups (Combined)	36.547	1	36.547	3.302	.071
	Within Groups	2191.208	198	11.067		
	Total	2227.755	199			

Hypothesis 4

4. How predictive are COMPASS Math test scores of a student's performance in math courses and his/her persistence to degree completion?

Ho_4: COMPASS Math test scores cannot statistically predict a student's performance in math courses and his/her persistence toward degree completion.

Ha_4: COMPASS Math test scores can statistically predict a student's performance in math courses and his/her persistence toward degree completion.

Performance in math courses. A regression analysis was completed to answer the research question on the predictive nature of COMPASS Math test scores on performance as measured by the math GPA. Math GPA was the dependent variable and COMPASS Math test scores was the predictor variable. The multiple regression results indicated that the model did not significantly predict performance as measured by math GPA, R^2 = (.011), adjusted R^2 = (.007), F (1, 232) = 2.538, p = .112. There was insufficient evidence to reject the null hypothesis. See Table 22.

Table 22

Predictability of COMPASS Test Scores on Performance

Model	*R*	*RS*	Adjusted *RS*	Std. Error of the Estimate
1	.104[a]	.011	.007	1.26614

Persistence to degree completion. A regression analysis was completed to answer the research question on the predictive nature of COMPASS Math test scores on degree completion as measured by degree or certificate completion (graduation). Graduation was the dependent variable and COMPASS Math test scores was the predictor variable. The multiple regression results indicated that the model did not significantly predict graduation as measured by COMPASS test score, R^2 = (.053), adjusted R^2 = (.048), F (1, 232) = 12.862, p = .000. There was insufficient evidence to reject the null hypothesis. See Tables 23 and 24.

Table 23

Predictability of COMPASS Test Scores on Completion

Model	*R*	*RS*	Adjusted *RS*	Std. Error of the Estimate
1	.229[a]	.053	.048	.232

Table 24

Predictability of COMPASS Test Scores on Completion ANOVA

Model		*SS*	*df*	*MS*	*F*	Sig.
1	Regression	.691	1	.691	12.862	.000[b]
	Residual	12.471	232	.054		
	Total	13.162	233			

a. Dependent Variable: Graduate
b. Predictors: (Constant) Test Type

Summary of Results

This study's purpose was to assess relationships between the COMPASS test scores of students who test into lower-level remedial math courses and their success and persistence in those courses. It also afforded the evaluation of variations of persistence and success based on COMPASS and ACT scores and examined the predictive nature of COMPASS Math and algebra test scores on student performance and their persistence to degree completion. The objective was to contribute statistical data that would inform stakeholders of any relationships that could affect the success of community college students who test into remedial math. In this section, I began with a discussion of the research design, approach, and scope of the study. Then I clarified any assumptions, limitations, and delimitations of the study based on the design. In addition I described the data collection and analysis process used to produce the findings.

Data collection and analysis began after approval from both the Walden University IRB and LCC's president and institutional research department. The sample (n = 234) included new students to LCC who tested into remedial math (Basic Math or Intro to College Algebra) based on their COMPASS test score. National Institutes of Health and Walden University guidelines were used to ensure protection for human participants. I also excluded identifiable information related to the students within the sample to ensure confidentiality.

Correlation and regression analyses identified no significant relationships between student placement test scores and their performance in math courses, persistence in college, or success to degree completion. There was no difference in results based on the LCC cut score as compared to the ACT cut score. I was unable to reject any of the four null hypotheses by analyses. However, independent *t* test and chi-squared analyses of the entire sample yielded statistically significant differences in persistence, success, performance, and progress between students who tested into the two math courses (Basic Math or Introduction to Algebra). Independent *t* test results were statistically significant for students' persistence (*t* [234] = -1.296, *p* = .039), performance in the math course (*t* [234] = -2.326, *p* = .008), and students' progress (*t* [234] = 3.364, *p* = .001). Chi-squared results for differences in success by initial math course ($\chi^2 = 12.291, p = .000$) were also significant. See Table 25.

Table 25

List of All Dependent Variables

List of All Dependent Variables	Operationalized	Group 1 Basic Math	Group 2 Intro to Algebra	Total	Test statistic Sig level
Persistence n = 234	Number of terms completed	4.77	5.41	Mean	$t = -1.296$ $p = .039$
Success n = 234	Degree/ certificate awarded	1.45%	12.5%	5.98%	$\chi^2 = 12.291$ $p = .000$
College Math Performance n = 234	GPA in math courses	1.2085	1.6083	1.3725	$t = -2.326$ $p = .008$
Progress n = 234	Number of credits earned	7.79	5.92	Mean	$t = 3.364$ $p = .001$

Although there were no significant relationships between the COMPASS test scores and the dependent variables, once students were placed into their first math course, there were significant differences in all four dependent variables (persistence, success, performance, and progress). Although cause and effect is difficult to substantiate, it appears that if students are initially placed in college-level math courses, as compared to developmental math courses, they will be more successful and persist more often to degree completion.

Assumptions and Limitations

Assumptions

- The college followed the ACT guidelines for COMPASS test administration and cutoff score assignment for each math category.
- Each student will have a score on at least two quantitative variables.
- At least two variables for each participant will be used for analysis.
- The dependent variables will be normally distributed.
- The scores on a variable from one case are independent of the scores on the variables for other cases.
- The standard deviation among groups will be equal (homogeneity of variance).

Limitations

Limitations of this study were defined by the design or methodology that sets parameters on the interpretation of the results. Correlation studies can suggest relationships between variables; however, they do not establish cause-and-effect relationships without future investigation (Lodico et al., 2010). The examination of human subjects produced some variables that were not measurable, such as differences in socioeconomic status, household dynamics, race, and ethnicity, and those that may be relevant to student success, which was an additional limitation. The sample was a convenience sample, and as such it was not generalizable to the national community college population.

Scope and Delimitations

The scope of this study was math preparedness, as established by college admissions testing, and its impact on academic success at a community college in the

United States Midwest. I examined whether a relationship existed between COMPASS Math test scores or ACT math scores and academic success among students who were enrolled in college for the first time in this study. Therefore a population of students whose time in college would permit successful math sequence progression was required for this study. This study was delimited to first-year students enrolling in the fall 2008 who had taken the COMPASS Math test or submitted ACT math scores to establish a level of math readiness.

Participants' Rights

Several steps were taken to ensure this study was conducted professionally and in an ethical manner. Prior to the collection or analysis of any data, approval for the proposal was obtained from the Walden University Institutional Review Board (IRB). Permission to access institutional data was also obtained from the president of the college, the vice president of academic affairs, and the director of the Strengthening Student Success program. Students were not active participants in this research. In addition, this study did not require a treatment that would affect a student's well-being; therefore, participant or parental consent was not necessary.

Confidentiality was assured by replacing the names and identification numbers of the participants and stakeholders using a numbered coding system. Only I had access to information collected from student files. Analyzed data were stored on a password-protected external drive. I will destroy the raw data after the required 5-year time frame. All results were presented in aggregates to protect the anonymity of study participants.

Conclusion

A professional development project providing training that could be a solution to the low achievement of students in remedial math courses was developed as a result of the data analysis. The project will help to equip instructors with the tools to identify the needs of students in their remedial math courses, teach to their needs, and monitor their progress. In the next section I will describe the project design and how it was selected, review literature related to the project design, and explain how the project will be evaluated. The project is included in Appendix A.

Section 3: The Project

This study and its findings were used to inform a proposed 3-day professional development (PD) workshop. This workshop project will be submitted to the LCC's Director of Strengthening Student Success, who will facilitate the training. This section describes this subproject's goals and rationale, literature review, implementation plan and evaluation overview, and implications for social change. The workshop is designed to include the findings and recommendations regarding relationships between Computer-adaptive Placement Assessment and Support System (COMPASS) or ACT test scores and persistence and success in math courses.

Project Goal

The findings from this doctoral study indicated that no significant relationships existed among the variables of COMPASS test scores, persistence, and completion. However, a significant difference in success and completion rates was observed between students at LCC who were enrolled in remedial math courses and students who tested into Introduction to Algebra. In an effort to address the low achievement of students in remedial math courses, I have focused this project on equipping instructors with the tools to identify student needs and to teach and monitor the progress of their students.

The goal of this PD workshop was to address the teaching strategies and assessment of remedial math instructors. Professional development has been found to be one of the few ways to improve instructor quality (Foster, Toma, & Troske, 2013). The workshop goals included participant understanding of how COMPASS Math test scores are chosen, how math cut scores were utilized at the study site, and the degree to which the math cut scores are related to student success and persistence. The workshop was also designed to expose participants to alternative instructional methods and informal classroom assessment techniques that could guide their instructional planning.

Rationale

The administration at the community college has stated its desire to improve the retention and completion rates of students who test into remedial math courses. These administrators have incorporated performance indicators directly tied to successful completion of college-level math into the strategic plans (LLC, 2012b). However, little institutional data is available to guide the college's initiatives of improving remedial programming based on COMPASS test scores. This gap in data prevents the college from understanding how COMPASS test scores influence remedial programming and student success. This PD workshop is an opportunity to train instructors to collect data that connect student performance and success to their placement in remedial math courses.

Educators at LCC have access to limited data that will support this project. According to 2011 data collected by the college, only 43% of the students who completed the remedial Basic Math course (CPE 091) at this school, and 55% of those who completed the second remedial math course Introduction to College Algebra (CPE 101) at this school earned a grade of D or better (LLC, 2011d). Low completion rates of this nature mean a significant number of students are retaking remedial math courses and delaying their degree/certificate completion. Therefore, administrators at the college must continue to develop strategies to promote successful completion of remedial courses upon initial registration. While institutional researchers at the college actively track the success of students in remedial math courses and report that data to the Ohio Board of Regents and Higher Education Information system, they currently do not include the degree/certificate completion rate of these students based on their math readiness (COMPASS test scores).

This project was designed in part to provide LCC with data that will assist administrators in making informed, research-driven decisions regarding students who require remedial math courses. In addition, the PD workshop provides a way to address retention concerns at the study site. The PD workshop is formatted so that it can be repeated every year. Additional data can be added based on the instructor's implementation of the suggested strategies. New research that promotes continuous assessment of the remedial program can be conducted on the incoming remedial math students.

Gersten, Taylor, Keys, Rolfhus, and Newman-Gonchar (2010) stated that the lack of research supporting a specific professional development approach as an effective method to improve math programs means administrators must select a method that best fits the needs of their institution. The training program in the proposed professional development workshop is based on the improvement process model. This model describes a systematic improvement process that involves the review of current practices and developing a solution for problems that are discovered (Sparks & Loucks-Horsley, 1989). These authors stated that solutions created using this model include developing curriculum, designing a program, or changing classroom practices. This PD workshop will afford participants the opportunity to change classroom practices. Instructors will be able to use this PD training workshop to review the current outcomes of the remedial math program at the community college and identify solutions that fit their personal instruction style that could improve these outcomes.

The PD workshop is formatted to recognize the participants as adult learners. It is important that adults learn through rational scenarios that promote the building of knowledge to improve perceptions (Knowles, Holton, & Swanson, 2011). Strategies used during this training will include group discussions and interaction and scenario building. The Director of Strengthening Student Success will facilitate the entire training and contribute additional input about the current status of the remedial math program as needed.

Review of Literature

This section is a review of literature on the effectiveness of professional development on math outcomes and topics related to the PD training. This literature review examined peer-reviewed articles, journals, books, and peer reviewed articles. The literature search primarily examined items identified via an online search conducted through EBSCO databases. I used the Walden University Library website to access Academic ProQuest, Academic Search Complete, Education Research Complete, and ERIC databases to search terms related to professional development training. Search terms included the following: *student learning*, *student achievement*, *classroom assessment*, *professional development*, and *improved student outcomes*.

Professional Development and Teacher Learning

A professional development design should reflect how various people gain knowledge, so as to support sustained learning (McNair, 2015). Close attention should be given to making connections for teachers between existing and new ideas, thereby providing opportunities for active learning that include engagement, discussion, and reflection and that challenge existing ideas and foster the construction of new ideas

(Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). This PD workshop experience was selected because of its ability to encourage participants to explore new concepts in an active learning environment.

I examined different types of professional development experience studies and highlighted how the participants benefited from them. Obara and Sloan (2010) conducted a case study that involved three sixth-grade teachers who attended a 5-day summer institute at Michigan State University to work with an instructional mathematics coach to implement new mathematics materials. After attending the summer institute, which included the sharing of new techniques, one teacher described how she came to a better understanding of how to use the materials, since the facilitators had presented the materials as if the teachers were students.

Another approach to professional development is through lesson study, also known as a demonstration classroom. Lewis, Perry, and Hurd (2009) conducted a lesson study as part of a summer workshop led by mathematics teachers. The 2-week session planned by the teachers incorporated the teaching of a lesson, participant observation and revision, and then the facilitators reteaching the revised lesson. The results provided three types of intervening changes produced by the lesson study. The intervening changes included changes in teachers' knowledge, in the professional community, and in teaching-learning resources (Lewis, Perry, & Hurd, 2009).

A more recent study indicated professional development programs should be based on a balance between the central role of educator and the instructor's role as an evaluator, manager, advisor, and researcher in order to better train teachers and increase the quality of their teaching (González-Sanmamed, Muñoz-Carril, & Sangrà, 2014). The above studies serve as examples of how professional development can be used as a tool with promising implications for bridging the research-to-practice gap (Ely, Pullen, Kennedy, & Cole Williams, 2015). The professional development workshop developed for this study (see Appendix A) will be utilized in a similar way to support student learning by using research to drive teacher training as it relates to teaching remedial math outcomes. The same theoretical framework used to conduct this doctoral study, andragogy, was used to create the professional development workshop.

The professional development workshop starts by presenting the statistical results from the correlation study between COMPASS Math test scores and student performance, persistence, and success at LCC. Opening the workshop with this information provides relevance and will help the educators connect their own social role in reforming the remedial math program at the college (Merriam et al., 2007). In addition, day one of the workshop summarizes the implications of the current status of the remedial program and introduces student-related services that the educators have access to that may help improve learning outcomes. Participants will be able to understand how low student achievement affects the college overall and then link current services provided by the college that can be utilized outside the classroom to improve learning.

Learning and Achievement

Instructors face many challenges, including classroom management issues, curriculum planning and implementation, assessments, and workload concerns (Towers, 2012). Student achievement is just one challenge that warrants the attention of administration and training professionals. Professional development programs focus on the enhancement of student learning, and this has been supported by current literature (Foster, Toma, & Troske, 2013).

Miller (2015) was able to show a weak correlation between student performance and self-regulation, citing research that has found that educators who introduce the notion of self-regulation into their classrooms see a slight improvement in student performance. As teachers learn to modify their expectations of students, student achievement could improve. Most literature has indicated that educators are eager to pursue new concepts and ideas that they believe will improve their teaching capability if it improves student learning and addresses their individual needs (Taub, Benson, & Szente, 2014).

Knowles (1980) theorized that nothing is more pertinent to adult learners than their belief that their learning is meaningful and relevant. Programs designed with the students in mind can be very successful. Jaggars, Hodara, Cho, and Xu (2015) found that students responded positively to an accelerated remedial program designed to improve the completion rate of college math; however, they noted that the program could benefit from systematic faculty development. Research also has indicated that not only student achievement but also instructor effectiveness can be influenced by professional development. DiVall et al. (2014) discussed the importance of creating a culture of assessment in both the development of a student’s ability to demonstrate achievement of educational outcomes and a faculty member’s ability to become an effective educator.

Day two of the workshop presented in Appendix A further describes the implications of the current status of the college’s remedial program and provides an introduction to learning strategies and assessment techniques. Outlining new instructional methods could inspire participants to invest a greater level of effort into modifying their own classroom techniques in order to increase student achievement.

Instructional Techniques

Research has revealed that educators reportedly connect their feelings about both their own preparedness and competencies to the amount of professional development they have been afforded (Parsad, Lewis, Farris, & Greene, 2001). Literature focused on effective professional development programs has centered mostly on the development of instructional expertise, consistency between learning goals and learning strategies, best practices related to the content or topic, and data collection to make research- and evidence-based decisions (McMeeking, Orsi, & Cobb 2012). Professional development and learning outcomes are typically centered on improving instructional techniques. Ford and Strawhecker (2011) stated that teachers must have an understanding of effective instructional practices as well as consider cognitive development, individual learning needs, and the role of cultural beliefs in the learning process. It has been perceived that an instructor’s experience would afford them these skills. However, Berliner (2001) emphasized that experience does not equate to proficiency and that the definition of proficiency is subject to different contexts and cultures. Educators should practice adapting their techniques to students’ diverse needs and make an effort to stay current in their field. Research has indicated that instructor awareness of effective instructional techniques can positively affect the student’s experience. In a study of doctoral students whose instructors utilized active learning techniques, Coley (2012) found that the students favored the techniques so much they requested faculty across disciplines to utilize them.

Day two of the workshop (Appendix A) allows the participants to demonstrate their new knowledge of learning strategies in a group environment. The sharing of knowledge will expose the participants to the diversity in implementing each strategy. Also, day two will introduce how the new learning strategies can best be assessed.

Classroom Assessment

Classroom assessment is typically done by the instructor using techniques that are specific to their teaching and grading style (Hartman, 2013). Research has recognized a perceived lack of quality assessment feedback in higher education (Ferguson, 2011). As a result of educators using diverse assessment strategies, there is growing literature on how to incorporate the best techniques that will affect student achievement. Typically educators are assessing their students based on individual abilities, behaviors, and deficiencies (McMeeking, Orsi, & Cobb 2012). Classroom assessment techniques help educators create a profile of each pupil that can also be used to justify outside support (Perry & Lewis, 2011). Researchers have found many ways to use classroom assessment. Marx, Solomon, and Tripp (2011) developed an assessment of the personal management skills of students that allowed instructors to connect classroom manners (i.e., cell phone usage) to student achievement and perception. Formative assessment (formal and informal) has become more attractive to educators and practitioners because of its benefits during the learning process (Liqiu, 2011). However, a brief review by Brookhart (2011) of the 1990 *Standards for Teacher Competence in Educational Assessment of Students* and their influence found that the standards were outdated in regard to formative assessment knowledge and skills, and they do not reflect teacher awareness and abilities required to be accountable in a “standards-based reform” context. Though dated, the

1990 *Standards for Teacher Competence in Education Assessment of Students* has successfully guided teachers as they have planned and implemented teacher preparation programs. As classroom assessment becomes a priority in the United States, especially regarding STEM (science, technology, engineering, and mathematics) preparation, it would be an investment in the field to revisit and update these standards (Brookhart, 2011). Davis, Drake, Choppin, and Roth McDuffie (2014) noted that the National Research Council emphasized the importance of clear standards and curriculum and a system that supports assessment and accountability in endorsing STEM education.

The last day of the workshop presented in Appendix A will allow the participant to exercise assessment techniques that can be done daily to monitor student learning and achievement. The new assessment techniques can be used to support the traditional formative assessment that educators are accustomed to using in the classroom.

Project Description

The professional development workshop has been designed to raise instructors' awareness of the diverse student population of students who are mathematically underprepared, inform instructors of how underprepared students can affect the college, and expand the instructors' knowledge of instructional strategies that could improve math readiness of their students. The goal of the project study was to identify relationships between the COMPASS test scores of underprepared math students and their performance in math courses, success in college, and degree completion. The results from the correlational analysis indicated no significant relationships between these variables. However, independent *t* test and chi-squared analyses of students who tested into Basic Math (n = 138) vs. Introduction to Algebra (n = 96) yielded statistically significant differences in persistence (p = .039), degree completion (p < .001), performance (p = .008), and progress (p = .001). These study results warrant additional attention, which is the goal of the professional development workshop.

I based the study on the theoretical framework of andragogy, whose third assumption suggests that adults respond best to learning when they are able to connect the learning experience to personal goals (Merriam et al., 2007). The 3-day professional development workshop begins with a presentation from the director of Strengthening Student Success outlining the college's enrollment and completion statistics of remedial math students. The awareness of the enrollment and completion data allows instructors to connect the current program status to ways they can contribute to improving that status. Also, Knowles' fourth assumption indicates that adult learning can shift from subject-centered to problem-centered based on the immediacy of application (Merriam et al., 2007). Activities during the workshop will increase the math instructors' knowledge of teaching strategies that will promote success among those students who require remediation. Instructors will be equipped to expand their personal teaching strategies and potentially improve student learning and success.

Iran-Nejad and Stewart (2010) summarized the Bloom's Taxonomy definition of comprehension as translation, interpretation, and extrapolation of someone else's knowledge and casting that knowledge into one's own words. Each day of the professional development project has been designed around one or more of the levels of intellectual behavior important in learning, as defined in Bloom's Taxonomy: Day 1, the knowledge (remembering) level; Day 2, the comprehension (understanding) and application (applying) levels; and Day 3, the comprehension (understanding), application (applying), and evaluation (creating) levels. Day 1 learning objectives will be accomplished through departmental presentations that will provide detailed descriptions of the current remedial math student services available at the college so that instructors can then begin building relationships across campus to assist students. Also, participants will be asked to discuss their reactions to audio clips that speak to new funding policies in Ohio. Day 2 learning objectives will be accomplished by asking participants to hypothetically apply the knowledge gained about patterns of learning from the presentations and demonstrate how their interpretation can create supportive learning environments. Day 3 learning objectives will be accomplished through a presentation and video clip on retention and assessment strategies, followed by an exercise of applying those strategies in the classroom, with the participants engaging with each other and articulating understanding through discussion and reflection.

Project Evaluation Plan

Desimone (2011) suggested several key elements that ensure successful professional development: teacher satisfaction, attitude change, or commitment to innovation. In addition, research has suggested that professional development should provide the following: (1) a job-embedded, coherent curriculum, practical tools and processes for the daily work of leading change; (2) a safe environment to hone and practice new skills; (3) ongoing support through coaching; and (4) an extended and sustained scholarly network for discussion and problem solving (Lawrence, Santiago, Zamora, Bertani, & Bocchino 2008, p. 224).

The professional development project will address the following objectives:

1. Familiarize instructors with the college and its current remedial math student population.

2. Build professional relationships and a cross-campus foundation to support instructors.

3. Demonstrate knowledge of recognizing patterns of learning and the ability to develop challenging learning experiences based on those patterns.

4. Apply knowledge of content and patterns of learning to create environments that are supportive of the diverse population of students and continuous evaluation of application of content.

5. Demonstrate an understanding of the use of multiple methods of assessment to monitor, engage, and build the skills of learners to apply content knowledge.

Knowles' assumptions are that adult learning needs to take place when the adults are most receptive to acquire knowledge (Merriam et al., 2007). I will use a self-reporting survey to measure each learning outcome for resourcefulness and content delivery quality each day of the training. Huff, Preston, and Goldring (2013) support self-reporting surveys as widely used tools of measurement.

The first portion of the daily survey consists of a Likert scale questionnaire that gauges the participants' satisfaction with the session, materials, content applicability, presentation, and atmosphere. A rating scale of *strongly agree, agree, neutral, disagree, strongly disagree* will be used to evaluate the participants' satisfaction.

The second part of the daily survey asks the following questions:

1. What is the most significant thing you learned today?

2. What support do you need to implement what you learned?

3. How will you apply what you learned today to your work?

4. How can we build on this session for follow-up learning?

5. If you weren't satisfied with any part of today's session, please explain why.

After the PD training, a follow-up survey will be conducted to collect data on how the participants are using what they learned in the classroom and to collect content suggestions for future PD training.

Project Implications

Findings from the correlation study examining COMPASS test scores, persistence, and completion indicated no significant relationships exist between the variables; however, we know from the institutional research data that many students at LCC are not successful in remedial math courses and graduating (LLC, 2010). In an effort to provide some resolution to the issue, this project focuses on equipping instructors with the tools to identify student needs, teach, and monitor the progress of their students.

Professional development has been found to be one of the few ways to improve instructional quality (Foster, Toma, & Troske, 2013). The goal of this PD workshop is to address the teaching strategies and assessment of remedial math instructors. I want participants to understand how COMPASS Math test scores are chosen, how the math cut scores are utilized at LCC, and the degree to which the math cut scores are related to student success and persistence. I also want to expose participants to alternative instructional methods and informal classroom assessment techniques that could guide their instructional planning and ultimately improve the retention and success of their students. I also hope that the instructors would want to continue this model of professional development annually to encourage continuous improvement within the remedial math department.

Section 4: Reflections and Conclusions

Introduction

This project study was designed to address the issues of retention, persistence, and success of community college students who tested into remedial math courses at a community college in Ohio. The resulting professional development (PD) training, entitled *Retention, Persistence, and Success for Remedial Math Workshop*, was designed to incorporate institutional research and best practices in advising, instruction, and assessment components to edify remedial math instructors. The purpose of this section is to reflect on the strengths and limitations of the PD training and highlight its impact on social change.

Project Strengths and Limitations

The findings from this study indicated that there is no significant relationship between students' Computer-adaptive Placement Assessment and Support System (COMPASS) Math test scores and their performance in remedial math courses, persistence in college, or chance of completing a degree or certificate. However, results from this study did identify statistically significant differences in persistence, success, performance, and progress between students enrolled in the two separate remedial math courses, Basic Math and Introduction to Algebra. These findings warrant additional investigation and attention. The 3-day professional development training described in the previous section was also created as a result of these findings.

The purpose of the training is to encourage remedial math instructors to be strategic in their instruction and assessment of learning so as to retain students and promote successful completion of their courses. The use of group collaboration, discussion, and demonstrations of a variety of learning strategies will help to achieve that goal (Suskie & Banta, 2009). A positive professional development experience is imperative to the success of the project. Selecting a professional development approach that was conducive to the concerns of the administrators and the needs of both the instructors and the students was my first priority.

This project utilizes a coaching approach to professional development, which will strengthen the training's ability to enhance the participant's competencies through discussion, reflection, and action, as suggested by McLymont and da Costa (1998). The presentation of the findings from the study will provide instructors with in-depth details of the population of students who are in their classrooms. This insight, in combination with the presentation of detailed review of retention and assessment strategies, is expected to inspire reflection and help to establish new thought processes among participants. This coaching approach to PD is known for creating trusting relationships among participants (Cheliotes & Reilly, 2012). The development of strong relationships among colleagues of similar interests will help to ensure the ongoing use of this PD training at the community college used in this study.

A limitation of the project is the challenge in securing instructors' participation in this professional development training. Instructors at the study site have a limited amount of work time, which is specified in their contracts. Extending instructors' work hours infringes on their personal schedules, which discourages participation. In addition, participation from adjunct instructors (or part-time instructors) will be even more challenging because their contracted hours are even less than full-time instructors. The time frame of the PD training will also require approval from the academic dean, whose buy-in is also needed to encourage participation in the training.

Participation is essential to measuring the effectiveness of the project. Another limitation to the project is the difficulty of measuring the outcomes and efficiently reporting the results so as to demonstrate the appropriateness of the training. Historically, the evaluation of professional development in general was simply administering a satisfaction survey; however, best practices require rigorous outcomes and higher standards of evidence (Desimone, 2011). The assessment tool for this PD workshop will address participant satisfaction and challenge participants to explain how they will use the new concepts in their classrooms. In addition, participants will be asked to provide input on how to expand the training for future training opportunities.

Recommendations

Statistical analysis used to answer the research questions yielded no significant relationships between the students' COMPASS test scores and persistence or performance in the corresponding remedial math course. This analysis established that COMPASS Math cut scores are not good predictors of persistence or degree completion when using recommended cut scores of either LCC or ACT. Conversely, statistically significant relationships were found among students' test scores and their persistence, performance, success, and progress when the students were grouped by math course (Basic Math and Introduction to Algebra) and compared. The college should focus more on researching the students in these two courses (Basic Math and Introduction to Algebra) for further research and analysis. In addition, the college should replicate this study each semester to determine whether the degree of relationships is consistent across all first-time students who test into remedial math courses.

Ultimately, the main recommendation from this study is to conduct further research to substantiate cause and effect between the variables with significant relationships of the two groups. The focus of this study was the impact of COMPASS Math test scores on students' persistence, performance, progress, and success. Unidentified factors affecting student success can affect educators' choice of instructional strategies (Grodsky & Riegle-Crumb, 2010). I believe that further qualitative research will yield interesting and important information regarding why there were such differences in outcomes when looking at the two groups. Additional conversations focused on remedial math professional development should be considered to address retention and completion concerns.

Scholarship

Throughout the process of this study, my scholarly writing has improved tremendously. I have never considered myself a good writer; I have always struggled with repetition and various grammatical rules. Through constant review and revisions, I became more aware of my weaknesses and have improved on self-correction. The support that I received from my colleagues, professors, and student services staff at Walden University was extremely helpful. The quality relationships that I have built have surpassed my expectations. I was skeptical that pursuing my degree online would foster such a reliable foundation and questioned the rigor of the curriculum. However, the intense focus on evidence-driven research and the meticulous review of my assignments is indicative of the care and high standards of the university as a whole. I am most satisfied with my personal change of mind in regards to practical solutions to issues that have social impact on those involved. The research process required by the program challenged me to question sources, inquire into the reliability and validity of data, and focus less on my own opinion and the opinions of others when addressing issues.

Project Development

Project development was fairly easy. My passion has always been in science, technology, engineering, and mathematics (STEM) related topics. My position as an academic advisor nurtured this passion, as I was in constant contact with students who were not successful with math concepts. I used this background to start a discussion with my supervisor about possible research avenues. It was through those discussions that I was informed of the research site’s need to understand why students were not successful in remedial math courses and were not persisting past their third semester. Connecting completion to the study came instinctively because of the college’s consistently low graduation rate. In addition, the college was aware of the new funding policy that was to come. I quickly realized after many discussions with my supervisor that I had a very relevant topic to research.

My original project idea was to create a policy paper that would provide evidence-based suggestions on how to improve the remedial math program at the college. However, after all the analysis had been completed, I noticed that the results yielded no relationships between variables that I had initially assumed would be related, requiring me to adjust my project. My faculty advisor and I discussed the results and concluded that while the data that answered the research questions were not extremely convincing and would not support a policy paper, there was enough evidence in the descriptive analysis to support a professional development project. My revised goal was to create a project that shared useful information in a practical format that would also contribute to the improvement of the current remedial math program. Evaluation of this goal will occur during the professional development training and afterwards when the participants complete the provided self-reporting surveys.

Leadership and Change

As I continue to grow professionally in the field of education, I will also continue to develop leadership. Early in my career, I was known to be a great team player, and I took great pride in that recognition. I enjoyed taking great ideas and playing a major role in making those ideas come to pass. Walden’s doctoral process challenged me to be the person who generated the ideas. I have grown more comfortable at connecting best practices to current concerns and reflecting on how to customize initiatives to the student or institution in question. When I began the doctoral process, I was not comfortable presenting my ideas to the college administration. I now have found my administration inviting me to brainstorming discussions and initiative meetings.

Since my study has begun, I have learned two valuable lessons. The first lesson is that when in a position of leadership, questionable circumstances will present themselves. I have learned that asking too many questions can sometimes result in the possession of a lot of useless information. I believe asking the right questions will result in effective decision-making and ultimately effective leadership. I also believe that in order to ask the right questions, I must listen carefully to the issue no matter how it is presented (data or discussion). Secondly, I have learned that I can never plan too much, nor will I ever be able to plan for every situation. Several deadlines were missed throughout my process, and it never did result in destroying my efforts. I have learned to be flexible and to not get overwhelmed with pacing myself with others. However, I have also learned that it is imperative to be prepared to plan accordingly when the unexpected does occur and be sure to be just as enthusiastic about the alternative plan as I was about the initial plan. I believe that had I lost all motivation, I would have become another statistic, another doctoral student who did not complete a degree. If it had not been for the inspiration of my faculty members and classmates, I may not have completed this journey. It is my goal to be that type of change agent for someone else. I plan to take these two simple lessons and continue to improve lives, policies, and minds.

Analysis of Self as a Scholar

I have always aspired to continue my education as far as I could financially and mentally afford. As a student, I enjoy learning new concepts and skills. I enjoy being pushed beyond my comfort zone and challenged to think beyond what is presented to me. However, at each level of education that I have obtained, I have found myself at a different point in life. As an undergraduate, I was a traditional student who matriculated from high school to college. I found myself between levels of maturity, and my motivation was strictly external. After working professionally in industrial engineering, my undergraduate field, I realized that external motivations may have resulted in my being in a profession where I was not comfortable. It was then that I decided to pursue my master's degree.

The decision to complete my master's was motivated by external and internal factors. I was unemployed; however, I wanted to change careers to a field I felt passionate about. I was determined to make a difference for someone who may have made a decision like I had previously done with my undergraduate major. I chose to go into education. I have enjoyed being an educator just as much as I have enjoyed being educated. Further, it was apparent early in my higher education career that if I wanted to affect lives, I had to be in a position to affect policies. This is why I decide to pursue my doctorate. As a scholar, my doctoral journey has been the most challenging. I made this choice at a point in my life when I had recently married and started a family. Although my passion to learn had not diminished, my energy had. If it had not been for the comprehensive programming and supportive student affairs services of Walden University, I am not sure I would have ever pursued this goal through completion. As a scholar, I now have a renewed passion for lifelong learning through research.

My personal definition of a practitioner is influenced by Nganga (2011), who used the definition of someone who engages in intellectual work and who practices the skill necessary to educate generations. I believe a practitioner is someone who engages in intellectual work and then uses this knowledge to positively affect their field. As a practitioner, I feel it necessary to contribute positively to my field whenever possible. I seek to share my knowledge with family, friends, community leaders, employers, and employees. My desire is to contribute my time to remedial math programs and to always be purposeful about how I affect the field of math education.

Analysis of Self as a Project Developer

My current position in higher education has benefited me as a project developer. As an academic advisor and currently as academic program director, I am challenged to develop or improve student programs professionally. I have created online curriculum, established learning outcomes for the first-year experience course, and developed training sessions for students and staff. However, most of those projects were created within a short amount of time based on need or request. As a Walden doctoral student, I now understand the need to be very intentional about the development of programs. I realized the intricate details that bring both validity and relevance to project development.

During the doctoral process I was required to develop a conceptual or theoretical foundation for my study. It was this research that refined my thoughts as I developed the project for this study. In addition, during the process of reading articles related to remedial math achievement, I learned the importance of seeing past preconceived notions and relying on sound statistical results. I also learned the importance of gathering good data to analyze the effectiveness of projects. Furthermore, I also learned how those statistical results are not always a definitive answer and how they can promote additional research.

Reflection

This project study was designed to add to the knowledge base of student success and persistence as it relates to math readiness, specifically for community college students. The goal was to do so by evaluating the relationships between COMPASS Math test scores, performance and success in remedial math courses, and persistence to degree completion. Four research questions were selected to achieve this goal: (1) What is the relationship between a student's COMPASS Math test scores and their persistence in math courses? (2) What is the relationship between a student's COMPASS Math test scores and their success in math courses? (3) What is the difference in success and persistence among students using COMPASS cut scores as defined by LCC in comparison to those suggested by ACT? (4) How predictive are COMPASS Math test scores of students' performance in math courses and their persistence to degree completion?

Early in the analysis of the data, I realized that research questions #3 and #4 were going to be a challenge. Both questions were actually two questions in one, which required twice the analysis. In addition, presenting the data for these two questions was equally challenging. After working through the complexity of the two questions with my faculty member, we managed to produce some comprehensive results. Reflecting on the process of selecting research questions, I believe I could have refined questions #3 and #4 and eliminated the obstacles I had to overcome to answer those questions. Ultimately, statistical analysis yielded no significant relationships between the students' COMPASS test scores and the previously mentioned variables. However, increasing the achievement of first-time students in remedial math courses is still imperative at LCC.

Further analyses of results unrelated to the research questions produced data worthy of discussion. It was those results that I built my project around. Reflecting on the process of creating the project, I believe I may have wasted some time on my first project consideration (a policy paper). If I had been open to alternative projects prior to having them suggested to me, I think I may have been able to complete sooner. However, I had invested many hours into researching the policy paper and I perceived changing as failing. Considering the final project and my goal to produce a practical and resourceful project, I am extremely satisfied with the decision to change projects and my end results.

Throughout my journey I have always kept the concept of social change in mind. Walden University has done a very good job at communicating their mission, to "provide a learning experience that encourages students to pursue and apply knowledge in the interest of the greater good" (Walden University, 2012). I believe that if this project is adopted into LCC as part of their professional development training for remedial math instructors, it will affect how math instructors design their curriculum, plan daily lessons, and administer classroom assessments. I also believe that it is this type of reform that will begin to improve the achievement of students who are required to take remedial math courses.

Implications, Applications and Directions, and Future Research

The purpose of this study was to address the following overarching research question: Is there any relationship between a student's COMPASS Math test score and their ability to perform well in math and persist to degree completion? Statistically no relationships were found to indicate that a COMPASS Math test score, by the community college or ACT standards, has any impact on remedial math students. However, statistically significant data were found when students of two groups (those in Basic Math and those in Introduction to Algebra course) were compared using the same variables (performance, persistence, and success). An implication of this study would be the increased awareness that these relationships could be significant to improving the achievement of students in remedial math courses at the community college. The instructors would be the most affected, provided they were aware of the analysis results. Providing instructors with the results (through professional development training) and bringing awareness to best practices related to improving achievement outcomes is also an implication of this study.

The professional development training provides an opportunity for the educators at the community college to learn the value of research and the data it affords, discuss possible recommendations to modify content delivery with colleagues, and exercise different classroom assessment techniques to improve student achievement. The improvement of student achievement would not only affect the retention and completion rate at the community college but also positively affect the college's funding potential in the future.

Recommendations for future research include duplicating this study every 4 years. I would suggest that the study be adjusted to compare the students in the two courses, Basic Math and Introduction to Algebra, utilizing the same variables. In addition, a second recommendation would be to conduct a study that focuses on the instructor's perception of his/her students' abilities in the classroom. A third recommendation would be to conduct a study on the students' perception of the content delivery and assessment in the classroom to determine factors that the instructors may not be aware of.

Conclusion

In the final section of this project study, I focused on the reflections and conclusions from the doctoral journey and development of professional development training. Topics included the project development, strengths, limitations, and implications. Because the results indicated some significant data when comparing the two courses (Basic Math and Introduction to Algebra), I felt the findings from the research indicated a need for this training for remedial math instructors. Evaluation of the project, once implemented, will contribute to the community college's growing institutional research regarding remedial math programming. This project will encourage instructor collaboration, which will influence the application of new content delivery methods and assessment strategies. Social change implications include the changing of methods used to deliver content in an effort to positively affect student achievement in remedial math courses.

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Appendix A: Professional Development Project

Purpose

A 3-day professional development training designed to improve the success of students who are required to take remedial math courses will be used to improve the curriculum design, content delivery, assessment, and intervention of remedial math coursework.

Goals

The goals of the professional development training are to (a) provide statistical data that will inform remedial math educators of the concerns of the current underprepared student population, (b) present educators with the most current research-driven, best practices in remedial math, and (c) promote continuous improvement and assessment of LCC's remedial math program.

Target Audience

The target audience for the professional development training will be all full-time and adjunct remedial math instructors at LCC.

Learning Outcomes

1. Instructional Development: Familiarize instructors with LCC population. Assist instructors in recognizing patterns of learning and developing appropriately challenging learning experiences based on those patterns.
2. Instructional Environment: Ensure instructors create environments that are supportive of the diverse population of students at LCC, to promote active learning and self-

motivation among learners, and to promote continuous evaluation by the instructors of the application of content.

3. Content Assessment: Increase the instructors' understanding of the use of multiple methods of assessment to monitor, engage, and build the skills of learners to apply content knowledge.

Timeline

The professional development training will be offered once a year, every fall semester the week prior to the start of the term. This week is generally reserved for faculty training, and this professional training will be offered to remedial math instructors only. The first day of the training will take place on the Tuesday of the training week so that the remedial faculty members do not miss any of the preliminary sessions that all instructors attend on Monday.

Schedule

Day 1

Learning Objectives:

1. To familiarize instructors with the college and its current remedial math student population.

2. To build professional relationships and a cross-campus foundation to support instructors.

Detailed Schedule – Day 1

8:30 a.m. – 9:00 a.m.

Check in and continental breakfast

9:00 a.m. – 9:30 a.m.

Welcome from director of Strengthening Student Success, review of workshop materials including daily agenda, icebreaker, and introduction of next speaker.

Icebreaker: Ask each table to identify two questions they hope to have answered during the presentation or session; ask for "volunteers" from each table to write their questions on an easel at the front of the room.

9:30 a.m. – 11:00 a.m.

Presentation of most current enrollment, registration, and completion statistics of the college's remedial math program from Institutional Research.

Group activity: On each table there will be a card that describes a student (student profile) based on the statistics that were shared in the presentation. The group will be asked to discuss and identify three advantages and three disadvantages their student may have based on their description. A representative from each table will be asked to share the group's perception.

11:00 a.m. – 11:30 a.m.

Break and morning snack (light refreshments)

11:30 a.m. – 12:30 p.m.

A presentation from the director of Strengthening Student Success: Remedial Education and Its Impact on Funding.

Audio clip

Discussion: Each table will be asked to discuss their reaction to the audio clip and select a representative to share their viewpoint.

12:30 p.m. – 1:00 p.m.

Lunch on your own

1:00 p.m. – 1:20 p.m.

Introduction of Testing Center and the services offered that support remedial math education.

Question and answer.

1:20 p.m. – 1:40 p.m.

Introduction of Advising and the services offered that support remedial math education.

Question and answer.

1:40 p.m. – 2:00 p.m.

Introduction of the Office of Accessibility and the services offered that support remedial education.

Question and answer.

2:00 p.m. – 2:40 p.m.

Introduction of Student Support Services and the services offered that support remedial education.

2:40 p.m. – 3:00 p.m.

Introduction of Counseling Services and the services offered that support students.

3:00 p.m.

Closing remarks from director of Strengthening Student Success and an introduction to Day 2 topics.

End of Day 1

Day 1 Materials:

1. Mock Student Profiles
2. Current Program Data Presentation

3. Ohio College Funding Audio clip: https://beta.prx.org/stories/113132

4. Presentation from director of Strengthening Student Success

5. Handouts provided by presenters.

Day 2

Learning Objectives:

1. Demonstrate knowledge of recognizing patterns of learning and the ability to develop challenging learning experiences based on those patterns.

2. Apply knowledge of content and patterns of learning to create environments that are supportive of the diverse population of students and continuous evaluation of application of content.

8:30 a.m. – 9:00 a.m.

Continental breakfast

9:00 a.m. – 9:30 a.m.

Welcome from director of Strengthening Student Success, review of workshop materials including daily agenda, icebreaker, and introduction of next speaker.

Icebreaker: Each table will be asked to review their student profile, including the advantages and disadvantages that they noted from the previous day. This exercise is used to refresh the memory of those who are in attendance. Also they will be asked to recall the questions they hoped to be answered by the end of the training.

9:30 a.m. – 11:00 a.m.

Adult Learning video presentation

Group activity: One person from each table will be asked if adult learning theory (andragogy) applies to their student profile and whether or not using this teaching style would benefit their student. A representative from each table will share their input.

11:00 a.m. – 11:30 a.m.

Break and morning snack (light refreshments)

11:30 a.m. – 12:30 p.m.

A presentation from the director of Strengthening Student Success: Remedial Education and Its Impact on Funding.

Classroom Assessment Techniques Video

Discussion: Each table will be asked to discussion their reaction to the video and select a representative to share their viewpoint.

12:30 p.m. – 1:00 p.m.

Lunch on your own

1:00 p.m. – 3:00 p.m.

Active Learning Activity: Each table will have an active learning strategy assigned to it. As a group the participants will discuss how that strategy can be incorporated in a remedial math class. A volunteer from each table will share their strategy and how they incorporated it into their class.

3:00 p.m.

Closing remarks from director of Strengthening Student Success and an introduction to Day 3 topics.

End of Day 2

Day 2 Materials

1. Adult Learning video clip http://youtu.be/vLoPiHUZbEw
2. Classroom Assessment Techniques (CATs) video clip

http://www.delts.mun.ca/portal/index.php?SAID=187&Cat=%22Teaching_and_Technology%22#second

3. Active Learning Strategies cards.

Opening Question:

Take a moment to reflect on your experience with PowerPoint.

Come up with a positive and a negative example.

Focused Listing

Take out a sheet of paper and list as many characteristics of good lecturing as you can.

Brainstorm

What do you know about the ways students learn?

Start with your clearest thoughts and then move on to those that are kind of out there!

If you could ask one last question. . .

what would it be?

Two Minute Paper

Summarize the most important points in today's lecture.

NOTE CHECK

Take a few minutes to compare notes with a partner:

- Summarize the most important information.
- Identify (and clarify if possible) any sticking points.

Question and Answer Pairs

Take a minute to come up with one question.

Then, see if you can stump your partner!

Day 3

Learning Objectives:

1. Demonstrate an understanding of the use of multiple methods of assessment to monitor, engage, and build the skills of learners to apply content knowledge.

8:30 a.m. – 9:00 a.m.

Continental breakfast

9:00 a.m. – 10:00 a.m.

Welcome from director of Strengthening Student Success, review of workshop materials including daily agenda, icebreaker, and introduction of next speaker.

Icebreaker: Each table will be asked to review their student profile, including the advantages and disadvantages that they noted from the first day. As a group each table will be asked to discuss a new or current instructional method that would encourage their student to engage in learning and promote persistence.

10:00 a.m. – 11:00 a.m.

Classroom Assessment Techniques (CATs) videos

Group activity: One each table will be asked if andragogy learning theory applies to their student profile and whether or not it would an andragogy teaching style would benefit their student. A representative from each table will share their input.

11:00 a.m. – 11:30 a.m.

Break

11:30 a.m. – 12:30 p.m.

A presentation from the director of Strengthening Student Success: Retention Strategies

Discussion: Each table will be asked to discussion their reaction to the video and select a representative to share their viewpoint.

12:30 p.m. – 1:00 p.m.

Lunch provided

1:00 p.m. – 3:00 p.m.

Round Table Discussions (3 topics)

3:00 p.m.

End of Day 3

Day 3 Materials

1. Muddiest Point: http://youtu.be/v_dt6VGjk7Y

2. One-Sentence Summary: http://youtu.be/ScLoLLMfyQ4

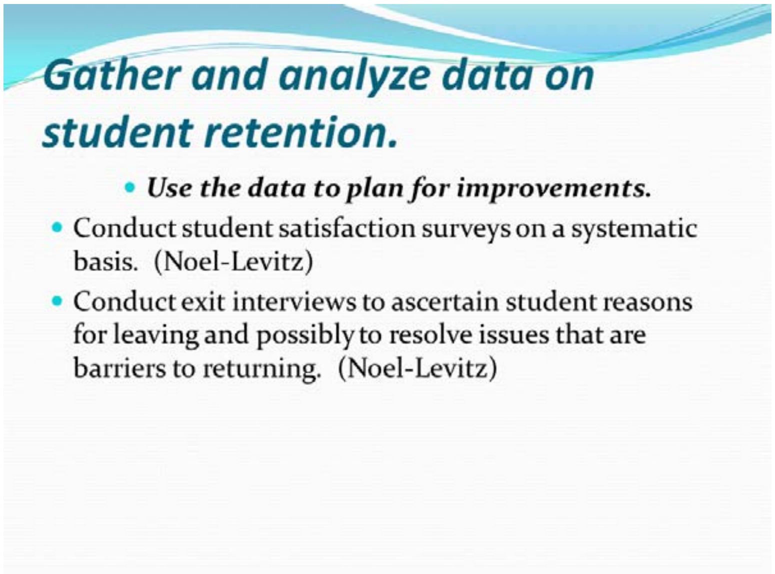
3. Retention Presentation Slides

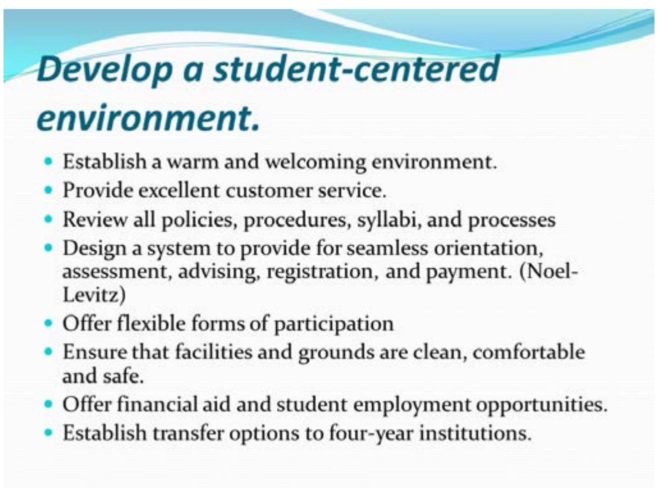
Introduction

- There is an abundance of research on best practices in student retention. Understanding these practices appropriate for community college settings is important to designing retention strategies that will meet the needs of our students. The following strategies are relevant to public, two-year, non-residential community colleges:

Commit to and invest in student retention.

- Develop a retention plan that sets goals
- Ensure all members of the campus community understand that they have a role and responsibility in student retention.
- Hire employees who embrace the institution's vision and values.


Gather and analyze data on student retention.
Use the data to plan for improvements.
Conduct student satisfaction surveys on a systematic basis. (Noel-Levitz)
Conduct exit interviews to ascertain student reasons for leaving and possibly to resolve issues that are barriers to returning. (Noel-Levitz)


Develop a student-centered environment.
Establish a warm and welcoming environment.
Provide excellent customer service.
Review all policies, procedures, syllabi, and processes
Design a system to provide for seamless orientation, assessment, advising, registration, and payment. (Noel-Levitz)
Offer flexible forms of participation
Ensure that facilities and grounds are clean, comfortable and safe.
Offer financial aid and student employment opportunities.
Establish transfer options to four-year institutions.

Ensure students are academically prepared for coursework.

- Mandate course placement testing.
- Require students showing deficiencies to complete remedial or developmental coursework.

Implement early alert methods.

- Identify students who are "at risk" and develop proactive intervention methods.
- Identify students who may be dropout-prone by observing "behavioral cues" (e.g., missing classes, failing to apply for financial aid, not pre-registering, or requesting a transcript). (Noel-Levitz)
- Use tele-counseling to contact students experiencing difficulty or planning not to return. (Noel-Levitz)
- Communicate with students who are in good standing who fail to enroll.

Develop study skills & understand effective learning strategies.

- Offer academic support services such as a tutoring center, learning center, math lab, language lab, etc. Encourage students to use these resources.
- Provide peer tutorial services.
- Provide Supplemental Instruction (SI) for classes that are extremely difficult.

Provide transition assistance programs

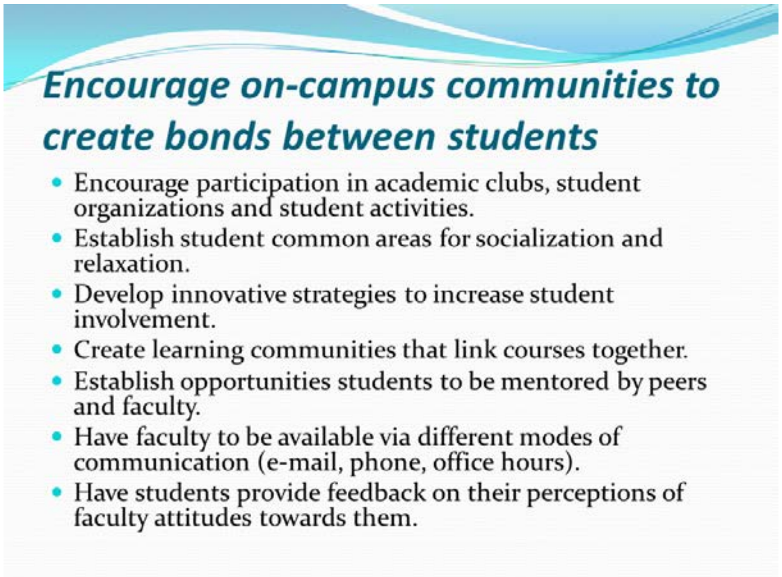
- ***Including pre-enrollment orientation and first-year seminar courses.***
- Offer workshops to help students develop skills such as time management, study skills, career exploration.
- Offer a first-year seminar.

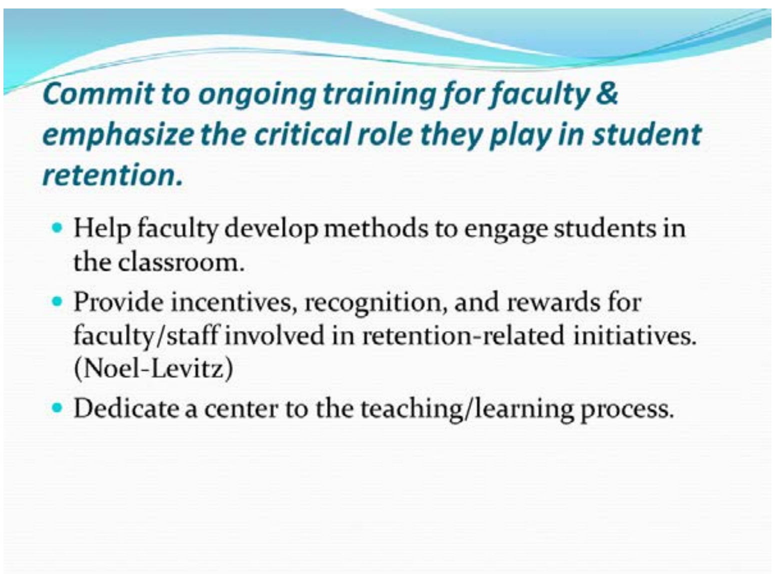
Develop an academic advising plan based on effective advisement strategies.

- Provide training for academic advisors.
- Design an evaluation program that assesses the effectiveness of the institution's advising program.
- Utilize a computerized degree audit system.
- Use a model of frontloading and progressive responsibility.

Provide career-counseling services.

- Research shows that students who are committed to their educational goal are more likely to persist. Helping students identify career goals and interests early can increase commitment.
- Encourage students to utilize technology with career exploration software such as FOCUS 2.
- Provide career counseling early in student's college experience.
- Offer career planning courses or workshops.
- Incorporate these services into classes.


Encourage on-campus communities to create bonds between students
Encourage participation in academic clubs, student organizations and student activities.
Establish student common areas for socialization and relaxation.
Develop innovative strategies to increase student involvement.
Create learning communities that link courses together.
Establish opportunities students to be mentored by peers and faculty.
Have faculty to be available via different modes of communication (e-mail, phone, office hours).
Have students provide feedback on their perceptions of faculty attitudes towards them.


Commit to ongoing training for faculty & emphasize the critical role they play in student retention.
Help faculty develop methods to engage students in the classroom.
Provide incentives, recognition, and rewards for faculty/staff involved in retention-related initiatives. (Noel-Levitz)
Dedicate a center to the teaching/learning process.

Establish opportunities for active and collaborative learning.

- Have students participate in class discussions.
- Incorporate hands-on learning activities.
- Offer early exposure to career-related coursework.
- Encourage group activities to break down barriers between students.

Demonstrate commitment to education of all students.

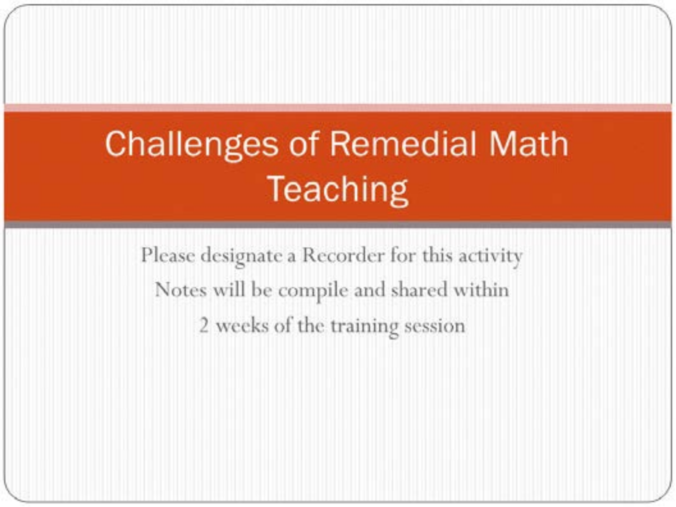
- Develop systems for proactive monitoring, formative assessment, early identification and feedback.
- Develop appropriate learning settings for different student populations.

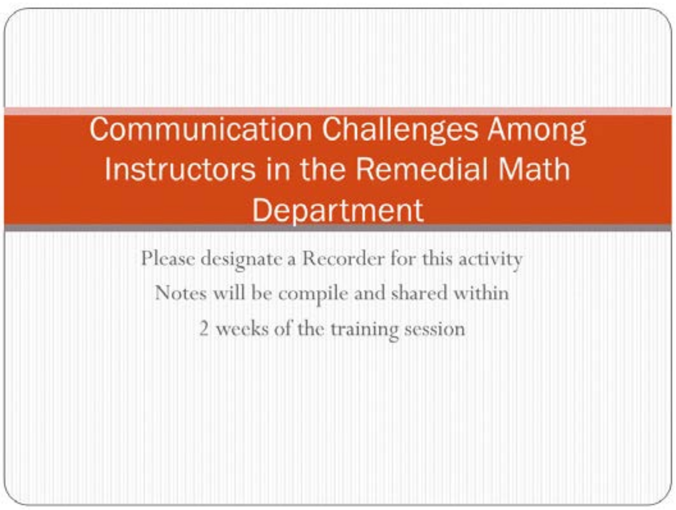
References:

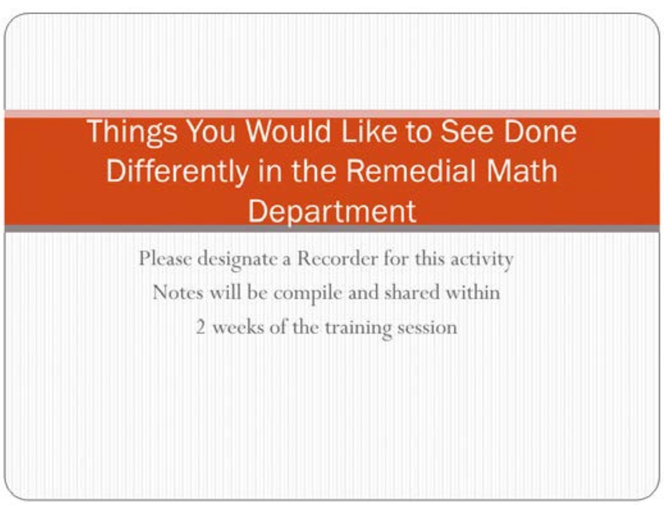
- McClenney, K.M. and Waiwaiole, E.N. (June/July 2005). "Focus on student retention: promising practices in community colleges." *Community College Journal*.
- Tinto, V. (1993). *Leaving Higher Education: Rethinking the Causes and Cure of Student Attrition.* Chicago: The University of Chicago Press.
- *Twenty-Nine Good Practices in Student Persistence (Retention)* (2005). Noel-Levitz, Inc.

- *College-wide Retention Task Force May 2006*

4. Round Table Discussion Topics







4. Daily Evaluation:

PROFESSIONAL DEVELOPMENT EVALUATION

We hope you enjoyed your stay with us! To help us better serve you, please complete this survey and return it to the reception desk at your convenience. Thank you!

Daily Session Date_________	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
I am satisfied with today's session.					
Handouts were engaging and useful.					
Time in the workshop was sufficient to allow learning and practicing new concepts.					
The workshop was well planned and interactive.					
The presenter(s) was effective.					
The atmosphere was enthusiastic, interesting, and conducive to a collegial professional exchange.					
Session content and strategies will be useful in my work.					
What is the most significant thing you learned today?					
What support do you need to implement what you learned?					
How will you apply what you learned today to your work?					
How can we build on this session for follow-up learning?					
If you weren't satisfied with any part of today's session, please explain why.					
Additional Comments:					

Appendix B: COMPASS Math Concordance Tables

COMPASS Pre-Algebra to ACT Math Concordance
(*n* = 152,675)

COMPASS Pre-Algebra scale score	Concorded ACT Math score	COMPASS Pre-Algebra scale score	Concorded ACT Math score	COMPASS Pre-Algebra scale score	Concorded ACT Math score
17	13	45	17	73	21
18	13	46	17	74	22
19	13	47	17	75	22
20	13	48	17	76	22
21	14	49	18	77	22
22	14	50	18	78	23
23	14	51	18	79	23
24	14	52	18	80	23
25	14	53	18	81	23
26	14	54	18	82	24
27	15	55	18	83	24
28	15	56	18	84	24
29	15	57	19	85	24
30	15	58	19	86	24
31	15	59	19	87	25
32	15	60	19	88	25
33	15	61	19	89	25
34	16	62	19	90	26
35	16	63	19	91	26
36	16	64	20	92	26
37	16	65	20	93	27
38	16	66	20	94	27
39	16	67	20	95	28
40	16	68	20	96	28
41	16	69	20	97	29
42	17	70	21	98	30
43	17	71	21	99	32
44	17	72	21		

COMPASS Algebra to ACT Math Concordance

(*n* = 175,039)

COMPASS Algebra scale score	Concorded ACT Math score	COMPASS Algebra scale score	Concorded ACT Math score	COMPASS Algebra scale score	Concorded ACT Math score
16	14	44	20	72	25
17	14	45	21	73	25
18	15	46	21	74	25
19	15	47	21	75	25
20	15	48	21	76	26
21	16	49	21	77	26
22	16	50	22	78	26
23	16	51	22	79	26
24	16	52	22	80	26
25	16	53	22	81	26
26	17	54	22	82	26
27	17	55	23	83	27
28	17	56	23	84	27
29	17	57	23	85	27
30	17	58	23	86	27
31	18	59	23	87	27
32	18	60	23	88	27
33	18	61	24	89	27
34	18	62	24	90	28
35	18	63	24	91	28
36	19	64	24	92	28
37	19	65	24	93	28
38	19	66	24	94	29
39	19	67	24	95	29
40	19	68	25	96	30
41	20	69	25	97	30
42	20	70	25	98	31
43	20	71	25	99	33

COMPASS College Algebra to ACT Math Concordance

(n = 42,478)

COMPASS College Algebra scale score	Concorded ACT Math score	COMPASS College Algebra scale score	Concorded ACT Math score	COMPASS College Algebra scale score	Concorded ACT Math score
15	13	44	19	73	27
16	14	45	19	74	27
17	14	46	20	75	27
18	15	47	20	76	28
19	15	48	20	77	28
20	15	49	20	78	28
21	15	50	21	79	28
22	15	51	21	80	29
23	16	52	21	81	29
24	16	53	21	82	29
25	16	54	22	83	29
26	16	55	22	84	30
27	17	56	23	85	30
28	17	57	23	86	31
29	17	58	23	87	31
30	17	59	23	88	32
31	17	60	24	89	32
32	17	61	24	90	33
33	17	62	24	91	33
34	18	63	25	92	33
35	18	64	25	93	33
36	18	65	25	94	33
37	18	66	25	95	33
38	18	67	26	96	33
39	18	68	26	97	34
40	19	69	26	98	36
41	19	70	26	99	36
42	19	71	26		
43	19	72	27		

These tables can be used to correlate ACT scores to COMPASS scores when placing students in Basic Math, Elementary Algebra, Intermediate Algebra, and College Algebra courses. These correlations are based on the scores of students who took both ACT and COMPASS tests.

Note the scores estimated in these tables should not be considered equivalent. They are estimate scores for which approximately the same ratio of students tested at or below each pair of concordant scores. Based on different samples of students, the concordant scores may vary slightly.

Appendix C: Letter of Cooperation

February 4, 2014

Dear Mrs. Brown

Based on my review of your research proposal, I give permission for you to conduct the study entitled:

A Correlation Study of Math Readiness and Student Success at an Ohio Community College
College.

As part of this study, I authorize you to collect data through the Office of Institutional Research and Planning from Colleague DataTel and disseminate results as possible upon the study's conclusion. This study will not require a treatment that would impact a student's well-being, therefore participant or parental consent will not be necessary. We understand that the Walden University faculty members' roles will be to supervise all research activities and will not be required n duties.

We understand that sponsibilities include: collect data, identify the changes needed to protect the assets against the breach of confidentiality, loss of data, integrity, and availability, remove identifiers, and provide location for result dissemination. We reserve the right to withdraw from the study at any time if our circumstances change. Except as required by law, we will maintain in strict confidence all data and information for this study and will not use or disclose, except to facilitate work under this agreement, any confidential information received from the other party.

I confirm that I am authorized to approve research in this setting. I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University IRB.

Sincerely,

Director Institutional Research and Planning

Walden University policy on electronic signatures: An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Electronic signatures are only valid when the signer is either (a) the sender of the email, or (b) copied on the email containing the signed document. Legally an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. Walden University staff verify any electronic signatures that do not originate from a password-protected source (i.e., an email address officially on file with Walden).

Appendix D: Data Usage Agreement

DATA USE AGREEMENT

This Data Use Agreement, effective as of ad between Jayna N. Brown("Data Recipient") and ("Data Provider). The purpose of this Agreement is to provide Jayna with access to a Limited Data Set ("LDS") for use in research in accord with the HIPAA and FERPA Regulations.

1. Definitions. Unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the "HIPAA Regulations" codified at Title 45 parts 160 through 164 of the United States Code of Federal Regulations, as amended from time to time.

2. Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable HIPAA or FERPA Regulations

3. Data Fields in the LDS. No direct identifiers such as names may be included in the Limited Data Set (LDS). In preparing the LDS, Data Provider shall include the data fields specified as follows, which are the minimum necessary to accomplish the research: Age or age range, gender, ethnicity, start date, major, COMPASS and ACT scores and grades by term in College Preparatory Education math courses.

4. Responsibilities of Data Recipient. Data Recipient agrees to:

   a. Use or disclose the LDS only as permitted by this Agreement or as required by law;

   b. Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

   c. Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

   d. Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

   e. Not use the information in the LDS to identify or contact the individuals who are data subjects.

5. Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS for its Research activities only.

6. Term and Termination.

   a. Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

   b. Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

   c. Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

   d. For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

   e. Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

7. Miscellaneous.

   a. Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

   b. Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

   c. No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

   d. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

c. Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA	RECIPIENT
Signed: [illegible]	Signed: [illegible]
Print Name:	Print Name: [illegible]
Print Title: [illegible]	Print Title: [illegible]