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Mixed-Methods Evaluation of a Developmental Math Program Redesign at a Community College

Elaine Sabrina Spellman
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Elaine Sabrina Spellman

has been found to be complete and satisfactory in all respects,
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the review committee have been made.

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Walden University

2019

Abstract

Mixed-Methods Evaluation of a Developmental Math Program Redesign at a Community

College

by

Elaine Sabrina Spellman

MS, Hunter College, 1990

BA, Hunter College, 1986

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

April 2019

Abstract

North Carolina's community colleges redesigned developmental math programs in 2011. The overall effectiveness of the redesign has not yet been evaluated. A concurrent mixed-methods study was conducted at Mid-Atlantic Community College (MACC) for a formative and summative evaluation of the redesigned program. Mezirow's transformative learning theory, along with an emphasis on designing individualized methods of instruction as outlined by Keller were the theoretical foundations of the evaluation. The extent to which the redesigned math modules affected the effectiveness of the math program at MACC was the guiding research question. Data on student outcomes and participant perceptions were collected for this concurrent mixed methods evaluation. Quantitative data from MACC institutional databases ($N = 827$) were used to compare the overall GPAs and mean passing grades for students in the old (2012-13) and new (2013-15) programs using an independent samples t test. There were no significant differences in students' mean passing grades or overall GPAs for the redesigned modules, compared to the semester classes. Qualitative data from 9 semi-structured interviews with 3 administrators, 3 instructors, and 3 students were analyzed inductively for thematic patterns. Qualitative results indicated that perceptions of administrators were more favorable regarding the effectiveness of the redesign than the perceptions of instructors and students and that programs implementing individualized modules need to provide professional development training to those individuals affected by the redesign. Results from this study can promote positive social change by providing information for improved teaching and learning practices among developmental math instructors.

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Dedication

Thank you God, Thank you God, and Thank you God. For you said in your word “Delight yourself in the Lord, and he will give you the desires of your heart” (Psalm 37:4).

I want to dedicate this project to so many family members and loved ones so please do not feel left out if you were not mentioned.

First, I want to dedicate this project to Charles Wade Welch, Sr. It was your continued encouragement, love, and support that I was able to fulfill my ultimate personal achievement. Words alone cannot express how grateful I am to have you in my life.

Secondly, I want to dedicate this project to my three children, Sabrina (DeMarkeus), Reggie (Aylonnah), and Keyron. I did not tell you that for the last six years I was enrolled in an online doctorate program so SURPRISE!!!

Thirdly, I want to dedicate this project to my four grandchildren, Da’Myra (MyMy), Raven (Elaine), Reggie (RJ), and Ay’Lena (LeLe). I did this for you guys. Love you all much.

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I would like to thank the administrators, instructors, students, and other stakeholders at MACC for allowing me to conduct my study at the site. I am so grateful for the opportunity to work together with MACC and to share the findings and recommendations from this evaluation.

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Section 1: The Problem

Redesigned developmental math modules have replaced semester-based developmental math courses at Mid-Atlantic Community College (MACC), a pseudonym, but have not yet been evaluated. I addressed that local problem by conducting a formative and summative, concurrent mixed-methods evaluation of the effectiveness of the new math modules.

State Context of the Local Problem

The local redesign at MACC was in response to action taken at the state level. In 2011, the North Carolina Community College System (NCCCS) implemented a redesign for state-wide developmental math curricula. When the developmental math redesign began in North Carolina, a Math Redesign Task Force was appointed from nominations solicited from each of the 58 North Carolina community colleges. Under the auspices of the NCCCS Developmental Education Initiative (DEI) State Policy Team, a statewide team of math instructors streamlined and replaced the semester-based developmental math classes with a new modular curriculum comprised of eight developmental math (DMA) modules. The focus of the math redesign was on increasing student success and raising mean pass rates as suggest by Cox (2015). The semester-based class once known as Math 060: Essential Mathematics was replaced with DMA 010, DMA 020, and DMA 030. Math 070: Introductory Algebra was replaced with DMA 040 and DMA 050. Math 080: Intermediate Algebra was replaced with DMA 060, DMA 070, and DMA 080 (North Carolina Community Colleges, 2012).

National Context of the Local Problem

The action of the state was in response to a crisis in remedial education in the United States. According to the 2015 Hunt Institute Blog, six of 10 students entering community colleges must take a developmental education course (Grovenstein, 2015). Many students enter colleges and universities underprepared for college-level material (Bol, Campbell, Perez, & Yen, 2016; Luoch, 2017). Underprepared students may face academic challenges prior to their first college-level course (Melzer & Grant, 2016). This places underprepared students, both traditional and nontraditional, at a disadvantage when entering higher education institutions (Benken, Ramirez, Li, & Wetendorf, 2015). Although, the average time it takes for a student to complete a degree at a community college is 3 years, the time may be extended if college students need several developmental education courses (Kowski, 2013). As a result, colleges and universities have experienced low graduation rates and attrition (Martin, Galentino, & Townsend, 2014). To assist entering students who need remedial education courses, some community colleges had implemented accelerated developmental math courses or redesigned its developmental math curricula (Walker, 2015).

Local Problem Summary

Although the state math curriculum redesign was implemented at MACC with its focus on increasing student success and mean pass rates, the new curriculum had not been evaluated, as recommended by Zientek, Schneider, and Onwuegbuzie (2014). The director of institutional research and effectiveness desired an assessment of this new curriculum (director of research and institutional effectiveness, personal communication,

October 6, 2014). The gap in practice was that a new developmental math curriculum had been implemented but had not been evaluated. Until the redesign was evaluated, it would not be clear if it was effective in raising student mean passing grades and overall GPAs. If mean passing grades and overall GPAs rise or fall, it would be important to understand the perceptions of participants (administrators, instructors, and students) as to why this might be so. Thus, a formative and summative evaluation was required.

Rationale

The director of institutional research and effectiveness along with other administrators at MACC would like to understand if there have been any positive significant changes in developmental math education outcomes since the implementation of the redesigned math modules (From director of research and institutional effectiveness, personal communication, May 10, 2016). It would be important for the state to know whether the redesigned modules have been effective at the local level.

Evidence of the Problem at the Local Level

Although the math redesign was implemented to increase student mean pass rates and overall GPAs, there was no information about whether the mean passing grades and overall GPAs had increased or whether students and instructors perceived that the new system was working. Prior to the redesign, MACC students only needed to pass the Math 060, Math 070, Math 080, or successfully pass the math placement exam, depending on their academic discipline, in order to begin taking college-level math courses. The developmental math courses were semester-long, stand-alone, instructor-led courses which met at pre-set times and intervals. The redesigned math modules allowed students

much greater flexibility regarding attendance and pace of learning enabling students to work at their own speed to master the material at hand, while integrating the learning experience into their individual readiness.

On May 10, 2016, I scheduled a meeting with the director of institutional research and effectiveness to review archived student data concerning student mean pass rate percentages prior to the developmental math redesign. Students enrolled in developmental math courses (Math 060, Math 070, Math 080) needed to complete the sequence of courses prior to enrolling in college-level math courses. As shown in Table 1 (director of institutional research and effectiveness, personal communication, May 10, 2016), the student mean pass rate in the developmental math courses (Math 060, Math 070, Math 80) are based in a final letter grade of D or better.

Table 1

Student Enrollment and Pass Rates for Developmental Math Courses in 2012-13

	Math 060	Math 070	Math 080
Student Enrollment	93	122	37
Pass Rate	52.7%	49.5%	79.4%

Table 1 shows an increase in student enrollment in Math 070, but a decrease in the pass rate when compared with Math 060. While the pass rate goes up for Math 080, the enrollment is very low. At that same meeting, the director of research and institutional research and effectiveness and I also discussed the student mean pass rate percentages in the new math modules. Tables 2 and 3 illustrate these data.

Table 2

Enrollment Numbers and Pass Rates for Developmental Math Modules in 2013-14

	DMA 10-30	DMA 40-60	DMA 70-80
Student Enrollment	83	91	20
Pass Rate	46.4%	52.8%	82.9%

Table 2 also shows a significant decrease in student enrollment in DMA 70-80. The low student enrollment may reflect one of two things: (a) students registered early and withdrew from the modules prior to the census date, or (b) students did not need DMA 70-80 prior to taking college-level math.

Finally, the director of institutional research and effectiveness and I also examined the results of the data 2 years after the developmental math redesign. Table 3

displays the student enrollment and pass percentages since the implementation of the new math modules.

Table 3

Student Enrollment and Pass Rates for Developmental Math Modules in 2014-15

	DMA 10-30	DMA 40-60	DMA 70-80
Student Enrollment	73	39	13
Pass Rate	53.3%	44.3%	65.2%

Table 3 shows a steady decline in student enrollment in the math modules during 2014-15. DMA 40-60 shows a large decline in student enrollment. However, the low student enrollment did result in a consistently higher student mean pass rate.

Reviewing the past student data on mean pass rates and overall GPAs presented in Tables 1, 2, and 3 provided the impetus for a more detailed evaluation. Although there was a steady decline in student enrollment in the modules (2014-15), the student mean pass rates fluctuated between the DMA 10-30, DMA 40-60, and the DMA 70-80 modules.

The mean pass rate data in Table 1 (developmental math courses) is like the data in Table 3 (developmental math modules). In both Tables 1 and 3, the initial mean pass rate was approximately 53%, while in the next course/module, there was a decrease in the mean pass rate, followed by an increase in the last course/module. The archived data on the modules caused a concern with the local community college administrators (director of institutional research and effectiveness, personal communication, May 10, 2016).

Conducting a mixed-methods study would shed light on varying perceptions on the overall effectiveness and the statistical significance of changes in mean passing grades

and overall GPA and address the concerns of the director of institutional research and effectiveness (director of institutional research and effectiveness, personal communication, May 10, 2016).

Based on the conversation between the director of institutional research and effectiveness and myself, an examination of archival student data, about whether the redesign could create better outcomes, a formative and summative evaluation of the redesign was conceived (director of institutional research and effectiveness), personal communication, May 10, 2016). This evaluation at MACC is needed to address the low student mean pass rates and overall GPAs in developmental math. Students needed to complete a sequence of developmental math courses (Math 060, Math 070, and/or Math 080) prior to taking college-level math.

Evidence of the Problem from the Professional Literature

Currently high numbers of students arrive at college underprepared for college-level courses (Fong, Melguizo, & Prather, 2015; Ngo & Kwon, 2015; Wilson & Lowry, 2017). From the onset of their arrival at any institution of higher education, these underprepared students face barriers to success and are often considered to be at-risk (Quarles & Davis, 2017). Khoule, Pacht, Schwartz, and van Slyck (2015) indicated that these at-risk students are likely to withdraw from the developmental courses and more likely to drop out of college than non at-risk students. They did a study on faculty pedagogy and student outcomes in developmental courses. 40% full and 60% part-time faculty at LaGuardia Community College (LCC) participated in an online professional development project called Taking College Teaching Seriously. Half of the participants

teach developmental math and the other half teach developmental English. The purpose of their study was to review teaching practices in developmental math and English courses taught online. Khoule et al. found that the full and part-time faculty alike were interested in enhancing their pedagogy. Full and part-time faculty demonstrated an increase in their knowledge on the use of effective strategies in planning, preparation, and implementation of lessons in developmental education. Participants indicated they were glad to be a part of a study that examined ways to address and to better serve at-risk students. As a result of this study, LCC implemented the following strategies to identify at-risk students: incorporating feedback taken from faculty assessments on pedagogy practices, utilizing information given from college support staff such as math tutors, and collecting data on student retention and success and comparing to previous mean pass rates.

The study by Khoule et al. (2015) is relevant because: (a) both LCC and MACC had their developmental math and English programs redesigned, and (b) LCC's study focused on faculty pedagogy and student outcomes. I also examined the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules. Interviewing administrators, instructors, and students about the effectiveness of the new MACC math modules would shed some light on instructor pedagogy practices as examined by Khoule et al.

Summary of Rationale

MACC is like other community colleges to which many students enter academically unprepared for college-level courses (Walker, 2017; Wheeler & Bray,

2017). There are more students enrolled in developmental math classes than developmental reading or English (Parker, 2016). One theory about why students have been unsuccessful in developmental math is because of its embeddedness in a sequence of semester-long courses as suggested by Yamada and Bryk (2016). To improve the effectiveness of developmental education, college administrators are redesigning developmental education programs and trying to determine the overall effectiveness of these changes (Xu & Dadgar, 2017). In this formative and summative, concurrent mixed methods project study, I addressed the local problem at MACC and contributed the professional literature by conducting a formative and summative, concurrent mixed-methods evaluation of the effectiveness of the new redesigned math modules.

Definition of Terms

Developmental courses: Developmental courses are courses that prepare students for college-level courses (Chingos, 2016).

Nontraditional students: Nontraditional students are college students who are aged 23 and older (Blau & Thomas-Maddox, 2014).

Remedial education: Remedial educational programs are designed to assist students in reading, writing, and mathematics (Ulmer, Means, Cawthon, & Kristensen, 2016).

Traditional students: Traditional students are college students between the ages 18-24. (Rabourn, BrckaLorenz, & Shoup, 2018).

Significance of the Study

Evaluating the effectiveness of the redesigned developmental math modules will be very useful to the local educational setting. Administrators, instructors, and students will benefit from the evaluation of the developmental math program redesign. Administrators will find the study significant because they are concerned about the low mean pass rates and overall GPAs in developmental math courses. Results from this evaluation study may bring awareness to the administrators on the effectiveness of the redesign. Instructors will find the study significant because they have been teaching the developmental math courses and have a vested interest in the success of their students. Results from this study may shed light on pedagogy and learning styles in developmental math. Students may find the study significant because they want to be successful in their courses, developmental or not. Results from this study may improve students' abilities to complete their studies and graduate from college. Stakeholders will find the study significant because they want to see the college remain competitive with other colleges in terms of its course offerings, programs of study, and student retention. Community college students might find this study significant because they want students to graduate, find gainful employment, and become responsible citizens.

Research Questions and Hypotheses

The new developmental math redesign has been implemented at MACC but has not yet been evaluated. The extent to which the redesigned math modules have affected the effectiveness of the math program was the guiding research question. More specifically, five research questions, two quantitative and three qualitative, guided the

evaluation. Quantitative questions addressed student outcomes and qualitative questions addressed participant perceptions.

Quantitative Research Questions and Hypotheses

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

H_01 : There is no significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

H_A1 : There is a significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

H_02 : There is no significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

H_A2 : There is a significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

Qualitative Research Questions

RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules?

RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules?

RQ5: What are the perceptions of students regarding the effectiveness of the new math modules?

Review of the Literature

The following literature review was comprised of two subsections: Theoretical Foundation/Conceptual Framework and Review of the Broader Problem. The research for the literature review was conducted online through the Walden University Library. Resources were found in Academic Search Complete database, ProQuest Central, and the Thoreau Multi Database. Search terms used in the databases included: *developmental education, developmental math, developmental programs, academic success, student success, student readiness, remedial education, remedial programs, placement testing, attendance, retention, instructor perceptions on math, students' perceptions on math, math anxiety, and Mezirow's Theory of Transformative Learning.*

Theoretical Foundations

The Mezirow's (2003) transformative learning theory was used as the theoretical foundation for the evaluation study. Mezirow's transformative learning theory was based on the premise that individuals actively interpreted information in their current lives to construct an understanding that will guide future decisions (Voinea, 2015). It was

Voinea's (2015) interpretation of adult learning that provided a framework for this evaluation study.

Mezirow (2003) first coined the transformative learning theory when he conducted a qualitative study on 83 women who returned to college or to the workforce after a lengthy absence. Mezirow aimed to identify issues the 83 women encountered that assisted or hindered their progress of returning to college or the workforce (Calleja, 2014). He described their experiences in 10 stages: (a) a disorienting dilemma, (b) self-examination, (c) sense of alienation, (d) relating discontent to others, (e) exploring options of new behavior, (f) building confidence in new ways, (g) planning a course of action, (h) knowledge to implement plans, (i) experimenting with new ways, and (j) reintegration (as cited in Howie & Bagnall, 2015). Mezirow's transformative learning theory had been widely used in higher education institutions as a conceptual framework for adult learning (Lundgren & Powell, 2016).

The 10 major stages demonstrate how learning was transformed through prior experiences. These 10 stages provided the foundation of how adult learners made sense of new learning as they understood it and applied it to their daily life. As adult learners encountered one of the 10 major stages, their way of thinking was transformed, and they began to see things from a new perspective. Based on their prior experiences, when adult learners were interested in the course content and actively engaged in their learning, they were at the cusp of a transformation.

There had been much research on transformative learning theory since Mezirow first expounded it in 1975 (Bouchard, 2016; Hassi & Laursen, 2015). According to

Mezirow (1996), transformative learning theory was based on how adults interpreted new things based on their prior experiences. Adults relied on their prior life and work experiences to make meaning in their daily lives. It was this prior existing knowledge that students drew upon when comprehending new information. Many adult learners processed new information when they felt it was important and pertained to their learning. The transformative learning theory relates to the study and research questions because students enrolled in the new math modules would only take the modules which they needed, prior to taking a college-level math course. Students will process the new information in the modules because the modules are individualized and pertain to their academic learning. A transformation generally occurs when adult learners transform their frame of reference and see things from a new perspective (Christie, Carey, Robertson, & Grainger, 2015).

Instructional Design

Such transformations as suggested by Mezirow (2003) are manifested through learning experiences, which in turn are heavily influenced by instructional design. In Keller's (1974) plan for instructional design, he describes a variety of instructional methods for adult learners. Keller argued that instructional design had measurable impacts on student learning outcomes in colleges and universities where instructional methods were aligned to meet the needs of diverse learners. When instructional methods were student-centered with greater emphasis placed on their motivation to reach their learning goals and objectives, student achievement was higher (Pappas, 2018). Modular coursework was one such instructional method. When students enrolled in modular

courses and worked independently and learned at their own pace, they achieved greater success than students who learned in traditional settings (Cengizhan, 2018).

Review of the Broader Problem

Student and college readiness issues. Student readiness for college has been a concern for community colleges (Royster, Gross, & Hochbein, 2015; Schademan & Thompson, 2016). According to Silverberg (2016), an operational definition for the term college readiness is the stage of development when enrolled students can succeed without remediation. Camara (2013) indicated there has been an increased concern about college and career readiness due to the high enrollment in remedial courses and the low graduation rates. Royster et al. (2015) suggested that being college ready is an ongoing process that begins much earlier than the start of senior year in high school. Many students enroll in community colleges; but, few students graduate because of their lack of readiness. Many of these underprepared students lack the necessary skills needed to be successful in college (Okimoto & Heck, 2015). They were often unprepared and do not know what to expect in a college setting (Hailikari & Parpala, 2014). The majority of students enrolled in developmental courses were from diverse family backgrounds (Houser & An, 2015).

The decline in passing scores for minorities on entrance college exams has raised a national concern in remedial education (Atuahene & Russell, 2016). A 2017 American College Testing (ACT) report indicated the readiness of high school students for transition to college-level courses. ACT examined the high school benchmark scores in four subject areas (mathematics, science, reading, and English). The results for North

Carolina indicated that 16% of African-American students and 18% of Hispanic students were deemed college-ready as compared with 20% White students in mathematics. 20% of White students were deemed college-ready as compared with 16% of African-American students and 18% Hispanic students in science. The study also indicated that 21% of White students met the ACT benchmark compared to 16% of African-Americans and 17% of Hispanic students in reading. Additionally, 20% of white students met the ACT benchmark compared to 14% African-American students and 15% Hispanic students in English (ACT, 2015).

Additional student issues. While all students attending higher education institutions face numerous issues, returning and adult students, in particular, face additional issues. One of the issues that may affect adult and returning student success is their class attendance. Nontraditional students often juggle a host of competing time demands including family and job responsibilities (Acosta, North, & Avella, 2016; Jameson & Fusco, 2014). Students with fewer absences have better grades than students with many absences (Cafarella, 2014). Because maintaining good attendance is directly tied to student success in courses, some colleges and universities have implemented attendance policies to ensure students maintain regular attendance in their courses. Attendance policies set the stage for student learning, student accountability, and are directly tied to academic success (Synder & Frank, 2016). When attendance policies are in place, students are made aware of the relationship between attendance and student responsibility (Zientek, Ozel, Fong, & Griffin, 2013). When attendance policies are in place, regular attendance is maintained in most classes (Snyder, Lee-Partridge,

Jarmoszko, Petkova, & D'Onofrio, 2014). However, adult students who may face competing demands from family and work commitments may face difficulties in attending stand alone, instructor-led courses (Kosiewicz, Ngo, & Fong, 2016).

Adult and returning students, who increasingly populate community colleges, may also face issues inhibiting their success (Panacci, 2015). For example, math anxiety and self-efficacy are issues that play a major role in students' mean pass rates in developmental education (Jameson & Fusco, 2014). Students' negative perceptions of math during their former school years may affect their attitude towards developmental math in their higher education setting. Leong and Alexander (2013) conducted a study to understand how students' attitudes were connected to their comprehension of mathematics. The focus of the study was on web-based homework given in developmental courses in community colleges. The authors examined the advantages and disadvantages of web-based homework in developmental math courses. An advantage was that students received immediate feedback, which helped them gain a better understanding of math. Although the automatic scoring system provided students with immediate feedback on their homework, a major disadvantage was that the feedback provided to students was not specific. The feedback only consisted of right or wrong responses to the students. Recent researchers examined how developmental courses have created barriers to student success. Benken et al. (2015) conducted a study on first year college students enrolled in developmental math courses. The study revealed barriers students face in developmental math courses. The purpose of the study was to examine students' attitudes and perceptions toward developmental math. They found that there

were several barriers that first year college students faced when taking developmental math courses. One barrier was that students are graduating from high school and are not academically prepared for college-level courses. Although students passed math courses in high school, it did not necessarily mean they were ready for college-level math courses.

A second barrier revealed that students' attitudes and beliefs on math during their former school years have caused them to have a negative perspective on their developmental math courses. The results indicated that students' perceptions have an impact on their participation, thus causing a barrier in developmental math courses. The study by Benken et al. (2015) is relevant because of its purpose, which was to examine students' attitudes and perceptions toward developmental math. Interviewing the students on the effectiveness of the modules in my study should reveal their perceptions toward developmental math and may contribute to understanding their overall passing/failing grade.

Developmental education debates. Many discussions about the usefulness of developmental education center around whether it works or not. Discussions about developmental education have led to several interesting debates on developmental education, especially centered on developmental math and the pass/fail rates. Student enrollment in developmental math courses is higher than the enrollment in developmental reading and writing courses (Zientek, Skidmore, Saxon, & Edmonson, 2015). Although developmental math programs are available to assist students in coursework so they can enroll in college-level math courses, there are some ongoing debates on the relevance of

the programs (Clotfelter, Ladd, Muschkin, & Vigdor, 2016). Bonham and Boylan (2012) suggested while the developmental math programs are in place to provide support for students, these programs may act as barriers for student success. One reason why these programs may act as a barrier is because of the high fail and/or noncompletion rates in developmental math courses. Many of the students who place into developmental math programs are from minority backgrounds or are first generation college students.

Developmental courses which are supposed to assist adult learners may instead create barriers to at-risk students from diverse family backgrounds.

Institutional responses from MACC. One institutional response has been to take a proactive role in maximizing student success in higher education. In 2010, MACC was selected as one of the eight leader colleges by Achieving the Dream (AtD). A nationally known initiative, Achieving the Dream's focus is on increasing the success of community college students (Hagedorn, 2015; Wilson & Bower, 2016). To be considered a leader college, an institution must demonstrate a commitment to make progress on four principles: (a) committed leadership, (b) use evidence to improve programs and services, (c) broad engagement, and (d) systemic institutional improvement.

A major institutional response at MACC was to implement five strategic interventions that will address issues students may encounter during their time at the college. These interventions include: (a) ACA 115/ACA 122- Success and Study Skills course, (b) early alert system, (c) intrusive advising, (d) open house, and (e) math placement test workshops.

The ACA 115: Success and Study Skills course, which is recommended for college freshmen, emphasizes the skills needed to be successful in classes. ACA 115 gives an overview of college life, touring different offices on campus such as student services, financial aid, academic labs, and the library. The ACA 122: College Transfer course is for students planning on attending a 4-year university. This course gives information on setting goals and how to successfully transition to a 4-year college. MACC has established an early alert system to assist struggling students before it is too late. Through a grant funded by Completion by Design (CbD), MACC was able to create two new job positions for a student success coach. The goal of the student success coach is to work closely with instructors to identify students who are struggling in their academics or even in their personal life, and to provide assistance. Course instructors can refer students to the student success coach or students can go on their own to the student success coach if they have a concern or issue such as low grades due to poor time management skills. Gampert and Jones (2013) conducted a study at Hostos Community College (HCC) on student success coaches. They described a student success coach as a contact person to assist students in identifying short and long terms goals. They indicated that all entering students at HCC are assigned a student success coach to remain with them as long as they remain enrolled as a student and/or graduate from the college. Students meet with their assigned student success coaches on a regular basis to address any concerns they may have with college life. Although the student success coach does not make any overall decisions about the students' courses, class schedules, or grades, they can provide guidance and assist students in making the right decisions, which is

important for retention purposes. Although, the study was conducted at the beginning of the implementation of the student success coach, there were no outcomes to report. However, the study concluded with an indication that other initiatives such as linking student success to curriculum revision and the inclusion of high-impact practices were put into place at HCC because of the study.

MACC has also initiated intrusive advising. Once again, with the assistance of Cbd, MACC was able to implement a new proactive advising model for college advisors. Advisors will use this model as well as the new software, Student Success Plan to assist students in creating their own plan (Retrieved from <https://apereo.atlassian.net/wiki/spaces/SSP/overview>).

MACC will host two different types of open houses. One open house event will be for the general public and the second event will be for high school students. The attendees at the open house event will learn information about the admissions process, have an opportunity to meet instructors, and tour the campus.

Placement testing. At MACC, professionals use various measures to determine a student's accurate placement into courses. All entering students at MACC are required to take a math placement exam or meet the requirements to waive the placement exam. MACC uses a computerized test called Accuplacer, a nationally recognized test for placement testing in reading, writing, or math (Retrieved from <https://accuplacer.collegeboard.org/>). Students can waive the placement test by submitting to the college their Scholastic Aptitude Test/American College Testing (SAT/ACT) scores, submitting an official transcript from an accredited two or four-year

higher educational institution, or receiving credit for college level English or math class from an accredited institution. In addition, there is a North Carolina High School Graduate Multiple Measures Policy in place for recent high school graduates. After examining the need for effective placement procedures, North Carolina community college officials implemented a multiple measures policy to assist recent high school graduates with placement in their college courses (Retrieved from <https://www.nccommunitycolleges.edu/student-services/multiple-measures>). The multiple measures policy outlines specific measures to determine students' readiness for college-level courses. The hierarchy of measures examines recent high school graduates' grade point average overall (GPA) to determine their college course placement. If their overall GPA does not meet the minimum requirement, colleges will use students' ACT or SAT score. If students' scores do not meet the minimum requirement or they do not have a recent high school transcript, colleges will administer a diagnostic placement test to determine their placement in courses.

The use of the multiple measures approach by MACC follows the current literature on course placement (Barbitta & Munn, 2018). MACC counselors and advisors review multiple sources of data (high school transcripts, college transcripts, and placement test scores) to determine an accurate course placement for students. Upon entering community college, new students are required to take placement exams to determine whether they can register for developmental or college-level courses (Ngo & Melguizo, 2016). There are many entering college students that are placed into developmental courses based solely on their placement test scores (Melguizo, Kosiewicz,

Prather, & Bros, 2014). Morante (2012) indicated that placement exams alone should not be an indicator for student success in college courses. Counselors and advisors use placement test scores to determine developmental or college-level courses for the new students. However, recent research has indicated that colleges and universities should not rely on placement test scores to determine students' accurate placement of college-level courses (Saxon & Morante, 2014). Colleges should not rely on placement test scores as the only determining factor for predicting student success in developmental courses (Belfield & Crosta, 2012). The use of multiple measures can provide academic advisors and counselors with a snapshot of students' educational background. Ngo and Kwon (2015) found that when multiple measures are used for student placement, the probability of student success in developmental courses increases.

Solutions. Given the nation's crisis in developmental education, community colleges have a major role in its choice of course delivery methods. Some states have chosen to offer developmental education courses to students in the traditional format, while other states have chosen to offer developmental education via modular methods (Caferella, 2016). Along with North Carolina, other states, such as Colorado, Florida, Ohio, Texas, Tennessee, and Virginia had their developmental education programs redesigned. North Carolina has opted to offer students developmental math courses through modules (Grovenstein, 2015). The math modules have been offered to students in an accelerated track. Students must be able to demonstrate mastery of each module prior to advancing to the next module in their sequence. Ariovich and Walker (2014) conducted a quantitative study on a modular math redesign at a large, diverse community

college. Like MACC, this large, urban community college is participating in the Achieving the Dream initiative to increase student success rates. During the Fall 2012-13 semesters, students were given an option to take developmental math in a traditional format or a modular (M) format. The study indicated that 77% of students opted for developmental math using the traditional format while 23% opted for the module (M) format. The results showed that 68% of students performed better in the traditional format compared to 28% of students in the module (M) format. Students needed a grade of 'C or higher' to pass a traditional format and a 'B or higher' to pass a module (M) format.

Implications

The information gained from this project study will be used to share with college administrators, instructors, advisors, counselors, students, and other stakeholders about the developmental math program redesign. Information from the literature review and recent findings from this study, a program evaluation was created and used as a resource guide to further discussions on the new math modules and student learning outcomes and mean pass rates. The information in the program evaluation about the new developmental math modules may provide insight into the teaching and learning practices of developmental math. The results of this study will be presented in the form of an evaluation report and given to the MACC administration and other key stakeholders. The report provides administrators and other key stakeholders with timely feedback that can serve as a resource guide for other academic programs considering a program redesign.

Summary

The concern about poor student outcomes in developmental programs continues to resonate nationally. The number of students enrolled in developmental math, reading, or English courses have steadily increased. Community colleges continue to seek ways to address the high student enrollment in developmental programs. Researchers have indicated the student enrollment numbers in developmental math is higher than the student enrollment numbers in developmental reading and English making this problem even more acute for those individuals. The goal of developmental programs is to prepare students for college-level courses. Students often withdraw from developmental courses or leave the college without taking a college-level math, reading, or English course.

Colleges and universities have acknowledged the high student enrollment in developmental programs and have created strategies to foster better student outcomes. Some colleges and universities have implemented summer bridge programs to prepare high school juniors and seniors for college-level courses. Other schools have implemented an early alert warning system to provide outreach for students who may be considered at-risk. MACC had redesigned its developmental programs to increase student success in developmental courses.

Prior to the redesign at MACC, the developmental math program consisted of compressed courses that were 16 weeks long. After the program redesign, the developmental math program consisted of accelerated math modules that were 5 weeks long and have not been evaluated by the institution. Examining existing data on the developmental math courses and new math modules will determine (a) if there has been a

rise in student mean pass rates, (b) if there has been a rise in student overall GPAs, and (c) develop important themes surrounding administrator, teacher and student perceptions of the redesign. The findings of this study will be beneficial for further institutional decisions about curriculum design in developmental education.

Section 2, The Methodology, explains study methodological elements: (a) mixed methods design and approach, including the intent of mixing qualitative and quantitative data, justifying the use of the design, providing the strategy for qualitative data collection, explaining the integration of data, and justifying the use of the type of evaluation; (b) setting and sample, which defines the population, explains the sampling method, describes the eligibility criteria for selecting participants, justifies the number of participants, explains the methods of establishing researcher-participant working relationship, and presents measures for the protection of participants; (c) qualitative data collection strategies, which identifies each qualitative data collection instrument and its source, establishes the sufficiency of qualitative data collection instruments, presents the plan for the number of interview sessions, describes the data tracking systems, identifies how triangulation was built in the process, explains the procedures for gaining access to participants, and presents the role of the researcher; (d) data analysis, including a review of the quantitative and qualitative data collection process, presenting how and when the data was analyzed, describing the process of gaining access to archival data, describing the analysis within the quantitative and qualitative approaches, presenting the validity and trustworthiness of the data, and explaining the procedure for integrating data and findings; and (e) limitations, which presents the limitations of the evaluation.

Section 2: The Methodology

Research Design and Approach

I addressed the local problem at MACC by conducting a summative and formative, concurrent mixed-methods evaluation of the effectiveness of the redesigned developmental math modules. Chyung (2015) stated, “Evaluation is one of the critical steps in the process of performance improvement” (p. 94). The purpose of this program evaluation study was to conduct a comprehensive examination of the new developmental math modules and to use that information to assist program administrators in future decision making. Lodico, Spaulding, and Voegtle (2010) indicated, “Program evaluation examines programs to determine their worth and to make recommendations for refinement and success” (p. 363). The goal of the program evaluation was to determine the effectiveness of the new math modules. A mixed-methods design was appropriate for this study because it provided answers to the research questions from different perspectives.

This summative and formative program evaluation was based on examining quantitative measures and qualitative perceptions of the semester based developmental math program when compared to the redesigned developmental math program. A mixed methods approach was used for this program evaluation (Venkatesh, Brown, & Sullivan, 2016). The intent of collecting both quantitative and qualitative data was to gather information from different sources to better understand the research questions. The use of this design and approach was appropriate because it yielded a greater breadth of perspectives on the problem. Archival quantitative data on overall GPAs and mean pass

rates were used to determine if there was a statistically significant difference after the implementation of the new math modules. The qualitative component focused on the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules.

Quantitative Design

Quantitative research studies are based on numerical data (Abbott & McKinney, 2013). Quantitative studies are based on a large amount of data which encompass either an entire population or a large random sample drawn from that population. When using archival data, inferential statistical tests such as the t test, can be used to make statistically warranted inferences about the data. The findings from statistical tests can be used to address the research hypotheses and draw inferences from the data (Kaufman, 2014). This kind of ex post facto nonexperimental approach was more appropriate to the sources of data than an experimental approach, which would also generate a series of ethical problems for the researcher (Radhakrishnan, 2013). It would be impossible and morally wrong, for example, for any researcher to manipulate human subjects by randomly putting them into alternate developmental math programs in order to test the effectiveness of each program (Camille, Nian-Lin, & Ban Leong, 2016).

A quantitative approach alone would not be appropriate for this type of study because I was seeking additional information such as the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules. Interviewing the stakeholders allowed the flexibility I needed to pursue a deep understanding of how each group perceived changes from to. These additional data

enhanced my understanding of the how and why curricular revisions were either improving student mean passing grades and overall GPAs, or not.

Qualitative Design

Qualitative research studies are based on the perceptions, observations, and/or experiences of the participants (Bender, 2016). Qualitative research studies have smaller sample sizes which are usually purposefully sampled. Data are often collected through structured or semistructured interviews. I used a qualitative approach to gain a better understanding about how individuals feel and think about a particular topic (Taylor, Bogdan, & DeVault, 2015). Because my college granted me access to interview the individuals involved, this approach made more sense than a more embedded phenomenological approach (McCoy, 2014). Using qualitative data alone would not have been appropriate for my project study because while I am interested in the participants' perceptions, I wanted to use these perceptions to deepen my understanding of the quantitative data.

This study provided both summative and formative evaluation data. A summative evaluation measures whether benchmarks, goals, and/or objectives have been met (Amua-Sekyi, 2016). A summative evaluation can help to determine the overall effectiveness in the new math modules (Kibble, 2017). The quantitative information gained in this study was used to ascertain if the new math modules had improved the student outcomes in developmental math. The summative evaluation approach was appropriate here because the findings indicated the new modules were not more effective than the old courses and offered insight on the results based on the perceptions of

administrators, instructors, and students regarding the effectiveness of the new math modules.

This comprehensive evaluation also provided a formative aspect. A formative evaluation method reports changes and provides feedback to stakeholders while the program is in progress (Peterson, 2016). Data were collected, analyzed, and the results will be reported in a timely manner back to the stakeholders. Data collection tools included archival data (quantitative) and researcher-produced questions (qualitative). Data were presented in tables in the project study, evaluation report, and appendices. The data gathered in this research might be used to improve the developmental math redesign.

Setting and Sample

This study was conducted at MACC. MACC is a small, rural community college located in northeastern North Carolina. In 1967, the North Carolina General Assembly originally authorized MACC as Mid-Atlantic Technical Institute. Once funding was secured, the new buildings, classrooms, and learning centers were constructed on a 65-acre lot, located west of Williamston, in Martin County, NC. In 1975, the General Assembly granted Mid-Atlantic Technical with community college status. MACC is 1 of 58 community colleges located in North Carolina. MACC, accredited by the Southern Association of Colleges and Schools (SACS), is a multicampus institution with the largest campus located in Williamston, NC. A second satellite campus, MACC 2 has programs for adult basic skills, adult high school education, and occupational and technical programming. A third satellite campus, MACC 3 has programs for adult basic skills and adult high school education. In 1984, an equine program was added to the

Williamston campus. MACC is the only community college in NC with an equine program. Students come from across the country to participate in the equine program. MACC offers programs in continuing education, general education, and vocational education. Students can enroll in an associate degree, diploma, or certificate program of study.

Quantitative Population

For the quantitative phase of this study, the Office of Institutional Research and Effectiveness provided archival data. I had access to the archival data, because this office was interested in the results of this evaluation. I examined and compared mean passing grades and overall GPAs for all students who enrolled in developmental math courses during the spring, summer, and fall semester (2012-13) and after the redesign during the spring, summer, and fall semester (2013-2015). All data were used in aggregate. I used data from the entire population ($N = 827$) of students who met the parameters of the quantitative aspect of this study.

Qualitative Sample

For the concurrent qualitative phase, I enlisted the aid of the registrar of the college who used purposeful sampling to select the participants along with e-mail addresses and college telephone extensions where possible. Purposeful sampling was appropriately used because of the need to select the administrators, instructors, and students who had experience with the developmental math program (Palinkas et al., 2015). There were five participants from each of the following groups of people (administrators, instructors, and students) who comprised a pool of eligible interviewees.

The pool represented an expert heterogeneous purposeful sample (Trochim, 2006). Eligibility criteria used for selecting the participants included administrators who had preliminary knowledge of the implementation of the new math redesign, math instructors who had taught developmental math courses and/or the new math modules and students who had been enrolled in the new math modules but who were not also a student in my department.

Though a total of 15 names were selected for the sample, five in each group, I randomly chose three from each subgroup and used the other two as back-ups, in case any individual chose not to participate. If I ran out of back-ups, I was going to ask the registrar for more names. A total of nine in-depth interviews allowed me to explore common themes that emerged through the interview process. Because I had ample time in the interviews to explore any questions in greater depth, I anticipated that nine would be enough interviewees (Marshall, Cardon, Poddar, & Fontenot, n.d.).

Ethical Safeguards

Quantitative. All data files were kept in a password protected file on my personal computer. My personal laptop computer was kept in a locked filing cabinet in my office. No personal identifiers of any sort were used in the quantitative data analysis, and all data were analyzed in aggregate.

Qualitative. All participants were at least 18 years of age. Written informed consent (Appendix E) was obtained prior to anyone participating in the qualitative part of the study. I had contacted the eligible participants by e-mail or by college extension and invited them to participate in the study. Both e-mail addresses and college extensions

were publicly published on the campus web pages. The e-mail and/or phone call provided the participants with additional information on the purpose, procedures, significance of the study, and the overall goal for conducting the study. A section on confidentiality was included in the e-mail and phone call, as was a statement indicating participation was voluntary. I assured participants that any information shared with me will remain confidential. Confidentiality of the qualitative data was protected since there were no identifiers, such as name, address, on the face sheets of reflective logs and interview protocols. There were no incentives for participating, no retaliation for not participating, and no known harm was done to the participants in the study. Participants could withdraw from the study at any time without any penalties or retaliation. I also stated to the participants that their participation in this study could lead to recommendations for teaching and learning practices in the new math modules. Additional measures were taken to ensure confidentiality including maintenance of data in a locked storage cabinet which required a unique-password protected identifier known only to the researcher.

Data Collection Strategies

Once I received approval from all committee members, I began the process of gaining access to the research participants. The IRB approval number is 08-10-17-0440965.

Quantitative Data

Quantitative data access. Archival student data collected by the director of institutional effectiveness was used for quantitative analysis. The director maintains all grades and overall GPAs for all academic programs. When the director collected and

stored the grades and overall GPAs, there were no identifying student information in the data file. Therefore, the data that was given to me from the director contained no identifying information about the students.

Quantitative data measures. The dependent variables for this study were mean passing grades and overall GPAs. For the semester-based classes, the mean passing grade was a “D” or better. For the modular classes a grade of “P” was given as a passing grade. Both are continuous variables. Both variables were recoded where “1” signified passing and “0” signified failing.

Independent grouping variable. The independent variables here were whether the student took developmental math as semester-based classes or as a set of modular classes.

Quantitative data validity and reliability. The validity and reliability of this data was provided by the director of institutional effectiveness.

Quantitative data availability. I explained the parameters for the data to the director. The parameters were to generate a de-identified listing of students in developmental math courses and modules and create an excel data file. The listing included students enrolled in developmental math courses before (2012-13) and after the (2013-15) redesign. The director of institutional effectiveness gave me permission to use the archival data. Once the listing was generated, the director forwarded the listing to my personal email. The data file received from the office was imported into the Statistical Package for the Social Sciences (SPSS) for analysis (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.).

Qualitative Data

A list of students enrolled in developmental math was generated by the college registrar. The registrar has access to all student information including college majors, programs of study, and academic advisors. The registrar ensured the students on the listing were not in my program.

Participant access. I met with the college registrar to explain the criteria for eligible participants for the study. I asked for a list of five administrators, five instructors, and five students who met the eligibility requirements and created a pool of participants. I made initial contacts with three individuals from each group over email or campus phone extension. In the event an individual could not or did not want to participate, I returned to the pool for an alternate participant.

Interview protocol. I created an interview protocol (Appendix D) because the research questions were specific to my institution (Castillo-Montoya, 2016). The interview protocol was used during the interviews to elicit in-depth responses from participants by allowing me to probe for in-depth responses. These in-depth responses assured that I would have sufficient data for my research questions. The use of the protocol ensured the interviews were conducted in a consistent, professional manner. Interview protocols were used during the study.

Rapport-building. My relationship with the participants included building a rapport so trust and credibility were established. I began by building a rapport with the participants by using active listening skills. Active listening demonstrated to them that I was interested in listening to their experiences in developmental math. I also created a

sense of mutual respect with the participants. I informed them that I was conducting this interview to learn from them. I wanted to learn more about their perceptions of and experiences with the redesigned developmental math program.

Location and duration. The semistructured individual interviews were audio-recorded with the participant's permission and were later transcribed by the researcher. Each participant was scheduled for one interview session, that lasted between 30 minutes to 1 hour. I had access to the Library Resource Center (LRC), which is a quiet isolated room inside the community college's library. The LRC was a private spaced used for board meetings, committee meetings, or job interviews. Once the days and times were confirmed with the participants, the interviews took place in the LRC. I reserved the days and times with the librarian so there be no interruptions during the interviews.

Recording and transcribing. The semistructured interviews were audio recorded with permission granted by each participant. Reflective notes were written during the interviews and documented on the right side of the page. Peer debriefing was used to ensure there was no researcher bias included in the study. After each interview was completed, I the immediately transcribed the audio. Member checking helped to ensure the accuracy and trustworthiness of each transcript (Birt, Scott, Cavers, Campbell, & Walker, 2016). All data were analyzed after they were collected. The researcher read the transcript and reflective notes and highlighted things that stood out during the interview. I repeated the entire process with the second participant. After the second participant approved the transcript, I reviewed both transcripts using the process of inductive reasoning to draw inferences about underlying patterns (McAbee, Landis, & Burke,

2017). The first and second transcripts and reflective notes were compared. Multiple readings of the data had shed light on emerging concerns and observations. Recurring concerns and observations were color-coded and placed into categories, from which they would finally be analyzed for themes. Concurrent triangulation strengthened the validity of the research data and findings. Common color-coded concerns and observations were saved as an Excel spreadsheet in a password protected file on my personal computer. This process helped with the categorization of the data (Chowdbury, 2015). This entire interview process was repeated for every participant.

Data Analysis

The purpose of the program evaluation was to determine the effectiveness of the new developmental math modules. Concurrent triangulation was used to integrate the qualitative and quantitative findings in this mixed-methods study. Concurrent triangulation was the best approach for comparing qualitative and quantitative data. Renz, Carrington, and Badger (2018) indicated that researchers use a triangulation method to compare and contrast the findings. A mixed-methods strategy was appropriate for this study to increase the validity and interpret the findings. Turner, Cardinal, and Burton (2017) often referred to the term linking when mixed strategies are used within a triangulation framework. A summative evaluation method was used to determine the overall effectiveness of the new math modules. The summative approach was appropriate for this study because it will be a cumulative assessment of the redesigned developmental math program. According to Kibble (2017), summative approaches are beneficial for assessing student learning, program improvements, and teaching effectiveness. At the end

of the study, an evaluation report of data will be shared with administrators, instructors, students, and stakeholders. The findings presented in that report will indicate whether the new developmental math modules are more effective than the former developmental math courses.

The results from this mixed-methods study also offered formative recommendations to the administrators, instructors, and stakeholders for improved teaching and learning practices in developmental math. Recommendations were included in the evaluation report located in Appendix A. Results from this study could be an impetus for other academic programs interested in a program redesign. Results from this study could also be used to increase the effectiveness in teaching and learning strategies in developmental math. The extent to which the redesigned math modules had improved the effectiveness of the math program in terms of student outcomes (quantitative) and participant perceptions (qualitative) is the guiding research question. Data were collected and analyzed to address the research questions.

Quantitative Data Analysis

There were two research questions for the quantitative part of this concurrent mixed methods with corresponding hypotheses:

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

H_01 : There is no significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses. This is the null hypothesis.

H_A1 : There is a significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

H_02 : There is no significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

H_A2 : There is a significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

Quantitative data were collected from archival data provided by the Office of Institutional Research and Effectiveness. Only I had access to de-identified student data. The archival data were used to compare student mean passing grades and overall GPAs for all students enrolled in developmental math courses before (2012-13) and after the (2013-15) redesign. Quantitative data were analyzed using the SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.).

The *t* test was an appropriate test because I wanted to know if there was a statistically significant difference between the means for student mean passing grades and overall GPAs for those students in semester-based classes versus those working independently with the redesigned math modules.

Qualitative Data Analysis

There were three research questions for the qualitative part of this concurrent mixed methods study.

RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules?

RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules?

RQ5: What are the perceptions of students regarding the effectiveness of the new math modules?

This study had one purpose which was to examine the effectiveness of the new developmental math modules, both quantitatively and qualitatively. To that end I also examined the following three things: (a) the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules, (b) the comparison of student passing grades in the developmental math courses during 2012-13 to student passing grades in the redesigned math modules in 2013-14 and 2014-15 to see if there has been a significant rise in the overall student mean passing grades using the new math modules, and (c) the comparison of overall GPAs in developmental math courses during

2012-13 to students in the redesigned math modules in 2013-14 and 2014-15 to see if there has been a significant rise in the student overall GPAs using the new math modules.

Qualitative data were collected from the semistructured interviews. The purpose of the semistructured interviews was to understand the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules. One-on-one interviews was selected because I wanted the participants to be straightforward and candid about their perceptions without the concern of retaliation from their peers.

The college registrar used purposeful sampling to select 15 names for the participants. Five participants from each of the following groups of people (administrators, instructors, and students) comprised a pool of eligible interviewees. I used random sampling to choose three from each group and use the other two as back-ups, in case an individual chooses not to participate. Initial contact to the eligible interviewees was made through e-mail and telephone contacts. Invitations to the interviews were emailed to the individuals. Once I received a reply to the invitation to interview, I called the person to set up a day and time to discuss the informed consent procedures. I followed the same format with each reply to the invitation to interview until I reached the target sample number.

A total of nine semistructured interviews were conducted in the LRC, a quiet, isolated room inside the community college's library. Qualitative data were collected over the 11-week period and at the same time as quantitative data were collected. Probes were used during the interviews to receive in-depth responses to the questions. Each participant was asked five open-ended questions. The half hour interviews were audio-

recorded and later transcribed by the researcher. Reflective notes were recorded to document insights that may shed light during interview transcription. Common themes were color coded, placed into categories, and saved on an excel spreadsheet. The following categories were created on an excel spreadsheet: (a) Student ID#, (b) Student GPA, (c) Pass/Repeat in Developmental Math Modules, and (d) Total # of Semesters.

A research log was used to record interactions on a given day. Member checking was used to ensure the accuracy of the interview transcript. Peer debriefing was used to ensure there was no researcher bias documented in the study. Trustworthiness was embedded throughout qualitative data collection using member checking and peer debriefing to guard against researcher bias (Shenton, 2004). I conducted peer debriefings throughout various stages in the qualitative data collection process. A cohort of Walden graduate students served on my committee for peer briefing. According to Collins, Onwuegbuzie, Johnson, and Frels (2013), peer debriefing is one strategy researchers use to increase authenticity during data analysis. Important feedback was shared from the peer debriefing committee members. The feedback was necessary because it provided me with additional clarity during the data analysis process.

An interview protocol (Appendix D) was used to elicit in-depth responses for every question. After each interview was completed, the audio was immediately transcribed by the researcher. Qualitative data were immediately analyzed after collection for recurring concerns and observations. During data analysis, reflective notes were used on common items that stood out. These were color coded and then categorized according

to their similarities. As similar categories emerged, data were placed into overarching themes.

Synthesis of Quantitative and Qualitative Data

These two phases of the research occurred at the same time. The integration of the approaches occurred during the analysis and interpretation stage of the study. After the interviews with the administrators, I transcribed audio transcripts. Member checking was used to ensure accuracy and trustworthiness of each transcript. Common concerns and observations were color coded, placed into categories, and analyzed for themes. Data were saved in a password protected file on the researcher's personal computer. The steps in the data analysis process were repeated for the interviews with instructors and students. Quantitative data were analyzed using the SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.). Concurrent triangulation was the procedure used to integrate the qualitative and quantitative findings in the study (Vaughn & Turner, 2016). Triangulation helped to strengthen the validity of data and research findings (Turner, Cardinal, & Burton, 2017). Qualitative data came from the semi-structured interviews. Quantitative and qualitative data collection occurred simultaneously and independent from one another. Quantitative data were analyzed during and immediately following receipt of the data. The quantitative and qualitative data were collected and analyzed concurrently to compare the findings.

The results of the quantitative analysis were compared to the emerging themes from administrators, instructors and students. Areas where the emerging themes were both consistent and incongruent with the quantitative results were noted and recorded. I

then revisited the member-checked qualitative transcripts again, as I interpreted the meaning of both these consistencies and incongruities.

Role of the Researcher

I began my employment as lead instructor for the early childhood program at MACC in 2010. Currently, I am the program advisor and lead instructor for the early childhood program. My undergraduate and graduate work has been in the field of early childhood and elementary education. I do not have any math teaching responsibilities in developmental math. Although, I do have a professional working relationship with some of the administrators, instructors, and students, any biases I may have had concerning the outcomes of the data analysis were held in check by my professional standards with regard to data analysis and my desire to have accurate information with which to improve the educational experience of the students at MACC.

Limitations

There are two limitations to this study. First, since this research was conducted at a small, rural community college in the mid-Atlantic United States, there exists a limited diversity among the research participants. Second, because this research was conducted at a single college, the results may not be generalizable to larger colleges and universities.

Data Analysis Results

Results from both the quantitative and qualitative aspects of this study are presented below. The guiding research question is the extent to which the redesigned math modules have improved the effectiveness of the math program in terms of student outcomes (quantitative) and participant perceptions (qualitative). The

quantitative part of the study addressed Research Questions 1 and 2, and the qualitative part of the study addressed Research Questions 3, 4, and 5.

Quantitative Findings

The quantitative data were provided by the director of institutional research and effectiveness. The research study used the SPSS for data analysis (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.) Analysis of the quantitative data utilized an inferential statistical approach relying on a two-tailed independent samples t test. The independent samples t test was appropriate for this data analysis because both dependent variables (mean passing grades and overall GPAs) were expressed as ratio data and could be aggregated as means. Statistical significance was established, a priori, at the $p < .05$ level. The independent samples t test determines if the means between groups are statistically significantly different from one another. The parameters of a two-samples t test assume that “1. There is one continuous dependent variable and one categorical independent variable (with two levels); 2. The two samples are independent [and] 3. The two samples follow normal distributions” (Retrieved from http://www.stat.purdue.edu/~tqin/system101/method/method_two_t_sas.htm).

The data set included a total population of $N = 827$ students who took developmental math semester classes or redesigned modules from 2012 through 2015 and received a grade. A total of $N = 199$ of those students took semester length developmental math classes and received a grade, and a total of $N = 628$ students took

the redesigned developmental math modules and received a grade. An initial examination of the mean pass rates yielded the information included in Table 4.

Table 4

Percentage of Passing and Failing Grades for Both Semester Classes and Redesigned Modules

		Type of Instruction		
		Semester classes	Redesigned modules	Total
Final grade	Fail	35.2%	45.5%	43.0%
	Pass	64.8%	54.5%	57.0%
Total		100%	100%	100%

While mean pass rates for both types were greater than 50%, the mean pass rates for the semester classes were higher than for the redesigned modules for students who received grades. This leads to an examination of RQ1.

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

H_0 1: There will be no significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses. This is the null hypothesis.

H_A 1: There will be a significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

Inspection of Q-Q Plots revealed that passing grades were normally distributed for both groups and that there was homogeneity of variance as assessed by Levene's Test for Equality of Variances. An independent t test was performed on the data with a 95% confidence interval (CI) for the mean difference. It was found that the mean passing grade for semester classes ($M = .65$, $SD = .469$) was significantly higher than for those taking the redesigned modules ($M = .54$, $SD = .498$), $t(345) = 2.635$, $p = 0.005$, with a mean difference of 0.104, 95% CI [0.025, 0.182]. I rejected the null hypothesis of no difference and accepted the alternative hypothesis. Table 4 indicates that the difference reflected that students in semester-based classes passed them at a higher rate than the redesigned modular classes.

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

H_02 : There is no significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

H_A2 : There is a significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

Inspection of Q-Q Plots revealed that overall GPAs were normally distributed for both groups but that there was not a homogeneity of variance as assessed by Levene's Test for Equality of Variances. An independent samples t test was run on the data with a

95% confidence interval (CI) for the mean difference. It was found that the mean overall GPA for semester classes ($M = 2.16$, $SD = 1.08$) was not significantly different from those taking the semester class than for those taking the redesigned modules ($M = 2.05$, $SD = 1.04$) $t(950) = 1.481$, ($p = 0.069$) with a mean difference of 0.117, 95% CI, [-0.038, 0.272]. I retained the null hypothesis of no difference for overall GPAs. No statistically significant difference was noted between overall GPAs.

Analysis of the quantitative data revealed that mean pass rates for the semester-based classes were higher than for the redesigned modules at a statistically significant level. There was no statistically significant difference in overall GPAs of those who took the redesigned modules from those who took semester classes, though notable is the .06 alpha value which is very close to the .05 probability level of rejection. If the standard for rejection were set less stringently, say at .10, the null hypothesis of no difference would have been rejected. This might also have been the case if the hypothesis was stated differently, and a one-tailed t test had been used. In this scenario, the mean overall GPA for students taking the semester-based classes would likely be significantly higher than for students taking the redesigned modular classes.

The analysis of the quantitative data indicated that the redesigned developmental math modules were not as effective as the semester-based developmental math courses as measured by a comparison of mean passing grades and overall GPAs.

Qualitative Findings

The following three research questions were used in the semi-structured interviews:

RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules? Qualitative data came from semi-structured interviews of administrators. Data was analyzed for thematic patterns. The results indicated that the perceptions of administrators were favorable regarding the effectiveness of the redesign.

RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules? Qualitative data came from semi-structured interviews of administrators. Data was analyzed for thematic patterns. The results indicated that the perceptions of instructors were less than favorable than that of the administrators.

RQ5: What are the perceptions of students regarding the effectiveness of the new math modules? Qualitative data came from semi-structured interviews of administrators. Data was analyzed for thematic patterns. The results indicated that the perceptions of students were less than favorable than that of the administrators.

Themes From RQ3

Importance of the developmental math redesign. All three administrators agreed that implementing a redesign in the developmental math program would be in the best interest of students. Administrator 1 stated, “Our college has low student enrollment and high student retention, especially in our developmental classes. A redesign in the developmental math and reading programs is not something that should take place, it is something that must take place.” Administrator 2 indicated that “Other colleges across

the state has been successful in the developmental math redesign and we need to get on board and follow suit.” Administrator 3 stated “A developmental math redesign is exactly what this school needs right now to address the low student mean pass rates in its developmental courses.”

Implementation of the modules. All three administrators wanted an effective and smooth transition from courses to modules, so instructors and students could get acclimated to the redesign. There were some concerns on the rollout of the accelerated math modules. One of the main concerns for Administrator #1 was whether or not the timing on the rollout was still on schedule.

Themes From RQ4

Importance of self-paced learning. All three instructors felt the self-paced modules provided students an opportunity to self-reflect on their work and track their progress. Instructor 1 indicated that “Students can study and focus on one module at a time and then take the test instead of studying several chapters and taking the test.” Instructor 3 stated “Having the modules in a self-paced format allows the students to focus on areas they feel they are weak in.” Instructors agreed with some of the seminal literature here. Deshler and Fuller (2016) indicated that teachers set the pace for learning in face-to-face classes while students learn the materials at their own speed. Because of that, students in self-paced classes can study and complete work at their own pace without the pressure of remaining on task with the rest of the class (Weng, 2015). Instructors 1 and 3 felt the self-paced modules were a strength in the redesign.

Importance of modes of delivery. All three instructors felt that putting the developmental math courses online were not conducive to student success and achievement. Instructor 3 indicated, “Online instruction is not for everyone, especially with at-risk students taking developmental math coursework. Some students may prefer to take developmental math courses in a traditional, face-to-face format.” This is an important finding because the delivery of math instruction to college students is critical in student success and student retention. Chekour (2017) suggested that colleges and universities should provide a variety of delivery methods in its developmental math courses to meet the needs of its diverse learners. Kosiewicz, Ngo, and Fong (2016) explained that reviewing how colleges deliver developmental courses to its students is essential to increasing student success.

Themes From RQ5

Effectiveness of the new math modules. All three students preferred having the developmental math modules offered in a traditional, face-to-face format instead of an online format. They felt their chances of succeeding would increase had the modules been taught in a regular classroom setting. Student 1 indicated that teaching style is important and being in the classroom helps me a great deal because I am a visual learner.” Student 2 discussed the anxieties of being in an online class and stated, “All of my other courses are in class and that makes me concerned about my online class.” Student 3 stated, “I like being able to work in pairs or groups because it helps me a great deal when learning about and solving math problems.” This finding is important because colleges and universities need to provide professional developmental (PD) opportunities

to its developmental math instructors. Severs (2017) stressed the importance of attending PD workshops and incorporating best practices in developmental math to increase student success.

Discussion of all Qualitative Findings

All three administrators agreed that the developmental math modules were a step in the right direction. Based on the prior student mean pass rates in the developmental math courses, all three administrators felt a redesign would be necessary to help improve the student success rates. All three instructors revealed that they felt they should have received some type of professional development training prior to the implementation of the developmental math redesign. Based on the prior face-to-face, traditional delivery for the developmental math courses, all three instructors felt the modules should have also been offered in the same format. All instructors felt that the online modules were not fair to the students taking the modules and the instructors teaching the modules. All three students argued that the developmental math classes should have been offered in a face-to-face format. In the end, positive perceptions of the redesign were not consistent across all three constituencies. Although there was considerable in-group convergence of perceptions, there was little convergence between the three groups of people.

The qualitative results indicated that although the perceptions of administrators were favorable regarding the effectiveness of the redesign, the perceptions of the instructors and students were less favorable. The findings for instructors suggested that they were less favorable because they wanted a professional development training prior to the implementation of the new modules. The findings for students were less favorable

because they preferred having the modules in a traditional, face-to-face setting rather than online. The students preferred to be in a classroom, so they could ask questions and work in small groups. Synthesizing the qualitative with the quantitative insights, the students and instructors who were directly involved in the learning process show a more negative but potentially more realistic perception than the administrators who were far removed from the learning process.

Section 3: The Project

Introduction

The new developmental math redesign has been implemented at MACC but has not yet been evaluated. The extent to which the redesigned math modules have improved the effectiveness of the math program was the guiding question. More specially, five research questions, two quantitative and three qualitative, guided the evaluation.

- RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?
- RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?
- RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules?
- RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules?
- RQ5: What are the perceptions of students regarding the effectiveness of the new math modules?

I used a mixed-methods research design to conduct a program evaluation at MACC. The purpose of the program evaluation was to evaluate the redesigned developmental math curriculum. The study had three main areas of focus: (a) to compare student passing grades in developmental math courses during 2012-13 to student mean

pass rates in the redesigned math modules 2013-14 and 2014-15 to see if there had been a significant change in the mean pass rates for students in the modules; (b) to compare overall GPAs in developmental math courses during 2012-13 to students in the redesigned math modules in 2013-14 and 2014-15 to see if there had been a significant difference in overall GPAs for students in the modules; and (c) to examine the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules. The quantitative and qualitative findings along with several recommendations were included in the evaluation report presented in Appendix A. The purpose of the evaluation report is to inform the administrators, instructors, students, and other stakeholders about the results of the evaluation and to present recommendations related to the redesigned developmental math program.

I conducted semistructured interviews with a sample of administrators, instructors, and students to understand their perceptions regarding the effectiveness of the new math modules. I used a detailed interview protocol to inform the participants of the study and to elicit in-depth responses to the qualitative research questions. Each interview session lasted approximately 30 minutes to 1 hour. Qualitative data were immediately analyzed after each session to check for emerging themes. Quantitative data were immediately analyzed after qualitative data collection for concurrent triangulation purposes. An independent samples *t* test was conducted to determine if the means (passing grades and overall GPAs) between the groups were statistically different from one another.

Rationale

There is a national concern about the developmental education programs as they currently exist and function in higher education. Several individual states including Colorado, Florida, Ohio, Texas, Tennessee, Virginia, and North Carolina have taken proactive measures to address these concerns about developmental education. North Carolina's community colleges redesigned their developmental education programs in 2011 (Bishop, Martirosyan, Saxon, & Lane, 2017). MACC had implemented a program redesign for its developmental math program. Prior to the redesign, the developmental math program had three semester-long courses. Since the redesign, the developmental math program now has eight individualized modules. The effectiveness of the new developmental math modules had not been evaluated. It is important for MACC's administrators, instructors, students, and stakeholders to know if the new developmental math modules were effective or not. Recommendations were included in Appendix A to increase and/or maintain the effectiveness of the new modules.

This project genre was chosen because the school administration and other key stakeholders at MACC are interested in seeking an effective instructional design for student success and student mean pass rates in its developmental education programs. In particular, they wanted an evaluation of effectiveness of the developmental math program after the implementation of the modular redesign. The evaluation report located in Appendix A will be shared with administrators, instructors, students, and other key stakeholders to assist the community college in making informed decisions regarding the new developmental math redesign.

Review of the Literature

The research for the literature review was conducted online through the Walden University Library. Resources were found in Academic Search Complete database, Education Research Starters, Education Source, ERIC, and ProQuest Central. The search terms included *evaluation reports*, *mixed-methods research*, *program redesign*, *program evaluations*, *summative*, and *formative assessments*.

Program Evaluations

Program evaluations confirm the effectiveness of the program to the administrators, instructors, students, and stakeholders. Before a program evaluation can occur, there needs to be some prior knowledge about the program, its mission statement, and the student learning goals and outcomes (Franklin & Blankenberger, 2016). Once program evaluations are conducted, they can show where improvement is needed in the program (Goldwasser, Martin, & Harris, 2017). Ongoing program evaluations demonstrate the need for program effectiveness to institutions and legislators (Greci, 2016). MACC had its new developmental math program evaluated. Results from the program evaluation can assist the administrators in changes that will address student mean pass rates and retention.

Summative evaluations. Summative evaluations measure whether benchmarks, goals, and/or objectives have been met (Amua-Sekyi, 2016). A summative evaluation can help to determine the overall effectiveness in the new math modules (Kibble, 2017).

Formative Evaluations. According to Phillips (2018), formative evaluations can assist program developers in making decisions on program improvements. Program

developers can determine what works, what does not work, or what needs to be improved with the use of formative evaluations.

Evaluation Reports

Evaluation reports can help colleges to determine the effectiveness of the programs, reach their goals and objectives, and make decisions for improvements (de Freitas, 2016). Evaluation reports can also establish best practices for teaching and learning strategies (Rathbun, Leatherman, & Jensen, 2017). I provided an evaluation report, included in Appendix A, to recommend best practices for teaching and learning in the redesigned math modules. Evaluation report standards are suggested by the United Nations Evaluation Group, (Retrieved from <http://www.unevaluation.org/document/detail/607>). The United Nations Evaluation Group provides a checklist to serve as a resource guide for researchers writing an evaluation report. The checklist includes the following eight headings: (a) the evaluation report, (b) object of evaluation, (c) evaluation purpose, objective(s) and scope, (d) evaluation methodology, (e) findings, (f) conclusions, (g) recommendations, and (h) gender and human rights. Each heading has a set of indicators to ensure the quality of the evaluation report. A different resource on evaluation standards is a workbook created by the Centers for Disease Control and Prevention office (Retrieved from https://www.cdc.gov/eval/materials/developing-an-effective-evaluation-report_tag508.pdf). The workbook offers guidance to programs going through an evaluation. The workbook includes a six-step process when conducting an evaluation. The workbook includes the following steps: (a) engage stakeholders, (b) describe the

program, (c) focus the evaluation design, (d) gather credible evidence, (e) justify conclusions, and (f) ensure use and share lessons learned. The steps are not linear, therefore, programs going through an evaluation can go back and forth between the steps. The process of going back and forth between the steps can ensure the consistency of the evaluation report.

Examples of Evaluations

Natkin and Kolbe (2016) conducted a mixed-methods study at the University of Vermont (UVM). The focus of the study was on the effectiveness of the sustainability faculty fellows (SFF) program. Faculty learning committees from cross-disciplinary programs were formed at UVM to discuss pedagogical content to increase their knowledge on various subject matter. Semistructured interviews with faculty were conducted and online surveys were administered to understand their knowledge on sustainability issues. The evaluation report indicated that participation in the SFF program encouraged instructor's educational strategies on curriculum and instruction and maintained their interest in sustainable education. In a similar study, Wheeler and Bray (2017) studied the effectiveness of a developmental math evaluation at a 2-year institution. The study consisted of two groups of students that needed developmental math education. One group of students were placed in developmental math and the other group of students were exempt from developmental math. The purpose of the study was to examine correlations between developmental math and student performance and to examine the relationship of developmental courses with graduation rates. The results indicated that the students taking the developmental math classes were just as successful

as the students that were exempt from taking developmental classes, thereby increasing the likelihood of college completion.

Mixed Methods Evaluations

Mixed-methods research is the combination of qualitative and quantitative research. Researchers have used mixed methods designs as a strategy to address the research problem. Schoonenboom (2018) described mixed methods as a methodology using different research components coming together in one study. Ivankova and Wingo (2018) suggested the integration of mixed methods provides additional opportunities to learn about the research problem. Mixed-methods designs add breadth and depth to a study where a qualitative or quantitative design alone will not suffice (McKim, 2017; Venkatesh et al., 2016). Mixed-methods designs employ the use of qualitative and quantitative data to make inferences and draw conclusions about the research study. There are four different types of mixed methods redesign designs including the triangulation design, the embedded design, the explanatory design, and the exploratory design (Almalki, 2016). For the purposes of this program evaluation, the best possible choice was a concurrent triangulation design because it increases the validity, therefore making the interpretation of the research findings more useful.

For example, Landers and Reinholz (2015) conducted a mixed methods study with community college students enrolled in a developmental intermediate algebra course. Landers and Reinholz compared college students' who participated in a homework reflection activity to college students' who did not participate in the homework reflection activity. Both groups met twice per week and were given the same

curriculum handouts, coursework, and assessments. Students in the reflection-based section had to complete 20 reflection logs for written assignments while the students in the other section were told to review feedback on their written assignments. The results indicated that students who participated in the homework feedback reflection activity did not outperform the students not participating in the reflection activity in coursework. However, the students who participated in the homework reflection activity learned how to become effective learners. The use of reflection in the developmental intermediate algebra courses helped students learn how to self-assess and take ownership of their learning (Landers & Reinholz, 2015).

Logue, Douglas, and Watanabe-Rose (2017) conducted a mixed methods study with 717 students across three New York City community colleges. The purpose of the study was to assess the effects of mainstreaming students who needed remediation into college-level courses. The method of the study was to mainstream students that placed in remedial math directly into one of three sections: traditional remedial elementary algebra, traditional remedial elementary algebra with a 2-hour weekly workshop, or a college-level statistics class with a 2-hour weekly workshop. There was a total of 12 instructors (four at each campus). Instructors were not told about the research hypothesis. They were told to teach the courses as they normally would have in previous semesters. The results indicated that students who needed remedial math and were placed in the college-level statistics with a 2-hour weekly workshop class did far better than their peers that were placed in the traditional remedial elementary algebra. Students enrolled in the statistics

course expressed positive perceptions about math, persisted in college and completed more college credits, and showed more student engagement in the course.

Guy, Cornick, Holt, and Russell (2015) conducted a mixed-methods study with students enrolled in a large, urban community college. In an effort to address the low student success rates in remedial courses, the community college chose to do a course redesign. The purpose of the study was to examine a new accelerated, developmental math redesign in terms of student mean pass rates. Students needing remedial arithmetic had a choice to enroll in a traditional, semester-long course or an accelerated four weeks, twenty-hour course. The method was to conduct the study during four semesters (Fall 2009, Spring 2010, Fall 2010, and Spring 2011). There was a total of 3,783 students who enrolled in one of two courses (traditional or redesigned arithmetic). Students with a Compass score of 25-29 were given an option to enroll in a traditional arithmetic course or in a redesigned arithmetic course. The results indicated the students in the accelerated course passed the exit exam at a higher rate. Those students did not pass a subsequent remedial algebra class. The findings indicated that the students did well in the accelerated course, but the achievement was in that particular class only, the results were not as significant in the subsequent remedial algebra class.

Program Redesign

There are several reasons why schools might choose to do a program redesign in developmental mathematics (Cafarella, 2016). One reason is to address the national concern on student retention and student success rates in higher education (Gauthier, 2016). Secondly, is to increase the completion rates of former developmental math

students currently enrolled in college-level math courses (Edwards, Sandoval, & McNamara, 2015). A third reason is to change the developmental education curriculum and students learn mathematical content (Kosiewicz, Ngo, & Fong, 2016). When schools implement program redesigns, change its delivery methods, or incorporate best practices in teaching, they are being responsive to meet the needs of its students (Andrade, 2016).

Program redesign is not new to colleges and universities. In 2005, a plan was implemented to redesign the developmental education programs in Louisiana's colleges and universities. The redesign plan included the removal of all developmental education programs from four-year institutions into two-year colleges (Park, Tandberg, Hu, & Hankerson, 2016). Students that did not meet the academic requirements at a four-year university were placed in developmental courses at a 2-year college. This redesign streamlined students' entrance into college-level courses at four-year universities by the completion of developmental courses at two-year colleges.

Importance of Summative and Formative Evaluations

Colleges can find out information on the effectiveness of academic programs by conducting summative and formative program evaluations. Aziz, Mahmood, and Rehman (2018) indicated that summative and formative evaluations are central to determining the quality and effectiveness of educational programs. School administrators can use summative evaluations to determine the effectiveness of programs and decide whether existing programs need a program redesign or if they need to terminate the program.

Pierce (2017) conducted a formative evaluation on the integration of a developmental reading and a developmental writing course at Kanawha Valley

Community & Technical College (KVCTC). The KVCTC administrators were concerned about students' acceleration and completion rates in the developmental reading and writing courses. Therefore, the administrators compressed all levels of developmental reading and writing into one course. A combined developmental reading and writing course was created (Reading, Reasoning and Writing). It was important for the educators at KVCTC to understand the effectiveness of the formative evaluation. By knowing its effectiveness, educators at KVCTC can determine whether the new Integrated Reading and Writing course was effective or not. The piloted study had two goals: (a) to design a research-based combined developmental reading and developmental writing course (Reading, Reasoning, and Writing) and (b) to perform a formative evaluation of the course once it was piloted. During fall 2011-12 semester, there were 12 students who self-enrolled in the Reading, Reasoning, and Writing course and participated in the pilot study. In fall 2011, the students completed written essays (pretest) based on various topics regarding on their reading habits, writing habits, and their writing fears. In spring 2012, the students completed written reflections (posttest) based on various topics regarding on their self-regulation, self-assessment, critical thinking, and goal setting skills. The results indicated that in fall 2011, the class average score increased from 56 (pretest) to 75 (posttest) on a scale of 100. In spring 2012, the results indicated the class average score increased from 59 (pretest) to 82 (posttest) on a scale of 100. There were significant improvements in the overall student success and mean pass rates in the combined Reading, Reasoning, and Writing course. 75% of students passed with a C or better (Fall 2011) and 82% of students passed with a C or better (Spring 2012).

Project Description

Resources, Support, Barriers, and Solutions

Resources will include a large conference room for the administrators, instructors, and stakeholders to learn about the findings from the project study. The audience will receive Appendix A handout for their review. Existing support continues to come from the college president, the dean of academic affairs, and the developmental math instructors. The college president granted me permission to conduct the research at the college. Having the support from the college president shows other stakeholders the importance of the project study. The support from the college president provides access to share information to the stakeholders and it shows that the college has a vested interest in this project study. The support from the dean of academic affairs and developmental math instructors provided access to share information with them about the research findings and recommendations. A potential barrier is scheduling a day and time when the administrators, instructors, and stakeholders can attend the presentation. A solution to the barrier is to present the findings on a professional development workday for the administrators, instructors, and stakeholders.

Proposal for Implementation

Once the project study is approved by the faculty and administration of Walden University, I will contact the executive assistant of the MACC president to schedule an appointment and schedule a presentation location. The purpose of the appointment is to meet with the administrators, instructors, students, and stakeholders to disseminate research findings. I anticipate the meeting will take place within 1 month of the

completion of this project study. I will begin the meeting by thanking the administrators, instructors, students, and stakeholders for their support of the research study. The evaluation report will be shared with the administrators, instructors, students, and other stakeholders. The evaluation report includes the purpose of the study, the findings, and recommendations for the redesigned developmental math program. I will present the findings and recommendations as the audience follow along on the handout. I will highlight the purpose, rationale, and methodology of the study. I will discuss the findings and recommendations. The meeting will be scheduled for 1 hour in length.

Project Evaluation Plan

The study used a comprehensive evaluation approach with both summative and formative aspects. According to Lodico, Spaulding, and Voegtle (2010) program evaluators often use summative and formative evaluation data to report back to the stakeholders. The justification for using this approach was because a summative method was the best approach to present the findings of the project study. According to Phillips (2018), when a decision needs to be made on whether to revisit a program to determine its effectiveness or replace a program altogether, a summative method is an excellent option. Summative evaluations can help individuals decide to keep a program or do another redesign. Formative data can help in understanding why the program may be either succeeding or not. The overall evaluation goal of this project was to conduct a comprehensive evaluation on the developmental math redesign to determine the overall effectiveness of the modules and understand the perceptions of various stakeholders.

The key stakeholders for the research included the following groups of people: (a) MACC administrators, (b) MACC developmental math instructors, and (c) MACC students. Additional stakeholders who have a keen interest in the outcomes of the research would include academic affairs department members who consist of the president, vice president, and the dean of academic affairs; student services department members including the college counselors, and the MACC board of trustees.

Project Implications

Social Change Implications

This project is significant to social change because student learning outcomes in developmental math education are important to MACC and other administrators, instructors, students, and other stakeholders. Developmental math continues to be a national concern in higher education institutions. Colleges and universities are implementing strategies for student success in developmental math education. All 58 community colleges in North Carolina have redesigned their developmental math programs in an effort to increase student retention and student mean pass rates. An implication of this study would be that other states review the effectiveness of this program to determine if a redesign is needed at their community college. This could lead to significant change in student outcomes in developmental education across different states. Reviewing the effectiveness in developmental math education could also be replicated at the high school level. Principals, teachers, and other stakeholders could review the high school student mean pass rates to determine if there are any gaps that exist in developmental math. If developmental math education is redesigned at the high

school level, perhaps more students would graduate and be prepared for college-level math. A second implication is for a professional development training to be implemented that aligns with the developmental math redesign and includes best practices for teaching and learning in the modules. The training will demonstrate to administrators, instructors, students, and stakeholders the importance of developmental education in community colleges.

Local Stakeholders

MACC is a diverse, rural community college located in northeastern North Carolina. Some of its residents are small, local business owners that have graduated from the college. Many of the graduates from MACC relocate to seek gainful employment in larger cities in their prospective careers. Only a handful of students remain living in the small-town community while seeking gainful employment. The residents of the community, as well as local stakeholders, are vested in the community college. Small and large businesses are seeking to hire MACC graduates to help their businesses grow, thrive, and prosper. This project study was important to the community and its local stakeholders. The effectiveness of programs at MACC prepares graduates for gainful employment. The effectiveness within the college prepares the students to become well-rounded citizens living and thriving in the community.

Larger Context

This project study is equally important within a larger context. Student success in developmental math is a national concern. Developmental math continues to be a barrier for students needing to gain entry into college-level math courses. Colleges and

universities have implemented various strategies to address the low student mean pass rates. Data from this project study will shed light to a larger context on examining the effectiveness of developmental education. The success of the project conducted at MACC may pose as an example for other colleges and universities from within the state. When developmental math is addressed on a smaller scale, then it can be successful on a larger scale.

Section 4: Reflections and Conclusions

Projects Strengths and Limitations

Low student mean pass rates in developmental math courses have become a state-wide concern in North Carolina. To address these concerns, the state implemented a developmental math redesign for its community colleges. This program evaluation was developed to understand the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules and to evaluate the effectiveness of the redesign using these perceptions and quantitative analysis. The chief strength of the research was to specifically evaluate the effectiveness of a new developmental math redesign at MACC. Xu and Dadgar (2018) conducted a similar study to examine the effectiveness of remedial math with community college students. I compared students with low math skills in a 3-course sequence in remedial math to students with low math skills in a 2-course sequence in remedial math. The results indicated the students in the 3-course sequence were less likely to earn a degree within a 4-year timeframe.

A second strength was the use of a mixed-methods design with the program evaluation. Semistructured interviews conducted with the administrators, instructors, and students provided an in-depth investigation of the first-hand experiences in developmental math. Qualitative results from the project yielded an accurate picture of the overall effectiveness by examining mean pass rates and final overall GPAs. A third strength is embodied in the individualized recommendations presented in Appendix A. Based on the findings in the project, five recommendations have been and will be

presented to MACC. These recommendations included strategies to directly address the effectiveness of the developmental math modules.

There are two limitations to this study. Because this research was conducted at a small, rural community college in the mid-Atlantic United States, there exists a limited diversity among the research participants. Because this research was conducted at a single college, the results may not be generalizable to a larger colleges and universities.

Recommendations for Alternative Approaches

Two alternative approaches would have made sense for approaching the problem under study here. One such approach would have been to additionally conduct a qualitative study in developmental reading to understand the perceptions of instructors and students at MACC. In such a study, I could compare and contrast the perceptions of instructors and students in developmental math with the perceptions of instructors and students in developmental reading classes. North Carolina also had its developmental reading program redesigned and it would have been interesting to learn the similarities and differences between the developmental math and developmental reading programs.

Another approach would have been to conduct a qualitative study in developmental math to understand the perceptions of teachers and students at a local high school and at MACC. In such study, I would have been able to compare and contrast the perceptions of teachers and students in developmental math at a local high school with the perceptions of instructors and students at MACC. It would have been interesting to learn the similarities and differences in perceptions and theme patterns between the local high student and MACC.

Scholarship, Project Development and Evaluation, and Leadership and Change

This research focused on the effectiveness of a developmental math redesign. The project will provide information to the administration and stakeholders with recommendations that may improve the overall effectiveness of the developmental math modules.

Self-Analysis of a Scholar

Eight years ago, when I began teaching at the community college, my goal was to instruct college students in their field of study. I had no idea that the teaching experience would someday help to shape my life. I found my true passion which was teaching adult learners, many of which were my same age. This led me to revisit and reflect on my educational goals and embark on this doctoral journey.

Five years ago, I called and spoke with an enrollment advisor at Walden University. The next semester I was enrolled in an online doctoral program. The coursework at Walden helped me to understand and appreciate the true meaning of a scholar. My definition of a scholar is someone who has tenure at a college or university, has experience in conducting research studies, and has written and published work. I have met some scholars during the residency that have given me advice on conducting scientific research and writing the dissertation. The people I met during the residency and throughout this journey have given me the insight I needed to transition into a well-rounded scholar. By insight, I mean the people at the residency have shared their educational background, their professional work experiences, and how their experiences help to shape them to be the experts they are today. In the future, I hope to continue

conducting research on developmental math education and collaborating with other scholars to write peer-reviewed articles and publish them in various journals.

Given my experience as a graduate student at Walden University, I also have come to understand the importance of scholarship in higher education. Being a novice researcher, this evaluation has given me new insight into conducting valid and reliable research. Conducting literature reviews on developmental math programs has increased my subject knowledge and my interest. Reading past research on developmental math has made me aware that this concern with low mean pass rates was not a community, local, or state issue but it was a national concern. Interviewing the administrators at MACC provided me an understanding that the developmental math redesign was not an option, but a priority for student success. I learned the importance of professional development training and how it is beneficial for instructors and students. Instructors can incorporate new teaching strategies learned into their curriculum. Students can receive current information on the subject area that may increase their engagement, participation, and overall success. Personally, I have learned a great deal of information about conducting a mixed-methods evaluation. I understand the breadth and depth of investigating scientific research and its relevance in academia. The overall experience will assist me in conducting future research.

Project Development and Application

This project study has increased my knowledge about developmental math, program redesign, and especially program evaluations. Since conducting the interviews, I have developed a huge respect for instructors in developmental education programs, as

well as the students enrolled in such courses. I have applied learning by being involved in the developmental math department meetings. Each month, the department math instructors meet to discuss program changes, curriculum revisions, and course modifications. From the administrator interviews, I have a deeper understanding of program redesigns and the impact it has on instructors and students. From the instructor interviews, I realized the importance of professional development and how it can affect teaching styles. I have also applied learning by being involved in a policy recommendation to have a college success course offered as a corequisite with a developmental math module. From the student interviews, I understand their point of view in wanting to be successful in the course and the importance of offering face-to-face courses.

Leadership and Change

Having grown professionally and academically, I feel I can contribute even more to leadership and change within my workplace. Taking on the role of a novice researcher has laid the foundation for my colleagues to view me as a leader the workplace. Conducting interviews with administrators, instructors, and students has provided me with ample opportunities to create change in the delivery methods and teaching styles in developmental math education. Because I have the skill set of conducting research, analyzing data, and writing up the findings, I can collaborate with MACC administrators to make changes in its developmental math program. These changes would include recommending best practices for the delivery methods and teaching styles. A change in the delivery methods would include offering the modules in a face-to-face format rather

than online. Some students may benefit from being in a class with the instructor, working in small groups, and being actively engaged in the class. A change in the teaching methods would include the developmental math instructors taking a professional development training geared for developmental math instruction. Minor changes in the delivery methods and teaching styles may lead to higher student mean passing grades and overall GPAs in the developmental math.

Colleges and universities continue to make changes in leadership and in academics to meet the demands of the workforce and society (Jones & Johnstone, 2016). The increase of nontraditional students returning to college for a credential or degree has schools rethinking their role in leadership and administration.

Reflection on Importance of the Work

The information I learned throughout my previous studies at Walden University--graduate courses, the residency, and in the intensive capstone courses--have prepared me for the final project study. After conducting two literature reviews on topics such as developmental math, program redesigns, and modular courses, I soon realized the importance of this project and the potential impact it has on my school and on the lives of the students who attend. This project study is beneficial to the stakeholders, community, and the society. Stakeholders are vested in the success of the college and its academic programs. The community benefits from having a local community college that meets the needs of its diverse student population and prepares students to be productive members in the workforce. Society plays a role as graduates become contributing members living and working in a thriving society. Overall, the study

provides useful information that can improve the teaching effectiveness in developmental math, lead to greater success among students, and aid in the furthering of their college and vocational career goals.

Implications, Applications, and Directions for Future Research

The study focused on the effectiveness of the new developmental math modules. The findings from the study highlight the importance of Keller's Plan for Individualized Instruction. It was in the mid to late 1960s, when Keller first introduced his individualized plan of instruction to higher education institutions (Purao, Sein, Nilsen, & Larsen, 2017). Keller's plan was viewed by colleges and universities as an alternative method of instruction as opposed to the traditional, lecture-based instruction. Over the years, colleges and universities have adapted this method of individualized plan of instruction. In this method, students complete modular coursework at their own pace. Studies have shown that students using this method have been more successful than students in a lecture-based setting (Svenningsen & Pear, 2011). One reason for this is the students take ownership in their learning. Students become responsible and want to be successful in their courses. Another reason is students learn at their own pace while mastering the materials at their own readiness. Students can move from one module to the next without feeling pressure from their peers. Lastly, the instructors become the facilitators in the setting. The facilitators allow the students to take the lead in their learning while providing the necessary support to help students achieve success.

At MACC, the developmental math program can increase its effectiveness if individualized instruction were embedded throughout the developmental math modules.

Students placed in developmental math modules vary greatly in their mathematic ability. Incorporating on individualized instruction to meet their diverse learning styles can lead to student success in developmental math. Providing professional developmental trainings on how to become facilitators in the classroom can lead to higher student retention in developmental math.

An implication of the study would be to have professional development training on the use of multiple measures for advisors, counselors, and instructors. Funded by College Spark, Placement 360 is an organization with expert practitioners who can provide a yearlong mentorship to colleges wanting to incorporate the use of multiple measures for students (Clark, 2018). Future research would include having other colleges replicate this study and determine the effectiveness of their developmental education programs.

Conclusion

Developmental math education affects not only students, instructors, and administrators, but it also affects communities, businesses, and society, as well. For some students, developmental math is a barrier which prevents them from taking college-level math. These students may eventually drop out from college because they did not pass developmental math. This may affect some communities because the residents are not college graduates and may have a difficult time finding employment with a high school education. When students enter colleges underprepared for success, placing them into ineffective developmental math modules is not addressing the problem. Colleges and

universities need to reexamine the effectiveness of their programs in order to address the low student mean pass rates in developmental math education.

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Appendix A: The Project

Evaluation Report of a Developmental Math Program Math Redesign at a Community

College

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Project Study Submitted in Partial Fulfillment

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Introduction

This summative and formative evaluation report will outline the problem statement and explain its rationale. In addition, it will list the research questions and present the findings and recommendations. The report is intended to be used as an evidenced-based evaluation leading to improving outcomes for developmental math students. In addition, I hope that it can be used for incorporating best practices for teaching and learning in the new developmental math modules at the community college.

The Problem

There is a national concern about the effectiveness of remedial education at the community college level in the United States. According to the 2016 Hunt Institute Blog, 6 out of 10 students entering community colleges must take a developmental education course (Grovenstein, Retrieved from http://www.hunt-institute.org/wp-content/uploads/2015/04/coNCEpts_20150315.pdf). It has not been clear whether remedial education has been effective at the community college level. Along with North Carolina, other states such as Colorado, Ohio, and Virginia have been redesigning their developmental education programs. The North Carolina Community College System (NCCCS) implemented a redesign in developmental math program in 2011. A major part of the redesign included a change in the delivery method and instructional format. Prior to the redesign, developmental math courses were offered in a traditional, face-to-face setting. These face-to-face courses were offered in a 16-week, semester-long format. Since the redesign, the developmental math modules were offered in an online, 4-week session.

Prior to the redesign, the developmental math program consisted of three semester-long courses: MAT 060: Essential Mathematics, MAT 070: Introductory Algebra, and MAT 080: Intermediate Algebra. Since the redesign, the developmental math program consisted of eight accelerated modules ranging from DMA 010-DMA 080. Therefore, Math 060: Essential Mathematics had been replaced with three, accelerated modules: DMA 010: Operations with Integers, DMA 020: Fractions and Decimals, and DMA 030: Proportion, Ration, Rate, Percent. MAT 070: Introductory Algebra had been replaced with two, accelerated modules: DMA 040: Linear Expressions, Equations, and Inequalities and DMA 050: Graphs and Equations of Lines. MAT 080: Immediate Algebra had been replaced with two, accelerated modules: DMA 070: Rational Expressions and Equations and DMA 080: Radical Expressions and Equations.

Rationale

MACC had redesigned its developmental math program and implemented a new math curriculum (Retrieved from <http://ncmatyc.matyc.org/wp-content/uploads/file/BetaVersionDevelopmental%20Math%20Modules%20-%20NCCCS%5B1%5D.pdf>). Prior to this study, there were no program evaluations conducted on the new developmental math modules. Therefore, there was no way of knowing if this new redesign was effective or not. The rationale was to use a concurrent mixed-methods research design to evaluate the new developmental math modules. As guided by Keller's Plan of Individualized Instruction, the qualitative data explored the perceptions of administrators, instructors, and students regarding the effectiveness of the new developmental math modules.

There were five research questions, two quantitative and three qualitative that guided the evaluation.

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules?

RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules?

RQ5: What are the perceptions of students regarding the effectiveness of the new math modules?

The research study had one area of focus which was to examine the effectiveness of the new developmental math modules, both quantitatively and qualitatively. The study also critically reviewed and compared the following: 1) student mean passing grades in developmental math courses during 2012-13 to student mean passing grades in the redesigned math modules in 2013-14 and 2014-15 to see if there had been a significant rise in the mean passing grades using the new math modules; and 2) overall GPAs for students in developmental math courses during 2012-13 to students in the redesigned

math modules in 2013-14 and 2014-15 to see if there had been a significant rise in the student overall GPAs using the new math modules. In addition, the study also critically reviewed and compared the following: 3) the perceptions of administrators regarding the effectiveness of the new math modules, 4) the perceptions of instructors regarding the effectiveness of the new math modules, and 5) the perceptions of students regarding the effectiveness of the new math modules.

The Specific Problem at The College

Although the math redesign was implemented to increase student grades and mean pass rates, there was no information about whether this had happened, or whether students and instructors perceived that the new system was working. Prior to the redesign, our students only needed to pass the math 060, math 070, math 080 or successfully pass the math placement exam, depending on their academic discipline, in order to begin taking college-level math courses. The developmental math courses were semester-long, stand-alone, instructor-led courses which met at pre-set times and intervals. The redesigned math modules, on the other hand allowed students much greater flexibility regarding attendance and pace of learning enabling students to work at their own speed to master the material at hand, while integrating the learning experience into their individual readiness.

Prior to the new curriculum redesign, students in the early childhood program, for example, needed to pass a semester-long class, math 060 or pass the placement exam prior to taking college-level math courses. Since the redesign, students in this program

can either pass the new developmental math modules DMA 010, DMA 020, and DMA 030 prior to taking college-level math courses or pass the placement exam.

The old Math 060: Essential Mathematics had been replaced with several, individualized modules: DMA 010 (operations with integers), DMA 020 (Fractions and Decimals), and DMA 030 (Proportion/Ration/Rate/Percent). Math 070: Introductory Algebra had been replaced with DMA 040 (Linear Expressions, Equations, and Inequalities), DMA 050 (Graphs and Equations of Lines), and DMA 060 (Polynomial and Quadratic Applications). Math 080 Immediate Algebra had been replaced with DMA 070 (Rational Expressions and Equations) and DMA 080 (Radical Expressions and Equations).

During a meeting with the director of institutional research and effectiveness, we discussed student mean pass rate percentages prior to the developmental math redesign. Students enrolled in developmental math courses needed to complete the sequence of courses prior to enrolling in college-level math courses. As shown in Table 1, the student mean pass rate in the developmental math courses are based in a final grade of ‘D’ or better.

Table A1

Enrollment Numbers and Mean Pass Rates for Developmental Math Courses, 2012-13

	Math 060	Math 070	Math 080
Student Enrollment	93	122	37
Pass Rate	52.7%	49.5%	79.4%

We also discussed the student mean pass rate percentages in the new math modules. Students enrolled in developmental math modules needed to complete the modules necessary for their program of study prior to enrolling in college-level math courses.

As shown in Tables 2 & 3, the student mean pass rate in the developmental math modules were based on a pass/fail grading system. Table 2 shows an increase in the mean pass rates.

Table A2

Enrollment Numbers and Mean Pass Rates for Developmental Math Modules, 2013-14

	DMA 10-30	DMA 40-60	DMA 70-80
Student Enrollment	83	91	20
Pass Rate	46.4%	52.8%	82.9%

The director of institutional research and effectiveness and I also examined the results of the data two years after the developmental math redesign. Table 3 displays the enrollment and pass percentages since the implementation of the new math modules.

Table A3

Enrollment Numbers and Mean Pass Rates for Developmental Math Modules, 2014-15

	DMA 10-30	DMA 40-60	DMA 70-80
Student Enrollment	73	39	13
Pass Rate	53.3%	44.3%	65.2%

Table 3 shows a steady decline in student enrollment in the math modules during 2014-15. DMA 40-60 shows a large decline in student enrollment. However, the low student enrollment in DMA 40-60 did not result in a consistent higher student mean pass rate. The low student enrollment in DMAs during 2014-15 may reflect one of two things: 1) students registered early and withdrew from the module prior to the census date or 2) students did not need DMA 40-60 or DMA 70-80 prior to taking college-level math.

Significance of the Study

We are not alone in our concerns. In fact, there is a national debate going on about the effectiveness of remedial education. There are an increasing number of students arriving underprepared for college-level courses (Dunston & Wilkins, 2015). Many colleges and universities have implemented accelerated tracks for their developmental courses or implemented a program redesign for the developmental programs (Ariovich and Walker, 2014; Cafarella, 2016).

In an increased effort to assist with student retention, student success, and increased mean pass rates, the NCCCS has implemented a redesigned math curriculum for its developmental math program. Research of this kind was significant because the effectiveness of these new developmental math modules had not been evaluated. Had the redesign addressed the persistently low mean pass rates? Had student overall GPAs improved under the redesign? This study helped address those questions for administrators, instructors and students at our community college. Decisions to keep or enhance the redesign had a foundation in data and statistical analysis. In the long run,

such sound decision-making can enhance pedagogical practices within the redesigned developmental math program.

Research Questions and Hypotheses

Developmental math has a greater student enrollment than developmental reading and English. The high student enrollment in developmental courses have caused many states to redesign their developmental programs. North Carolina was one of the states that implemented a new developmental math program redesign in its community colleges with the intent on student success and mean pass rates. The goal of the redesign was to enable students to complete individual modules rather than semester long courses in developmental math. Students can take the necessary new developmental math modules prior to enrollment in college-level math courses.

Examining the data on mean pass rates and student overall GPAs can help us understand whether the redesign has improved student outcomes. Examining the perceptions of administrators, instructors, and students regarding the effectiveness of the new math modules may shed light on why the redesign is or is not effective.

The extent to which the redesigned math modules have improved the effectiveness of the math program in terms of student outcomes (quantitative) and participant perceptions (qualitative) was the guiding research question.

There were two research questions for the quantitative part of this concurrent mixed-methods study.

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

There were two hypotheses for this research question.

H₀₁: There is no significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

H_{A1}: There is a significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

There were two corresponding hypotheses for this research question.

H₀₂: There is no significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses. This is the null hypothesis.

H_{A2}: There is a significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

There were three research questions for the qualitative part of this concurrent mixed-methods study.

RQ3: What are the perceptions of administrators regarding the effectiveness of the new math modules?

RQ4: What are the perceptions of instructors regarding the effectiveness of the new math modules?

RQ5: What are the perceptions of students regarding the effectiveness of the new math modules?

Quantitative Analysis

Quantitative data was collected from the archival data provided by the Office of Institutional Effectiveness. Prior to the redesign, students that placed in developmental math courses may be required to take Math 060, Math 070, or Math 080 as a prerequisite to college level math. The quantitative findings indicated that student enrollment in Math 070 increased, but the student mean pass rate dropped as compared to Math 060. The student enrollment in Math 080 dropped significantly but the student mean pass rate was highest when compared to Math 060 and Math 070. The data in Math 080 reflected that fewer students need Math 080 as a prerequisite to college math as deemed by their program of study. However, the fewer number of students in Math 080 was correlated to their success in the mean pass rate. Since the redesign, students who placed in developmental math modules may be required to take DMA 10-30, DMA 40-60, and DMA 70-80 as a prerequisite to college-level math. The quantitative findings indicated that student mean pass rates were higher in the semester-based developmental math classes than in the developmental math modules.

RQ1: What is the difference between the mean passing grades of students enrolled in the redesigned math modules and the mean passing grades of students enrolled in prior developmental math courses?

H_{01} : There is no significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses. This is the null hypothesis.

H_{A1} : There is a significant difference between the mean passing grades of students enrolled in the redesigned math modules ($\alpha = .05$) and the mean passing grades of students enrolled in prior developmental math courses.

Inspection of Q-Q Plots revealed that mean passing grades were normally distributed for both groups and that there was homogeneity of variance as assessed by Levene's Test for Equality of Variances. Therefore, an independent t test was performed on the data with a 95% confidence interval (CI) for the mean difference. It was found that the mean passing grade for semester classes ($M = .65, SD = .469$) was significantly higher than for those taking the redesigned modules ($M = .54, SD = .498$) $t(345) = 2.635, p = 0.005$ with a mean difference of 0.104, 95% CI, [0.025, 0.182]. I rejected the null hypothesis of no difference and accepted the alternative hypothesis. Table 4 indicates that the difference reflected that students in semester-based classes passed them at a higher rate than the redesigned modular classes.

Table A4

Final Grades for Developmental Math Semester Courses and Redesigned Modules

		Type of Instruction		
		Semester courses	Redesigned modules	Total
Final grade	Fail	35.2%	45.5%	43.0%
	Pass	64.8%	54.5%	57.0%
Total		100%	100%	100

RQ2: What is the difference between the overall GPAs of students enrolled in the redesigned math modules and the overall GPAs of students enrolled in prior developmental math courses?

H₀₂: There is no significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

H_{A2}: There is a significant difference between the overall GPAs of students enrolled in the redesigned math modules ($\alpha = .05$) and the overall GPAs of students enrolled in prior developmental math courses.

Inspection of Q-Q Plots revealed that overall GPAs were normally distributed for both groups but that there was not a homogeneity of variance as assessed by Levene's Test for Equality of Variances. Therefore, an independent samples t test was run on the data with a 95% confidence interval (CI) for the mean difference. It was found that the mean overall GPA for semester classes ($M = 2.16$, $SD = 1.08$) was not significantly different from those taking the semester class than for those taking the redesigned

modules ($M = 2.05$, $SD = 1.04$) $t(950) = 1.481$, $p = 0.069$) with a mean difference of 0.117, 95% CI [-0.038, 0.272]. I retained the null hypothesis of no difference for overall GPAs. No statistically significant difference was noted between overall GPAs.

Quantitative Findings

Analysis of the quantitative data reveals that mean pass rates for the semester-based classes were higher than for the redesigned modules at a statistically significant level. This was the opposite of the hypothesized relationship. Additionally, there was no real difference in the overall GPAs of those who took the redesigned modules from those who took semester classes.

All in all, the analysis of the quantitative data indicated that the redesigned developmental math modules were not as effective as the semester-based developmental math courses as measured by a comparison of mean pass rates and overall GPAs.

Qualitative Interviews

RQ3 asked about the perceptions of administrators regarding the effectiveness of the new math modules. It was broken down into several interview questions.

Interview question: “What kinds of instructional support does the college have to increase the effectiveness of its programs?” Administrator #1 indicated “We have monthly meetings so the instructors can discuss strategies to increase student success.”

Administrator #2 stated “We send out surveys asking the instructors what kinds of professional development trainings they would like to attend. Then we bring in guest speakers to provide the trainings.” Administrator #3 stated “We provide instructional

support through webinars, trainings, and meetings. The instructors attend webinars online and go to professional conferences annually.”

Interview question: “How does the college evaluate the effectiveness of the new developmental math modules?” Administrator #1 indicated “At the end of each semester, we have the students evaluate the modules and the instructors to see where improvements are needed.” Administrator #2 stated “The students help to determine how effective the modules are. They are the best indicators when it comes to determining best practices.” Administrator #3 stated “Students have an opportunity to complete surveys on the effectiveness of the modules. Their feedback is very important to us. We are interested in hearing about their likes and dislikes in developmental math including teaching style, delivery method, and modular content.”

Interview question: “What are your perceptions regarding the effectiveness of the new developmental math modules? All three administrators felt the developmental math redesign was a step in the right direction in regard to student retention. They acknowledged the former structure of developmental math courses was not effective in terms of student success and believed that the implementation of the modules showed an effort towards positive change.

Themes from RQ #3.

Importance of the developmental math redesign. All three administrators agreed that implementing a redesign in the developmental math program would be in the best interest of students. Administrator #1 stated “Our college has low student enrollment and high student retention, especially in our developmental classes. A redesign in the

developmental math and reading programs is not something that should take place, it is something that must take place.” Administrator #2 indicated that “Other colleges across the state have been successful in the developmental math redesign and we need to get on board and follow suit”. Administrator #3 stated “A developmental math redesign is exactly what this school needs right now to address the low student mean pass rates in its developmental courses.”

Implementation of the modules. All three administrators wanted an effective and smooth transition from courses to modules, so instructors and students could get acclimated to the redesign. There were some concerns on the rollout of the accelerated math modules. One of the main concerns for Administrator #1 was whether or not the timing on the rollout was still on schedule.

RQ4 asked the perceptions of instructors regarding the effectiveness of the new math modules. It was also broken down into several interview questions.

Interview question: “What are the strengths and weaknesses of the redesign? with the probe, “How can the weaknesses be overcome?” Instructor #1 indicated as a strength of the online modules that “Students can learn at their own pace with the developmental math software. Students can complete one module at a time and then take the exam.” Instructor #2 stated “A strength in the developmental math modules is that the modules are only five weeks long. If a student is struggling with the content, that student will have a shorter experience struggling with it as opposed to struggling for 16 weeks in a semester-long class.” Instructor #3 stated “A strength is that the modules are self-paced. Students can study the content, take the exam, and move on to the next module.”

Instructor #1 indicated as a weakness of the online developmental math was that “Some students who enrolled in the online modules and were not computer literate. These students had difficulties from the onset. Some students experienced difficulty logging on into Blackboard, some had trouble with creating a username and password to access the software, while others had issues with gaining access to the study materials.” Instructor #2 stated “A weakness in the modules would be that nontraditional students are ill-prepared for taking online developmental math courses. They are from a different generation and did not learn the new math like the traditional students. The weakness in these modules is that the students who need to pass it are the older students who hated math during their formative school years.” Instructor #3 stated “A weakness would be that the developmental math modules were offered online this semester. Students in developmental courses need to be in face-to-face classes so they can ask questions and learn from one another. Online learning is not for everyone and it is definitely not favorable for students needing developmental courses.”

When asked “How these weaknesses could be overcome?” Instructor #1 felt this weakness could be overcome by having the Blackboard administrators at the school provide students with an online Blackboard training prior to enrolling in an online class. Instructor #1 stated “Students should not be allowed to enroll in an online class until after they have successfully completed the online training. This way, students will not experience frustration from the onset with the basic blackboard logistics such as creating a username, password, and gaining access to study materials.” Instructor #2 felt that this weakness could be overcome by providing academic support to the students. Instructor

#2 stated “A weakness in the modules would be that nontraditional students are ill-prepared for taking online developmental math courses. They are from a different generation and did not learn the new math like the traditional students. The weakness in these modules is that the students who need to pass it are the older students who hated math during their formative school years.” Instructor #3 stated “A weakness would be that the developmental math modules were offered online this semester. Students in developmental courses need to be in face-to-face classes so they can ask questions and learn from one another. Online learning is not for everyone and it is definitely not favorable for students needing developmental courses.”

When asked “Do you think these new assessments and/or strategies will influence the overall effectiveness of the redesign?” If so, in what ways, please discuss. Instructor #1 stated “Students have indicated that they are pleased with the test review. It prepares them with test taking strategies and study methods. This review has helped several students in the modules and has increased their confidence in their test taking skills.” Instructor #2 indicated “Volunteering in the lab shows students that the instructors are there to help them succeed in their courses. Students can now come to the academic skills lab and work with the instructor and develop a professional rapport with them which is important in developmental and face to face courses.” Instructor #3 stated “Yes, the practice quiz helps to prepare the students mentally and emotionally. They will know what to expect on the actual test.”

Interview question #3 was “What kinds of professional developmental training did you receive to increase the effectiveness of the redesign?” additional probes asked,

“Do you think the professional development you received may have increased the effectiveness of your teaching strategies?” and “If so, in what ways, please discuss.” All three instructors indicated they did not receive professional development training prior to and since the redesign.

Interview question #4 was “What types of instructional strategies do you think are most effective when teaching developmental math modules?” additional probe asked, “What instructional strategies are least effective?” Instructor #1 indicated “The instructional strategies most effective when teaching developmental math modules is reducing the class and offering the modules in a face-to-face format. The student/teacher ratio in developmental courses needs to be lowered so students can have a higher chance of being successful.” Instructor #2 stated “Instructional strategies most effective would be to allow students to work together in pairs or small groups. Students learn from one another. You see students working in pairs in other courses, why not in developmental courses where they need as much help as possible?” Instructor #3 stated “Giving the students’ math homework and providing feedback is the most effective strategy.”

In terms of which instructional strategies were least effective, Instructor #1 stated “The least effective strategy was offering the modules online as opposed to a face-to-face format. This was my first time teaching developmental math modules online and this strategy is not working. There were some students that had math anxieties from their former school years and there were other students that have not taken an online course. This was overwhelming for students and the instructor.” Instructor #2 indicated “Not

having a support system in place was the least effective strategy”. Instructor #3 stated “putting the developmental math modules online was least effective and not in the best interest of student success.”

Interview question #5 was “What are your perceptions regarding the effectiveness of the new developmental math modules?” All three instructors felt the developmental math modules should have been offered in a traditional format. All three instructors felt that they should have received some professional developmental training prior to the implementation of the math redesign.

Themes from RQ#4.

Importance of self-paced learning. All three instructors felt the self-paced modules provided students an opportunity to self-reflect on their work and track their progress. Instructor #1 indicated that “Students can study and focus on one module at a time and then take the test instead of studying several chapters and taking the test.” Instructor #3 stated “Having the modules in a self-paced format allows the students to focus on areas they feel they are weak in.” Instructors agreed with some of the seminal literature here. Deshler & Fuller (2016) indicated that teachers set the pace for learning in face-to-face classes while students learn the materials at their own speed. Because of that, students in self-paced classes can study and complete work at their own pace without the pressure of remaining on task with the rest of the class (Weng, 2015). Instructors #1 & #3 felt the self-paced modules were a strength in the redesign.

Importance of modes of delivery. All three instructors felt that putting the developmental math courses online were not conducive to student success and

achievement. Instructors #3 indicated “Online instruction is not for everyone, especially with at-risk students taking developmental math coursework. Some students may prefer to take developmental math courses in a traditional, face-to-face format.” This is an important finding because the delivery of math instruction to college students is critical in student success and student retention. Chekour (2017) suggested that colleges and universities should provide a variety of delivery methods in its developmental math courses to meet the needs of its diverse learners. Kosiewicz, Ngo, and Fong (2016) explained that reviewing how colleges deliver developmental courses to its students is essential to increasing student success.

RQ5 asked about the perceptions of students regarding the effectiveness of the new math modules and had only one main interview question, which was “What are your perceptions regarding the effectiveness of the new developmental math modules?” All three students felt the developmental math modules should have been offered in class instead of online. Student #1 stated, “I do not like math, but I really feel that if these modules were offered in class instead of online, my grades would be slightly higher.” Student #2 indicated I always had good grades in math. This is the first time I had an online class. I just wish it wasn’t for developmental math.” Student #3 stated “If I need to repeat the developmental math module, I do not want to take in online.”

Themes from RQ#5.

Effectiveness of the new math modules. All three students preferred having the developmental math modules offered in a traditional, face-to-face format instead of an online format. They felt their chances of succeeding would increase had the modules

been taught in a regular classroom setting. Student #1 indicated that teaching style is important and being in the classroom helps me a great deal because I am a visual learner.” Student #2 discussed the anxieties of being in an online class and stated “All of my other courses are in class and that makes me concerned about my online class.” Student #3 stated “I like being able to work in pairs or groups because it helps me a great deal when learning about and solving math problems.” This finding is important because colleges and universities need to provide professional developmental (PD) opportunities to its developmental math instructors. Severs (2017) stressed the importance of attending PD workshops and incorporating best practices in developmental math to increase student success.

Discussion of Major Themes

All three administrators agreed that the developmental math modules was a step in the right direction. Based on the prior student mean pass rates in the developmental math courses, all three administrators felt a redesign would be necessary to help improve the student success rates. All three instructors revealed that they felt they should have received some type of professional development training prior to the implementation of the developmental math redesign. Based on the prior face-to-face, traditional delivery for the developmental math courses, all three instructors felt the modules should have also been offered in the same format. All three instructors felt that the online modules were not fair to the students taking the modules and the instructors teaching the modules. All three students argued that the developmental math classes should have been offered in a face-to-face format. So in the end, positive perceptions of the redesign were not

consistent across all three constituencies. Although there was considerable in-group convergence of perceptions, there was little convergence between the three groups of people.

Qualitative Findings

Semi-structured interviews were conducted with administrators, instructors, and students to understand their perceptions regarding the effectiveness of the new developmental math modules. An interview protocol was used to guide the interview process. Probes were used during the interview to elicit in-depth responses from each participant. Interviews were recorded with permission granted by each participant. After each interview, I immediately transcribed the audio. The qualitative findings indicated that although the perceptions of administrators were favorable regarding the effectiveness of the redesign, it was found that the perceptions of the instructors and students were least favorable. This may be so because the administrators felt a redesign was needed to improve the student mean pass rates in developmental math. They felt the implementation of the developmental math modules was in the best interest of student success and retention. The instructors had less favorable perceptions because they preferred to have professional development trainings prior to the rollout of the modules. One instructor felt that having an implementation of a redesign without having some type of professional developmental training was not in the best interest of the instructors. The students also had less than favorable perceptions because they wanted the modules in a traditional, face-to-face setting rather than in an online format. One student felt if the

developmental math modules were in a traditional class setting, the likelihood of him passing the module would have increased.

Conclusion

Community colleges offer developmental math courses to prepare students for college-level math (Wheeler & Bray, 2017). However, developmental math education in community colleges continues to be a barrier towards student success (Park, Woods, Hu, Bertrand Jones, & Tandberg, 2018).

Our community college had redesigned its developmental math program to address the low student mean pass rates. The results from this study may provide us with information regarding the effectiveness of the redesigned developmental math modules.

The qualitative data showed varying perceptions from the administrators, instructors, and students. The perceptions from administrators were favorable regarding the effectiveness of the redesign while the instructors and students had less the favorable perceptions. I learned from the qualitative data analysis that the redesign made a lasting impact on those affected by the redesign. The instructors were adversely impacted by the redesign because they did not receive professional development training prior to the implementation of the redesign. The students were adversely impacted by the redesign because the modules were not offered in a face-to-face setting.

The quantitative data indicated the student mean pass rates were higher in the semester-long developmental math courses than in the redesigned modules. What I learned from the quantitative data analysis is that although the developmental math program was redesigned, it did not necessarily mean the modules were effective. I

realized that moving the developmental math program from courses to modules without providing appropriate training for instructors was not in the best interest of instructors. Simultaneously, moving the face-to-face developmental math courses to an accelerated online format was not in the best interest of students.

Recommendations

Recommendation 1: Require professional developmental training for developmental math instructors. Given the increased student enrollment in developmental math and the low student mean pass rates, developmental math instructors need a training on best practices in student success (Severs, 2017). Community college instructors can benefit from annual professional development workshops to improve their teaching practices. However, many of these workshops are not aligned specially for developmental math instructors. These instructors need professional development workshops geared for teaching and learning in developmental math instruction. Our community college can require the developmental math instructors to attend local, national, regional, or statewide conferences geared solely for developmental math instructors. The National Association for Developmental Education (NADE) and the American Mathematical Association of Two-Year Colleges (AMATYC) holds an annual conference. The developmental math instructors can collaborate and network with a group of professionals and learn pedagogical strategies to increase the effectiveness in the new modules. Another professional development opportunity geared for advisors, counselors, and instructors would be to consult with Placement 360 (Clark, Retrieved from <https://www.sbctc.edu/colleges-staff/programs-services/assessment-teaching->

learning/placement-360.aspx). Administrators can contact Placement 360 to receive additional information on the professional services it offers to colleges. Placement 360 offers a yearlong mentorship to colleges looking for ways to use multiple measures effectively with college students. Networking with Placement 360 can ensure entering college student will be placement in the appropriate course at MACC.

Recommendation #2: Offer the developmental math modules along with a college success course. Our community college already offers the following two college success courses: (1) ACA 115: Success in Study Skills and (2) ACA 122: College Transfer Success. Both introductory courses are one credit each and can be taken face-to-face or online. Our academic programs include one college success course in the program of study. Both college success courses provide students with an orientation overview of the community college campus. However, our community college does not require that students enroll in a college success course in their first year. Students just need to complete the college success course prior to graduation. In my experience, I have seen students prolong registering for the college success course until the last semester prior to graduation. I believe student put the course off because of two things: (1) the college success course in only one credit and (2) they feel the course is not important to take during freshmen year. They rather take courses listed in their major rather than electives. Therefore, it is highly recommended to offer a student success course as a corequisite for students enrolled in developmental math. This may increase the likelihood of students passing the developmental math modules.

Weisburst, Daughtery, Miller, Martorelli, and Croosairt (2017) conducted a study on innovative pathways in developmental education. The study examined two pathways: 1) a study skills course offered alongside a developmental math course and 2) an accelerated developmental math course. The results of the study indicated that students enrolled in developmental math have an increased chance of passing it when taken along with a student success course. Also, students in the accelerated course had a higher percentage of passing developmental math and college-level math with a year. The pairing of a student success course and developmental math had positive student outcomes.

Recommendation #3. Provide a mandatory Blackboard orientation training for all students. Students must successfully complete this training prior to enrolling in an online course. The Blackboard training will cover the basics of computer literacy such as setting up a Blackboard account and an email with username and password. It will also cover such topics as submitting assignments in Blackboard, taking exams, and joining discussion boards.

Recommendation #4. Offer the developmental math modules in a traditional, face-to-face format. In the interviews, students made it clear to me that they preferred to have the developmental math modules in a traditional, face-to-face setting. They felt having the modules in class may increase their chances of success in developmental math.

Recommendation #5. Assign a student success coach to the students enrolled in developmental math courses. Our college received a grant for an early alert system and

we hired two student success coaches. These coaches are available to provide students with assistance in academics or in their personal life. However, I believe this early alert system is not being utilized to its fullest potential. In other words, instructors must give students a referral to see the student success coach or students can go make an appointment for themselves. Thus far, this approach has not been successful as few instructors have issued referrals and even less students have made appointments. Therefore, I believe the student success coaches should be given a listing of students enrolled in the developmental math modules and keep track of their progress. Our registrar can generate a listing of students enrolled in the developmental math modules. The number of students enrolled in the modules can be divided between the coaches. At the beginning of each semester, the coaches will make the initial contact with the students through their school email or phone number they provided on the college application. The coaches will establish a working relationship with the students. Since the modules are at an accelerated pace (5 weeks long), the coaches will contact the students each week to provide technical assistance as needed. This approach can help us monitor 'at-risk' students from the onset and assist them when necessary.

Overall Conclusion

Our community college had redesigned the developmental math program with the intent to increase student mean pass rates and overall GPAs. However, after conducting this study, I found that the student mean pass rates for the semester-based courses were higher than in the modules. Therefore, developmental math continues to be a concern for our administrators, instructors, students, and other stakeholders.

The overall recommendation for this report is that our community college needs to continue to strengthen its developmental math program. We need to evaluate the developmental math program on an annual basis to determine its effectiveness in terms of student success. We should not rely on perceptions alone as a guide to future decision-making regarding developmental math. We need to look at the developmental math program from different perspectives and use multiple measures to determine its overall effectiveness. We need to follow up on the recommendations made in this report to see if we are increasing the mean pass rates and overall GPAs in developmental math. We need to ask ourselves the following questions:

1. Has there been a statistically significant rise in mean pass rates and overall GPAs since the instructors received professional development training?
2. Has there been a statistically significant rise in mean pass rates and overall GPAs since the developmental math modules have a college success course as a corequisite?
3. Has there been a statistically significant rise in mean pass rates and overall GPAs since a mandatory Blackboard training have been in place for all students?
4. Has there been a statistically significant rise in mean pass rates and overall GPAs now that the modules are offered in a face-to-face, traditional setting?
5. Has there been a statistically significant rise in mean pass rates and overall GPAs since developmental math students have been assigned to a student success coach?

We need to revisit these recommendations regularly and determine whether the recommendations were effective or not. We need to come together as an institution and

rededicate ourselves to student success and retention. This means collaborating more within the college. Developmental math instructors and student success coaches should meet often to identify 'at-risk' students and provide strategies to success. Developmental math instructors and the ACA 115 and ACA 122 College Success instructors should meet regularly and discuss the barriers that developmental math students face in the modules. Together, they can create a study guide with tips aligned for students enrolled in the developmental math modules. Increasing mean pass rates and overall GPAs in developmental math is a team effort and all of us have a responsibility if we are going to make a difference in student success.

It has been a privilege to be part of this project for the overall benefit of our college and our students. I hope to be able to revisit these findings in the future.

Appendix B: Invitations to Interviews

Invitation to participate in a research project study titled: “Evaluating a Program Redesign in Developmental Math”

Hello,

My name is Elaine Spellman and I am a doctoral candidate in the College Teaching and Learning program at Walden University. I am in the process of writing my project study. The purpose of the research is to examine the effectiveness of the new developmental math modules.

I am conducting interviews as part of a research study to increase my understanding on the effectiveness of the new developmental math modules. As a(n) I will specify administrator, instructor, or student, you are in an ideal position to give me valuable first-hand information from your perspective regarding the new developmental math modules at Mid-Atlantic Community College.

The semi-structured interview will last approximately 30 minutes to 1 hour. I am simply trying to capture your thoughts and perspectives on being a(n) I will specify administrator, instructor, or student in developmental math. There are no known risks for your participation in this research. Your responses to the questions will be kept confidential. Measures will be taken to ensure confidentiality. Each interview will be assigned a number code to help ensure that personal identifiers are not revealed during the analysis and summary of the research findings.

I will contact individuals on a first to respond/first to interview basis until the target sample and/or saturation has been reached. Written consent will be obtained from

all participants prior to being interviewed. There is no compensation for participating in this project study. You can withdraw from the project study at any time. However, your participation in this project study will be a valuable addition to my research and findings and could lead to greater public awareness of the new developmental math modules.

If you are interested in my project study, please suggest a day and time that is convenient for you and I will try my best to accommodate your needs. If you have any questions, my contact information is listed below. Please feel free to contact me with any questions about the interview, the project study, or to schedule a day/time for the interview.

Elaine Spellman

Appendix C: Invitation to Interviews (Telephone)

Hello, my name is Elaine Spellman and I am a doctoral candidate at Walden University. I am conducting a research study on the developmental math modules and I thought you might be interested.

Is this a good time? *(If yes, I will continue with the script).*

If you are interested and this is not a good time, I can leave you with my contact information so that you can call me. *(If yes, I will provide them with my name and phone number).*

If the person is not interested, I will thank the person for his or her time.

Thank you for your interest in my project study. If you have any questions, please stop me at any time.

You are being invited to participate in this study because you are a(n) I will specify administrator, instructor, or student in developmental math. The name of my project study is “A Concurrent Mixed Methods Evaluation of a Developmental Math Program Redesign at a Mid-Atlantic Community College”. The purpose is to evaluate the Part of my project study consists of conducting interviews with administrators, instructors, and students to gain a better understanding on their perceptions of the new math modules. During the interviews, I am simply trying to capture your thoughts and perspectives on being a(n) I will specify administrator, instructor, or student in developmental math. The interviews will be held on the MACC campus, in the Library Resource Center (LRC), which is an isolated room inside the library. The interviews are expected to 30 minutes to 1 hour. The interview will be recorded without your name and/or any other personal

identifiers. There are no known risks for your participation in this research and you will not be penalized in any way for participating, not participating, or withdrawing from the study. Participation is completely voluntary and there is no compensation for participating in this project study. Do you have any questions? (If no, I will continue with the script. If yes, I will answer the questions).

Your responses to the interview questions will be kept confidential. Measures will be taken to ensure confidentiality. Each interview will be assigned a number code to help ensure that personal identifiers are not revealed during the analysis and summary of the research findings.

I will contact individuals on a first to respond/first to interview basis until the target sample and/or saturation has been reached. You can withdraw from the project study at any time. However, your participation in this project study will be a valuable addition to my research and findings and could lead to greater public awareness of the new developmental math modules.

Do you think this is something you would like to participate in? (if yes, I will schedule a day and time for the interview. If no, I will thank the person for his or her time).

Appendix D: Interview Protocol

Introduction- before the interview begins, the participants will be reminded that:

The interview will be audio-recorded.

Their identity and individual responses will be kept confidential.

They must be at least 18 years of age and have a signed written letter of consent.

They can withdraw from the study at any time without any penalties or retaliation.

Their participation is voluntary and there are no incentives for participating.

There is no harm done to the participants in the project study.

Only questions relating to perceptions of effectiveness were analyzed to address research questions.

Interviewee (Administrators)

Have you encountered some resistance from math instructors to the math redesign? (probe) If so, what was the main concern of the resistance? (probe) Was this resistance solved, unsolved, or ongoing? (probe) Do you think this resistance may influence the overall effectiveness of the redesign?

What are some major challenges/barriers during the implementation of the developmental math redesign? (probe) Do you think these challenges/barriers may influence the overall effectiveness of the redesign? If so, how, in what ways?

What kinds of instructional support does the college have to increase the effectiveness of its programs?

How does the college evaluate the effectiveness of its programs and instructors?

What are your perceptions regarding the effectiveness of the new developmental math modules?

Interviewee (Math Instructors)

What are the strengths and weaknesses of the redesign? How can the weaknesses be overcome?

What new assessments and/or teaching strategies have you implemented since the redesign? (probe) Do you think these new assessments and/or strategies will influence the overall effectiveness of the redesign? If so, in what ways, please discuss.

What kinds of professional development did you receive prior to and/or since the redesign? (probe) Do you think the professional development you received may increase the effectiveness of your teaching strategies? If so, in what ways, please discuss?

What types of instructional strategies do you think are most effective when teaching developmental math modules? What instructional strategies are least effective?

What are your perceptions regarding the effectiveness of the new developmental math modules?

Interviewee (Students)

What are some of your earliest learning experiences in learning mathematics? (probe) Discuss your favorite and least favorite subject in school when you were younger.

Describe your study habits. (probe) How do you go about studying for an exam? (probe) How much time do you spend studying for an exam? How do you feel when you take a math test?

What types of academic support do you seek at the college? (probe) Do you go to the academic skills lab for assistance with a project or assignment? (probe) Do you seek assistance from a tutor at the school? (probe) If you have a question, do you go the instructor or the student success coach?

Discuss your grades in math as compared to other subjects. (probe) Do you think the teaching style, and/or your learning style has an impact on your understanding of math?

What are your perceptions regarding the effectiveness of the new developmental math modules?