ABSTRACT

WINKLER, JONAH. Development of an Instrument to Measure the Relationship Between Community College Developmental Math Instructors' Perceptions of Student Success and Instructional Practice (Under the direction of committee chair Dr. Susan Barcinas).

Community college developmental math instructors possess extremely important roles for many students' initial college and higher education experience. Current research does not reflect the importance of these instructors in promoting the success of college students (Grubb & Worthen, 1999; Caffarella, 2014). The research purpose is to develop and validate an instrument that quantitatively measures the relationship between North Carolina's community college instructors' perceptions of student success and their instructional practice. Instrument creation includes multiple recognized survey development and validation methods used with intentions to answer specific research questions. Methods include a factor analysis and Cronbach's alpha tests. After a pilot and validation study are conducted with an initial survey instrument, a final more valid survey instrument is created. Results from this research are measures of how developmental math instructors perceive student success and instruct in their practice. In addition, results reveal important relationships between instructors' perceptions of student success and the instructional practice they provide to many first-year college students.

Development of an Instrument to Measure the Relationship Between Community College Developmental Math Instructors' Perceptions of Student Success and Instructional Practice

by
Jonah Winkler

A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Educational Research and Policy Analysis

Raleigh, North Carolina

2018

APPROVED BY:

Dr. Susan Barcinas Committee Chair	Dr. Michelle Bartlett
Dr. Timothy Drake	Dr. Chad Hoggan

BIOGRAPHY

The basics of whom I am paint a portrait of my physical position in the educational research I wish to conduct. My name is Jonah Daniel Winkler, I am 32 years old, and I am a male graduate student working on the degree of Education Research Evaluation and Policy Analysis PhD at North Carolina State University. I have an undergraduate and graduate degree in mathematics from Appalachian State University. I am currently employed as a graduate assistant doing online instructional design in masters' students' course sites.

In addition, the process by which I attained my educational status and degrees impacts my views and interpretation of college experiences and institutions. I attended community college directly after high school for four years to attain my associate's degree in science. My enrollment while in community college was considered part and full-time during the four years. I attended Appalachian State University immediately after finishing community college for 5 years to attain both my undergraduate and graduate degrees in mathematics and adult education. I am currently in my fifth year of doctoral studies at North Carolina State University, so I have a large amount of experience with college educational processes. The experiences I have encountered certainly affects how I interpret research on college student situations.

ACKNOWLEDGMENTS

I would like acknowledgements to center on my family and their support provided during the pursuit of my education. I would like to personally thank my mother, Paula Winkler, and father, Doug Winkler for their continuous commitment and support during my 13-year college education. My parents are the most ideal, loving, supportive, and proud parents that I could ever ask for, and I feel not only lucky, but proud to still have them in my life.

An additional acknowledgement I would like to make concerns my graduate school advisor and committee chair, Dr. Susan Barcinas. Dr. Barcinas substantially influenced my entrance into my doctoral program by advising me on how to improve my application before I was a student, rather than simply saying that my application was denied. I would like to thank Dr. Barcinas for her commitment and support not only during my entrance into the program, but throughout my five-year experience in the College of Education here at North Carolina State University.

I would also like to acknowledge my committee members Dr. Michelle Bartlett, Dr. Tim Drake, and Dr. Chad Hoggan. All three have played multiple important roles in my graduate career at NCSU. Thank you very much for your time and support throughout the years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Instructors have more important roles in promoting success of college students than current research acknowledges (Grubb & Worthen, 1999; Caffarella, 2014). In particular, community college developmental math instructors perform critical roles for many college students' experience. Developmental math programs are important avenues to higher education, and are proven to be effective at preparing students for college level material. The appropriate implementation and content of developmental math programs are highly scrutinized and debated. Therefore, institutional reform and program changes highly influence developmental math environments and processes. Many first-year college students personally experience these changes (Hodara, Jaggers, & Karp, 2012). For example, approximately 41 percent of all community college students require some form of developmental course work, and developmental course work typically takes place during students' first year of enrollment. (McCabe, 2000).

Community college developmental math programs are focal points for many educational organizations and institutions. Benefits from developmental programs has been apparent for quite some time and has gained substantial attention from a variety of student success initiatives. For example, the American Association of Community Colleges has demonstrated interest in developmental math student success by creating benchmarks and desirable student outcomes for developmental math program assessment (American Association of Community Colleges, 2012). More particularly, community colleges currently receive attention and experience program reform to help further promote students success (Squires, Faulkner, & Hite, 2009). Examples of measurable outcomes are students' college readiness, developmental course progression, course completion, credit accumulation, and student persistence. Current public educational landscape is focused upon issues of community college student demographics, student completion, student success, and identifying ways to support underprepared college students through the use of specific programs or strategies (Bailey, Jeong, & Cho, 2010; Aycaster, 2001; Fike & Fike, 2008). Therefore, efforts to improve developmental math curriculum and structure are a large part of the reform process in community colleges (Fike & Fike, 2008).

Substantial amounts of money and time are spent to improve and reinforce the current state of developmental math programs. However, implementation of developmental math programs creates unintended outcomes that current research highlights and discusses in detail. Unfortunately, developmental math curricula negatively affects many students' college experience (Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Fike & Fike, 2008; Jenkins, Jaggers, & Roksa, 2009; Perin 2002). Direct results of developmental math course work on community college students are reduced student retention, prolonged college experiences, and diverted college careers. A large portion of the negative influence from developmental math programs originates from three key issues. The three key issues are that developmental math students historically possess low success rates, there are inconsistent definitions of developmental math program student success within research and practice, and there is a small amount of research currently utilizing community college developmental math instructors. Therefore, an overall result is that developmental math courses are known as "gatekeeper" courses in higher education, and are especially gatekeeper courses at community colleges (Jenkins, Jaggers, & Roksa, 2009).

In addition to important background information about community colleges, a significant portion of my discussion includes information about the negative influence developmental math curricula has on student experiences. Therefore, developmental math curricula's negative influence is discussed in detail. Then I define my dissertation's purpose and research questions alongside a conceptual framework. The conceptual framework assist in answering research questions to fulfill this research's purpose and create a valid measurement instrument. Discussion about the conceptual framework includes descriptions and originations of all variables researched, and also includes justification for their use and consideration in my research. This introduction concludes with an explanation of this dissertation's significance, research assumptions, and limitations associated with all methods taken.

Focus on North Carolina Community College Context

This dissertation is focused on the North Carolina developmental math program context. Therefore, this dissertation quantitatively researched North Carolina community college developmental math instructors with the use of a mixed-mode survey in order to analyze student success in critical gatekeeper courses to higher education. A mixed-mode survey is chosen to be most appropriate for this research due to researchers' ability to conform mixed-mode surveys to complex multi-faceted situations while maintaining overall survey quality (Dillman, Smyth, & Christian, 2014). As part of this research, a pilot study of developmental math instructors is conducted with the use of an internet/online survey that quantitatively records variables that depict instructors' perceptions of student success and their instructional practice. The creation and validation of a mixed-mode survey answers questions about how to measure perceptions of student success, how to measure instructional practice, and relationships between the measures of instructors' perceptions of student success and practices in developmental math environments. Therefore, this dissertation creates and develops a survey instrument that captures desired measures and information from North Carolina's community college developmental math instructors. In addition, all methods followed during the development and administration of the survey reduce the four most common types of survey error, coverage, sampling, nonresponse, and measurement (Dillman, Smyth, & Christian, 2014).

A mixed-mode survey instrument was administered to gather and analyze data about North Carolina community college developmental math instructors. However, the main focus of implementing the survey instrument into a pilot study was to test variable constructs and instrument design. Therefore, coverage, sampling, and nonresponse error of the final survey are not as critical in this research as is the process of creating accurate and valid measurements of desired variable constructs. The mixed-mode survey and methods used to gather data were piloted and highly analyzed for survey accuracy and reliability related to quantifying instructors' perceptions of student success and instructional practices. All information gathered during my research and particularly from the pilot study directly relates to student success in North Carolina community college developmental math courses as perceived by instructors that personally observe and experience student success. Therefore, this dissertation produced a mixed-mode survey and process that provides a valuable avenue to important information about student success in North Carolina community college developmental math courses.

North Carolina Community Colleges and Developmental Math

North Carolina is the third largest community college system in the United States (Get the Facts, 2017). North Carolina's community college system currently enrolls 73,500 new higher education students each year, and all of North Carolina's community colleges utilize developmental programs. National student enrollment among community colleges has increased 21.8% since 2007 (Mullin & Phillippe, 2011). Developmental course work for incoming college students are increasing presence such that 99 percent of our nation's community colleges contain developmental math programs (McCabe, 2000; NC Community College Creating Success, 2017). All of North Carolina community colleges provided developmental course work, and recently, the system endorsed open enrollment for all community colleges (NC Community College Final Report, 2013). Open enrollment increases the number of first-year students, and does not turn away students that need high levels of developmental course work before official college enrollment begins (Boggs, 2004). Therefore, current reforms in North Carolina community colleges focus on large-scale institutional structures and curriculum modifications to support developmental math programs (Santikian, 2015).

The current developmental math course policy put in place by North Carolina's community college system was implemented in 2013 (Santikian, 2015). The policy reform requires all North Carolina community colleges to implement a standard modularized curriculum for their developmental math courses (Developmental, 2011). In addition, the design allows developmental math courses to count as financial aid credit hours demonstrating students' need for financial aid, however the courses do not count as college credit hours earned for students' time spent.

Student Placement into Developmental Courses

All first-year community college students in North Carolinas are evaluated for their college readiness in mathematics with a two-prong strategy. The first strategy is via a placement exam with cut-scores to assess their readiness for college level course enrollment (NCCCS, 2017). The second strategy is via an exemption scheme that is based on student attributes. Students are exempt from taking a placement exam if they have graduated high-school within the last five years with a grade point average of 2.6 or better, scored a 530 or more in math on their SAT, scored a 22 or more in math on their ACT, or have previously enrolled in college-level courses. Previous assessment of North Carolina students' knowledge uses the Accuplacer placement exam created by a company titled College Board (Kalbaugh, personal conversation, September, 2017). Recently, the Accuplacer has been replaced with the North Carolina Diagnostic Assessment and Placement, NCDAP, as of 2015 for all North Carolina community colleges.

Placement exams and the process of appropriately placing incoming students into math courses they can succeed in is a large part of current reform. Therefore, I elaborate on important attributes of the North Carolina Diagnostic Assessment and Placement exam, NCDAP, that determine students' placement. The NCDAP contains eight modules of twelve questions (Kalbaugh, personal conversation, September, 2017). To pass a module, students must successfully answer 7 out of the 12 questions for that particular module's material. For modules students do not successfully answer seven questions, students are required to take corresponding developmental math course modules. Students are allowed to take the placement exam two times per year for free at all North Carolina community colleges. To assist incoming students with completing the placement exam, many high-school students are sent in groups during planned field trips to community colleges to take the placement exams. Some high-schools even allow students to take the placement exam on site, so potential community college students do not have to leave their school to take the NCDAP. Therefore, there is substantial interest, support, and dedication for accurately placing incoming college students into North Carolina's developmental math curricula.

Statement of Problem

Negative Influence of Developmental Math Curricula

Developmental math courses found in community colleges are currently "gatekeepers" for students with low mathematical abilities that require math remediation before attending college level courses (Jenkins, Jaggers, & Roksa, 2009). Literally, developmental math courses within community colleges are physical barriers for students to overcome in order to achieve higher education. In North Carolina community colleges, if students are required to take but do not pass developmental math's curricula, they cannot enroll in college level requisite math courses. Nearly all college programs require at least one college level math course. Thus many community college students are sidetracked or delayed from pursuit of educational credentials in their first-year by their remedial courses. Given that these courses do not award college credit, many college students are sidetracked by their developmental math courses (Jenkins & Cho, 2012). As a result, developmental math curriculum in North Carolina's community colleges have simultaneously become a necessary support and a costly barrier that prolongs and extends many college students' experiences.

Three main factors significantly contribute to the negative college level developmental math outcome discussion. The first contributing factor is that generally speaking, community college developmental math courses have low student success rates (Bailey, Jeong, & Cho, 2010). There are multiple explanations within current literature and research that describe why critical foundational courses have such low success rates. In particular, student background and information about community college developmental math environments create a large portion of the explanations for low student success in developmental math course work. Therefore, substantial amounts of background information concerning developmental math students, developmental curricula, and developmental environments are highlighted for discussion.

The second significant factor that contributes to developmental math's negative influence on student experience is the existence of a variety of conceptualizations and practical definitions of student success for developmental math students. Inconsistent definitions within academic research and professional practice arenas have produced vastly different methods and measures to conclude student success in developmental math environments. Therefore, inconsistent conceptualizations of student success are substantially influencing practice, policy, and pedagogical implications for both students and institutions.

The fact that there exists minimal research on college level developmental math instructors is the third contributing factor to developmental math courses' negative influence on student experience. Developmental math instructors manage, promote, and explore developmental math student success as a chosen profession, and they often have many years of experience doing so. However, current research underutilizes the knowledge and experience that instructors possess about student success and developmental math environments. The experiential knowledge that instructors possess can provide information about how and why developmental math courses significantly influence many students. Therefore, developmental math instructors possess a large amount of information that has not been studied or shared with recent educational research pursuits. I elaborate further on each of the three contributing factors in the following sections.

Low Developmental Math Student Success

To understand the problem of low success rates from students in developmental math courses and the influence developmental math curricula has on student experiences, background information about developmental math's position in community college environments is presented here. In addition, information about students that enroll in developmental math and how developmental math results in prolonging student timelines are provided here.

Background Information

Developmental math's position in community college curriculum influences many students' experience enrolling in and completing higher educational programs. Most colleges are experiencing increasingly diverse students with diverse needs associated with acquiring college ready math skills (Perin, 2002). Dr. Pitt, a community college math department chair, states that a majority of students enrolling in developmental math course work are either high-school graduates who have decided to go to community college at the last minute, or they are older students returning to school from the work force (D. Pitt, personal conversation, March 2017). A major roadblock many of these new college students immediately encounter is their low level of math competency. In fact, in 2011 69 percent of all recent high school graduates placed into a developmental course during their application process to North Carolina community colleges (NC Community Colleges Final Report, 2013). This staggering number translates to approximately 10 percent of North Carolina's community college budget dedicated to facilitating supporting developmental coursework. However, previous strategies implemented and maintained meant to promote student success in what are critical developmental college courses are known to be inconsistent at best (Aycaster, 2001). Therefore, the growing number of first-year college students that possess low mathematical abilities created a substantial investment into college level developmental math programs.

Community colleges are known for providing learning opportunities to all, and also as a stepping-stones to higher education institutions. In particular, North Carolina's community college system offers open enrollment to residents. While this practice offers widespread opportunity for learners, it also results in a reduction in program completion rates, prolonged college enrollment periods, and extended college graduation rates (Jenkins & Cho, 2012). Many community college students enroll in what are critical developmental math courses. For positive college experiences to take place, the completion of these very important courses is essential. If students do not complete developmental courses they are referred to, students must re-enroll in them again before attempting college requisite courses. Therefore, background information and the impact of developmental math courses' position in college curricula highly contributes to the negative influence developmental math curricula has on community college student experiences.

First-Year Community College Students

Developmental math courses primarily enroll first-year college students (Puaa, 2011). A majority of first-year student enrollment is because basic advising standards/guidelines suggest that students enroll in a math and English course each semester until they no longer need those subjects to graduate (Pitt, personal conversation, March 2017). Since developmental math courses are prerequisites for all college level math courses, first-year students that cannot place out of them, find themselves starting in developmental programs.

Students Avoid Math Based Programs

Compounding the issue of delayed graduation dates, some first-year students are able to control and manipulate their schedules online with or without the presence of an advisor (Pitt, personal conversation, March 2017). For example, at a North Carolina community college, first-year students are required to enroll in courses their first semester with advisors present and assisting them. However, after an initial enrollment session, most students are in control of changing and making their course choices online. Note that this is not the case for other community colleges in North Carolina, however this is a real example. In addition, at community colleges that require advisors to enroll all students, students are able to complete add and drop forms to potentially avoid mathematical content. Therefore, requiring students to take placement exams and requiring/referring developmental education before requisite college courses are enrolled, does not automatically ensure students enroll/stay enrolled in developmental course work. Students in this unfortunate situation either make enrollment mistakes, or have other priorities influencing their enrollment decisions, which highly prolongs their community college experience.

Further compounding the negative influence of developmental math programs is that any increase in time to graduation caused by enrollment in developmental courses is highly influential on student decisions (Choy, 2002). Students' low level of performance in mathematics influences their choice of program, and often deters students away from fields that involve math or science knowledge requirements. Students are deterred away from or discouraged during higher education because of potential delays to important college curricula caused by required developmental programs. In addition, students' expected graduation dates weighs heavily on their choice of program and desired college course work. Therefore, current issues of low mathematical ability from first-year college students appears in college developmental math courses that prolong college enrollment and ultimately deter students away from curricula related to math.

Definition of Student Success in Developmental Math Research

The definition of student success for community college developmental math students takes multiple forms within current literature, research, and practice. The definition of student success is very important in college level developmental math environments because different perceptions and uses of student success produce different instructional practices. Personal experience has demonstrated that certain perceptions of student success relate to different student instructor relationships, different types of student support, and different long-term student outcomes. The literature review provides six different examples of how research defines student success in developmental environments, and how definition inconsistencies influence developmental math environments and practice.

Inconsistent Definitions' Influence

In addition to current literature's views and research strategies, current policy and curriculum modifications reflect the problem of inconsistent definitions with student success. The issue appears within political debates and efforts to solve community college student skill deficiencies. Policy and curriculum modifications define student success for college level developmental math courses numerous ways in efforts to understand positive outcomes of their programs. The choice of which definition of success to follow highly influences modifications made to the school systems and curricula (Bahr, 2008; Bailey, Jeong, & Cho, 2010; Aycaster, 2011). The definition of what student success is, and how to evaluate successful experiences from students highly influence how developmental math programs accomplish objectives and interact with students. When considering the fact that instructors of developmental math courses instruct cognitive math skills as well as influence affective learning components related to math and college, measuring student success becomes vague. Determining what student success for developmental math is has been researched and elaborated on by authors such as Aycaster, Bahr, and Bailey (Aycaster, 2001; Bahr, 2008; Bailey, 2009). However, clear demarcations of success are not established, implemented, or recognized in literature about community college developmental math programs.

Available Research on Instructors

Instructors' Knowledge and Experience

Available research about developmental math topics routinely omits instructors' information, demographics, perceptions, and overall importance related to the subject or student. Developmental math instructors experience student failure as well as student success, and everything between. However, college level developmental math's current literature provides very little substance about developmental math instructors. Previous college level developmental math research focuses on student knowledge, student demographics, institutional changes, particular developmental math programs, and developmental math strategies (Bailey, Jeong, & Cho, 2010; Caffarella, 2014; Edgecombe, 2011; Hodara, Jaggers, & Karp, 2012; Kee, 2013; Sivley, 2013). Instructors of developmental math courses possess first-hand knowledge and realistic perceptions of what student success is, what successful student experiences are, and what successful strategies are appropriate for students that enroll in these courses (Caffarella, 2014). Therefore, developmental math instructors experience and know about a large portion of what current literature and research are omitting in their attempts to understand student success. Therefore, instructors' perceptions and knowledge of success provide vital information about creating and implementing community college developmental math courses that promote student success.

Research on developmental math course success focuses on students' program progression and individual course completion as means of defining success (Karp, 2011; Bailey, Jeong, & Cho, 2010; Aycaster, 2001). Developmental math instructors experience success, know what success is, and routinely promote success of students in developmental math course environments. A previous qualitative study confirmed suspicions that some developmental math instructors rarely mention course completion as a measure of success in their developmental environments, while others highly rely on this measure, as well as others. The qualitative pilot study I conducted focuses on understanding developmental math instructors' perceptions of successful student experiences and how they think successful experiences for students are accomplished in their practice. This previous research and the importance of its findings are discussed and elaborated on in the up-coming conceptual framework section.

Literature Search Results

Multiple databases search results for information about developmental math instructors in current literature are carried out during preliminary research for this dissertation. Results from database research supports the fact that little information on college level developmental math instructors exists. In addition, information about developmental math instructors' demographics for systems, states, and colleges is not obtainable through online searches due to how they are not available. For example, a 2015 system wide statistical report for North Carolina's universities and colleges does not disaggregate developmental instructors from college instructors, or math instructors from other subject instructors (University of North Carolina, 2015). The 2015 example report provides gender, level of education of professors, number of associate professors, number of assistant professors, and number of instructors for each college, but does not include any other relevant information about college level developmental math instructors.

Problem Conclusion

The problem of developmental math curricula's potential negative influence on many college students' experiences is well known and researched. I have grouped current literature and research into three contributing factors to this problem. The first and most previously researched factor is low developmental math student success rates. Reasons behind low success rates in developmental math curricula are related to high school students' exiting public education with low math skills, the fact that developmental education is intended for first-year college students, and the fact that developmental education increases students' time spent in college before degree obtainment. The second contributing factor is that research and literature about developmental math student success references multiple definitions or perceptions of student success in developmental math environments. Inconsistencies within the definition of student success influence developmental math curricula and practice. The third contributing factor to developmental math's negative influence on students' college experience is that very little research utilizes developmental math instructors' knowledge about student success. Previous research focuses on student demographics, course completion, college completion, and instructional strategies associated with student success in developmental environments. However, current literature does not focus on what student success actually is. In addition, multiple data base search results produce very little material and literature appropriate for use or discussion within my research about college level developmental math instructors. The problem of developmental math curricula's negative influence on college students' experience is known to the research community, however solutions and routes to understanding student success are not yet available.

Research Purpose

The purpose of this research is to develop and validate an instrument that quantitatively measures the relationship between North Carolina's community college instructors' perceptions of student success and their instructional practice. Instrument creation includes multiple recognized survey development and validation methods. A pilot and validation study are conducted after an initial survey is developed, and a final survey is created after analysis of all pilot study data.

Research Questions

The creation and validation of a quantitative survey instrument that measures the relationship between instructors' perceptions of student success and their instructional practice answers the following research questions. The questions this dissertation and the creation of the survey instrument answer are directly related to instrument development, perceptions of student success, and instructional practices within North Carolina's community college developmental math courses. The following main question and three sub-questions guide this dissertation's research. The three sub-questions are intentionally used to completely explore and answer the main question about survey instrument development.

1. What instrument can be created to measure the relationship between community college developmental math instructors' perceptions of student success and their instructional practice in classrooms?
    a. What is the reliability and validity of the survey's measure for instructors' perceptions of community college developmental math student success?
    b. What is the reliability and validity of the survey's measure for instructors' personal instructional practice in community college developmental math environments?
    c. What is the relationship between the measure of the instructors' perceptions of student success and instructors' personal instructional practice?

Conceptual Framework

There currently is a need to research, understand, and promote student success in North Carolina's community college level developmental math courses. Many instructors in developmental math environments have experience with and possess extensive knowledge about student success. Therefore, the following conceptual framework in Figure 1.1 represents a way to quantitatively research variables that represent instructors' perceptions of student success and instructional practice in community college developmental math courses. Past research acknowledges that instructors' beliefs and values about teaching and learning influence educational environments and practices (Clark & Peterson, 1986; Fang, 1996; Kagan 1992; Stipek, Givvin, Salmon, & MacGyvers, 2001; Thompson, 1992). Therefore, all variables directly relate to perceptions of student success and instructors' personal instructional practice in this conceptual framework. The six perceptions of student success variables originate from a review of the literature.

The five instructional practice variables originate from my previous qualitative study. Therefore, this framework utilizes instructors' experience with successful students unlike any previous research. In addition, the framework investigates current perceptions of developmental math student success potential relationship with instructors' personal practice. The conceptual framework is graphically depicted in Figure 1.1.

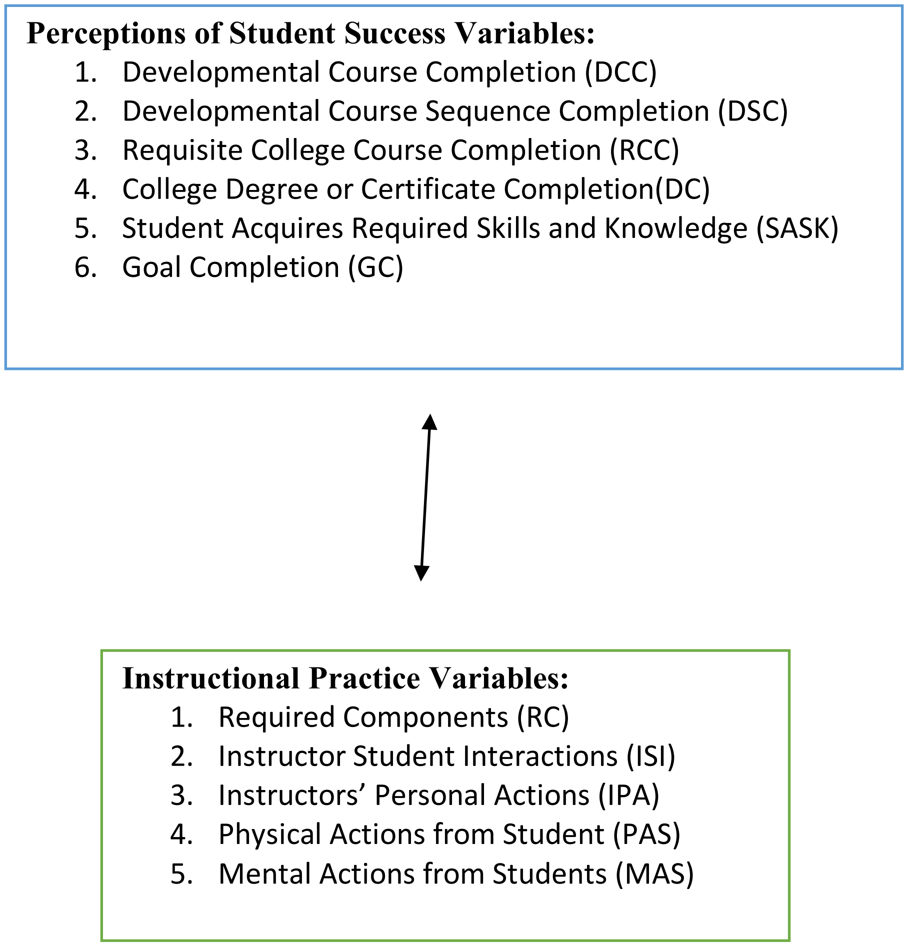

Figure 1.1. Conceptual Framework

Perception of Student Success Variables

For the purposes of this research, instructors' perceptions of student success are defined as how community college developmental math instructors express or define student success. In general, community college developmental math instructors' perceptions of student success are not utilized in current research, literature, or practice. Therefore, variables of instructor's perceptions of student success are researched and analyzed in depth for potential use. A literature review produces six perception variables that represent six particular perceptions of student success. The six perceptions of student success are Developmental Course Completion (DCC), Developmental Course Sequence Completion (DSC), Requisite College Course Completion

(RCC), College Degree or Certificate Completion (DC), Student Acquires Required Skills and Knowledge (SASK), and Goal Completion (GC). This dissertation demonstrates that community college instructors' perceptions are important and have a place in research, especially about community college student success.

Instructional Practice Variables

Instructional practices are all aspects of an educational environment that instructors perform in their profession. More particularly, my research only considers instructional practices to be aspects of developmental math course environments that instructors have control over. Aspects of their instructional practice that instructors have control over are what instructors are thinking, what instructors expect students to do, and what instructors are doing in their profession. Current literature and research provides multiple explanations, discussions, and justifications for instructional practices in community college developmental educational environments. In order to further understand developmental math instructors' practice beyond what literature has to offer, I conducted a qualitative study in 2015. The study is titled *Developmental Math Instructors' Impressions of a Successful Student's Experience*. My primary focus is to understand successful student experiences and how instructors think success in college level developmental math environments is accomplished (Winkler, 2015). Further details about this qualitative study are provided in chapter 2, the literature review of this dissertation. Results from the qualitative study produce five categories that directly relate to instructors' practice. The five categories are required components, instructor student interaction, instructors' personal actions, physical actions from the student, and mental actions from students. Each category represents a different aspect of developmental math instructional practice. Therefore, these five categories of instructional practices in developmental community college environments serve as my research's five instructional practice variables. The combination of perception and instructional practice variables allows this research to explore potential relationships between instructors' perceptions of student success and their personal instructional practice.

Significance of Research

The research uniquely contributes to the existing information about successful student outcomes in college level developmental math environments. My dissertation fills the gap between the large amount of literature concerning college level developmental math student success and developmental math instructional practice. A focus on developmental math instructors' perceptions of student success and personal instructional practice together links literature related to successful developmental student outcomes and best instructional practices for developmental environments. In addition, the source of data used in this research adds to the significance of all results. The source of the data taps into the under-utilized knowledge of developmental math instructors. Instructors experience situations that promote student success, and their experience is valued, utilized, and explored in my research.

This research produced a survey instrument and used method of gathering data that any future research can utilize. I provide valuable information about how to measure perceptions of student success, how to measure instructional practices, and how to explore the relationship between the two measures. Also, the development of the survey itself provides a better understanding of instructors' perceptions and personal definitions of student success. This dissertation produced further knowledge on the current yet evolving developmental math course environment to explore any and all perceptions of student success that lead to successful practices being implemented. Any community college or university that utilizes developmental math programs, and especially North Carolina community colleges will highly appreciate information provided in this research.

Definition of Terms

For the purposes of this research, the following definitions of terms are utilized:

The Accuplacer exam is an exam that new non-exempt community college students took as part of their enrollment process into a North Carolina community college (NC Community College Creating Success, 2015). The Accuplacer exam includes sections of reading comprehension, English use, and math skills assessment. A software company named College Board creates and sponsors the use of their Accuplacer exam. College Board states that their exams allow accurate placement of students based on multiple customized variables and modularized tests that align with government regulations and expectations (College Board, 2017).

A cut-score is defined by Boston College to be the point on a score scale that separates one performance standard from another (Horn, Ramos, Blumer, & Madaus, 2000). In North Carolina community colleges, cut-scores are the scores that determine if college students are required to enroll in developmental curricula, and which courses they should enroll in.

Developmental math curricula also known as developmental math courses, is defined as: Post-secondary remedial education with special attention being given to remedial mathematics course work (Bahr, 2008). In addition, developmental math taught in college is termed high school algebra remediation, because of the large amount of high school level algebra these courses contain. Students place into these curricula or courses before official enrollment, and are required to pass all remedial courses before attempting college level math or science courses that require developmental math curricula as a prerequisite. For an example of developmental math curricula, consider North Carolina community colleges developmental math curricula. There are eight developmental math, DMA, courses students can be referred to enroll in in the NC community college system. They are titled DMA1-DMA8, and must be completed in order from 1 to 8.

Developmental math instructors are any person with experience teaching developmental math material at community colleges. To elaborate, any instructor of a community college who currently or has previously taught at least one developmental math course at a community college.

Instructional practice is defined here as any and all activities related to facilitating developmental math courses at community colleges that instructors have control over. Aspects of instructional practices such as college environments and system wide policies are not consider instructional practices that instructors have control over. Other the other hand, instructional practice do include course preparation, student interactions, teaching style, and choice of course materials.

Mixed-mode survey designs allow researchers to reduce potential errors associated with asking multifaceted questions and analyzing responses from target audiences (Dillman, Smyth, & Christian, 2014). Mixed-mode surveys are used in situations that gather two types of data through two different means. More appropriate for this research, mixed mode surveys methods reach out to target audiences in more than once in efforts to complete a single survey instrument.

Open Enrollment is the when an institution or organization removes all requirements or prerequisites for acceptance into the institution or organization. Open enrolment refers to community colleges removing all acceptance requirements of student candidates before being accepted as a students. For example, North Carolina community colleges have open enrollment.

Therefore, any North Carolina resident can go to a local community college and expect to be accepted and allowed to enroll in course work.

Perceptions are defined as ways an individual understands, frames or interprets an experience. This dissertation's research focuses on how instructors understand and interpret student success in developmental math environments, and gathers instructors' perceptions for analysis with the use of a mixed-mode survey.

A current definition of *success* comes from Oxford's dictionary, which states that success is defined as "The accomplishment of an aim or purpose" (Oxford, 2017). In connection to developmental math students, success is the accomplishment of whatever the students' aim or purpose is.

Survey is defined as a means to investigate the opinions or experience of a group of people by asking them questions (Oxford, 2017). A survey is the tool this research creates and uses to investigate instructions' perceptions of student success and experiences promoting student success. Questions asked within the survey align with the variables and constructs of interest researched.

Assumptions

Assumptions play a role at many points during this research. The most obvious assumptions are discussed here with the intention to assist understanding and acceptance of this research's methodological choices. An assumption is something that is taken to be true even though the direct evidence of its truth is either absent or very limited. The following basic assumptions guide this research and particularly relate to perceptions of the primary researcher conducting this study.

My dissertation assumes that instructors in practice have highly valuable, significant, and useful information that is promoting student success in college level developmental math courses. Going further, the most valuable information available for increasing student success in developmental math courses is known by developmental math instructors themselves, and not by data analyst or school administrators attempting to study student success. Therefore, a high level of value and significance is placed on instructors' knowledge, and obtaining their knowledge substantially guides this research proposal's methods.

Another assumption that guides my research is that to promote developmental math student success is to understand what student success actually is. The assumption provides justification for methodological avenues chosen throughout, and explains why instructors' perceptions of student success are important variables within this research. Therefore, the content of this dissertation focuses on understanding student success' definition. After understanding the definition of student success, a relationship to instructional practices and instructional experiences is analyzed.

Limitations

Limitations are discussed here to provide a foundation for how this research originated, was carried out, and the significance of results concluded. An initial overarching limitation to this research is the positionality of me, a solo researcher conducting both research and analysis. My personal position may impact results and variable creation. I have years of experience teaching and building relationships with both developmental math students and instructors. My experience although useful in some aspects, may limit or guide interpretations of data collected. In addition, due to my direct involvement with developmental math student success, preconceived ideas or notions of what participants mean, or why they answer the way they do can be unintentionally be implemented into the findings.

In addition, the ethnical position I maintain can be considered an extreme source of biasness in my research. I am a white, male, American. Not only am I of the majority ethnic group, but I am participating in a society that caters to the success of white males. In reference to my topic of interest, this fact becomes substantial as I strive to understand a continuously diversifying community college student population.

Another limitation to the proposed research is how applicable measures and constructs created are to studying specifically North Carolina community colleges. Quantitative measures take many forms and specific measures created during this research are intuitive constructs rather than predefined methods of measurement. To be clear, current literature supports all content used to create quantitative measures related to student success and instructional practice, and all measures specifically relate to North Carolina community colleges in current literature. However, this research's measures of student success and instructional practice are intuitive constructs that are being quantified for the first time. Therefore, different interpretations of appropriate ways to quantify student success and instructional practice could potentially create different results and overall implications.

A final limitation addresses the statistical power of factor analysis results. For factor analysis results to possess enough statistical power to justifiably use results to make claims, there needs to be enough responses. Typical factor analysis results require a number of responses between 7 and 10 times the number of statements for significant statistical power to be obtained. Since my research has 37 statements in the factor analysis and I only had 52 complete responses, my research does not have substantial statistical power. Results of my pilot study are preliminary findings that provide information behind new constructs and new relationships. While the results do not possess statistical power, they do provide a foundation for understanding and improving the usefulness of the instrument created.

Chapter 1 Summary

There is a large and diverse investment into facilitating and promoting developmental math curricula in community colleges. Developmental math programs have proven effective at preparing college students for college level requisite material. Unfortunately, large portions of students are experiencing unintended outcomes of implementing large scale developmental math programs. The result is that developmental curricula negatively influences many students' college experiences. The negative influence appears as poor student performance, low student retention, inconsistent definitions of success in developmental environment, and the omission of instructors' input within current research. In particular, I research North Carolina's community college developmental math curricula to focus on a certain developmental math context. The purpose of this dissertation's research is to create a quantitative survey instrument that can reliably quantify and understand relationships between instructors' perceptions of student success and their instructional practice. The conceptual framework provides a graphical depiction of how instructors perceptions and practice are researched. In addition, my framework depicts all variable constructs that represent the important information my research gathered and analyzed. All variables of interest are related to perceptions of student success and instructional practices. In order to answer research questions associated with instrument development, this research creates, pilots, and verifies a reliable means of obtaining desired information. All information is obtained through a mixed-mode survey of North Carolina's community college developmental math instructors. After a brief pilot study and analysis of data gathered, improvements to the instrument, measures, and survey are made. Therefore, this research produced a critiqued and final version of the piloted mixed-mode survey. This research uniquely links literature between developmental math student success and instructional best practices. The following chapter two reviews relevant literature about developmental math and provides a foundation for why research on this topic currently possesses substantial educational merit.

CHAPTER 2: LITERATURE REVIEW

Introduction

A demographic overview of community colleges in United States starts the foundation for this literature review. Definitions of student success, developmental education, developmental math, and developmental math students are discussed in detail. Also, North Carolina's community college system and developmental math curriculum are described and explained to provide information about a particular community college developmental math context. Community college developmental math and student success are strongly connected within current research and literature. This connection presents itself through the variety of perceptions of developmental math student success that appear within many research projects. In addition, I discuss a previous summary of literature about best instructional practices in community college developmental math environments is also provided. I conclude this literature review with a description of relevant available research on community college developmental math instructors, and recent similar research that merits discussion in my research.

Demographic Overview of Community Colleges in United States

Community colleges first appear in United States' higher education system in the early 1900's (Brint & Karbela, 1995). At the time, higher educational pursuits in community colleges were directly linked to labor and job market skill obtainment. Approximately two percent of incoming college freshmen attended the small number of community colleges available. Since then, United States has created over 1,200 community colleges that are considered within a reasonable commuting distance to 90 percent of the population (Boggs, 2004). In addition, community college curriculum and pathways expand to include labor market skills, degree programs, certificate programs, adult educational programs, college transfer eligibility improvement, and much more. National student enrollment among community colleges increased 21.8 percent since 2007 (Mullin & Phillippe, 2011). Over 95 percent of 2-year college enrollment are at publicly funded institutions, and in 2015 nearly 8 million students enrolled in 2-year institutions (NC Community College Creating Success, 2017). Of the 1,200 current community colleges, 90.8 percent have no application criteria or restrictions for college acceptance, and 99 percent offer developmental services for college students that enter underprepared. Institutional statistics also include the fact that 61.2 percent of students are retained by 2-year colleges in comparison to 80.8 percent at 4-year colleges. Therefore, community colleges have cemented their position in United States' higher education system by becoming more popular and expanding options of higher educational pursuits available to many students.

Nationally, community colleges experience an increase in diverse students with diverse needs associated with acquiring college skills (Perin, 2002). For example, in 2015, three million full-time students enrolled in two-year institutions, while nearly five million enrolled part-time (National Center Education Statistics, 2016). Therefore, most community college students, five out of eight, enroll part-time, and pursue higher education at individualized paces. Also, for fall 2015, racial demographics of students that enroll in community colleges include approximately three million Caucasians, one million African Americans, 1.5 million Hispanics, and 0.4 million Asians. These racial demographics demonstrate a diverse student population among incoming freshmen at community colleges. Going further with demographics, students at community colleges in 2014 were 68.2 percent dependent, 14.5 percent independent with no dependents, 6.6 percent married with dependents, and 10.8 percent married without dependents. Also in 2014, 12.7 percent of two-year colleges' students were disabled. Therefore, community college students are unique and represent a diverse student body in United States higher education system.

In addition to student demographics, particular educational skills and knowledge levels associated with community college students are also unique. Students that enroll in community colleges are either high-school graduates, or are older students that return to school from the work force (Pitt, personal conversation, March 2017). For example, in 2015, 85.8 percent of students that enrolled in community colleges previously completed high-school, 24.2 percent had less than basic algebra math skills, 44.4 percent had less than algebra 2 skills, and 31.5 percent had taken a pre-calculus math course or higher (National Center Education Statistics, 2016). These statistics correspond to the important fact that 32.2 percent of incoming students are required to take a developmental courses in order to prepare for them college level material. Going further, 8.8 percent of community college students' grade point average exiting high school is below 2.0, 41.2 percent are between 2.0 and 3.0, and 50 percent are over 3.0. These developmental courses combined with students' poor performance in high school contribute to the fact that in 2012 at 2-year institutions students were 29.1 percent likely to graduate within 150 percent of the expected time required to complete their degree of choice. Therefore, students that enter community colleges are not necessarily ready for college course environments, and do not successfully complete college course work without an extended timeline to graduation.

Instructors and faculty members at community colleges mediate fulfilling institutional policies and requirements with successful student experiences and outcomes. To conduct this mediation, United States' community colleges employee 622,362 staff members in 2015, with 344,695 faculty members considered to be dedicated instructors (National Center Education Statistics, 2016). Therefore, instructors at community colleges make up over 50 percent of faculty. In addition, instructors at community colleges in 2015 were approximately 79 percent Caucasian, 10 percent African American, 7 percent Hispanic, and 5 percent Asian. Average full-time salary for 2015-2016 2-year college staff is $67,300. In particular, assistant professors make on average $49,618, instructors make $21,405, and lecturers make $4,541 annually at 2-year colleges. In addition, approximately 65 percent of 2-year institutions faculty members are full time equivalent staff with 35 percent being part-time staff. Therefore, instructor demographics in United States' community colleges are not as diverse as the students they provide services to, most of the community college faculty are instructors, and instructors expect to make well below the average community college staff member.

Definition of Student Success

Attempts to improve schools' curriculum cannot be successful without substantial agreement about the purpose of the curriculum and the direction of student success (Herring, 1992). The Oxford dictionary states success to be defined as "The accomplishment of an aim or purpose" (Oxford, 2017). In relation to students that enroll in college courses, student success is the accomplishment of an aim, a purpose, or a goal of enrollment into college courses. There are three main perspectives of student success in college contexts, the students' perspective, the instructor's perspective, and the institution's perspective. Other perspectives of student success originate from parents, communities, and local policies. With this in mind, students' perception of student success or purpose for enrollment into college courses may or may not agree or align with other perspectives. In order to capture as many perspectives as possible, student success is defined broadly here. Therefore, student success is the accomplishment of either students', community colleges', parents', or communities aim, purpose, or goal of student enrollment into college curricula. To obtain student success, many organizations are driven to invest time, money, and effort into all parts of this particular definition of student success. The definition of student success is extremely important, because how student success is perceived or defined leads, guides, and manipulates research that strives to understand it.

Community Colleges and Student Success

To start, open admissions are standard practice for over 90 percent of the nation's community colleges (National Center Education Statistics, 2016). In addition, between 35 and 40 percent of freshmen entering college at any college enroll in developmental course work (Bettinger & Long, 2009). Sixty percent of students that enroll in community colleges are required to take developmental courses, and in low-income or racially diverse student populations, up to 90 percent of students are required to take developmental course work (Achieving the Dream, 2017). Therefore, a large need to ensure the success of underprepared students has been established and put in place for United States' community colleges (Bryant, 2001). This is in part due to the reduction in admissions' requirements. Community colleges react to underprepared college students by providing various academic support programs. Examples of such support programs include, summer bridge programs, learning communities, co-curricular support, academic counseling, financial aid, child care, and subject specific tutoring. College developmental courses, also known as college remediation, is the most common approach to prepare students without the college skills needed to succeed (Martorell & McFarlin, 2012). This intense focus on developmental course work nationally cost freshmen that enter college over one billion dollars annually. In addition, seven billion dollars are spent annually on developmental coursework for colleges nationwide (Clayton, Crosta, & Belfield, 2014). Therefore, this substantial investment makes college developmental course work the largest intervention intended to improve outcomes for underprepared college students.

The substantial importance of developmental education combined with administrations' intentions to help students succeed has created many types of developmental curricula within the United States. In particular, the American Association of Community Colleges has recently shown particular interest in developmental math student success in college. The AACC initiative is to award five million more students degrees or certificates by 2020 than previously predicted (AACC, 2017). The American Association of Community Colleges created benchmarks and desirable student outcomes developmental math programs in United States community colleges are to be measured by (American Association of Community Colleges, 2012). These measurable outcomes are students' college readiness, developmental course progression, course completion, credit accumulation, and student persistence. The current public educational landscape is focused upon issues of community college student demographics, student completion, student success, and identifying ways to support underprepared college students through the use of specific programs or strategies (Bailey, Jeong, & Cho, 2010; Aycaster, 2001; Fike & Fike, 2008). Efforts to improve developmental math and reading curriculum structure are a large part of the reform process at community colleges (Fike & Fike, 2008). Analysis of data on over 28,000 students demonstrates that students enrolled in developmental course work are more likely to persist in college when compared to students with similar backgrounds that did not take developmental course work (Bettinger, Long, 2009). Therefore, remediation and developmental course work continues to be a large part of community college student success strategies and tactics.

Student success in community college environments is supported by many large collaborative organizations that are highly invested and interested in higher education. To name a few, organizations that support research and programs for student success particularly in community colleges include Achieving the Dream, the American Association of Community

Colleges, the Association of Community College Trustees, Completion by Design, Coalition on Adult Basic Skills, and the Aspen Institute College Excellence Program.

Achieving the Dream focuses on closing achievement gaps for diverse and low-income students (Achieving the Dream, 2017). Current student success initiatives for Achieving the Dream include programs such as the Community Colleges Count. The Community College Count is a national student success initiative to increase the number of degrees and certificates awarded to community college students. Achieving the Dream continues to be a large contributor to community college representation and research, and is discussed further later in this review. The American Association of Community Colleges dedicates themselves to being the national "voice of community colleges" (AACC, 2017). This association of trustees represent the 1,200 national community colleges in discussions with administration such as the United States congress, the Department of Education, and the Department of Labor. Therefore, community colleges have large organizations that represent and support their interest and voice. In a particular reference to student success, the Association of Community College Trustees promotes policies and services that foster completion, workforce training, and transfer of skills to create self-sufficient community members. This support appears in student success initiatives such as Title III Strengthening Institutions Grant, where eligible institutions are assisted in serving low-income students with stable quality academics. In addition, Completion by Design is a five-year national student success initiative funded by the Gates Foundation to significantly increase completion and graduation rates of community college students (Completion by Design, 2017). Completion by Design intends to increase student success by maintaining access and quality with minimal cost. Results of Completion by Design include creating a Developmental Education Initiative as well as many other initiatives. The Developmental Education Initiative was a three-year initiative to understand policies, practices, and resources community colleges successfully implement to assist students in need of developmental education (Achieving the Dream, 2017). The Coalition on Adult Basic Education, COABE, is a group of educators, administrators, and mentors that advocate to create new opportunities for adult students and provide educational faculty support (COABE, 2017). COABE is dedicated to adult education and providing adult students means to obtain better jobs and better ways to support their family. In addition, the Aspen Institute College Excellence Program aims to advance college practices and significantly improve student outcomes (The Aspen Institute, 2017). The accumulation of effort from these organizations as well as many others creates an avenue for community college staff and administration to voice concerns and opinions about community college practice or policies. Results of these organizations forming and following initiatives of student success include more informed policy decisions, more informed practice, and better overall student outcomes. Therefore, programs and initiatives for student success in community college environments possess high levels of national support and interest from a variety of well-established organizations.

Developmental Education

By 1890, 80 percent of colleges possess college-prep course work (Dotzler, 2003). College-prep course work, or developmental course work, prepares students to enroll and succeed in college courses. In particular, introducing open enrollment to public institutions in the 1960's created a dramatic increase and need for post-secondary developmental education. The initial idea that students need a remedy for academic deficiencies produced the name of remedial education for courses that cater to underprepared college students. Today, remedial education in college environments is better known as developmental education and developmental course work. The idea that students' skills for college courses need to be developed in order for them to succeed produced the name developmental education. Typical developmental education courses include three main topics of interest, reading, English, and math. These three main topics of student development where introduced in 1849 at the University of Wisconsin as reading, writing, and arithmetic, and was housed in designated college preparation departments. Remarkably, subject headings of college level developmental courses remain relatively the same since that time. Today's college developmental course work includes subjects of reading, English, and math, and currently excludes any further subject specific pre-course work. Therefore, college level developmental education has existed for many years and particularly refers to pre-college course work in the three subject areas of reading, English, and math.

What developmental education is and how it relates specifically to community colleges portrays developmental education's purpose in college curricula. Unfortunately, developmental education gets lost in many higher education discussions (Kalbaugh, personal conversation, September, 2017). However, many researchers do focus on its significance. Current educational researchers state that, "Developmental education is designed to provide students who enter college with weak academic skills the opportunity to strengthen those skills enough to prepare them for college-level coursework" (Bailey, 2009). In 1991, approximately 74% of the nation's colleges and universities provided remedial or developmental courses to students (Boylan 1995). Today, 99 percent offer developmental course work to incoming students (National Center Education Statistics, 2016). So, the need for student remediation and development has been apparent for many years, but developmental course work is often overlooked in higher education's pursuits and discussions toward student success.

Consider the statement that, quality education that meets all students' needs must acknowledge that not all students can be placed on the same educational assembly line and expect equal educational obtainment (Herring, 1992). Developmental education is a means of building students' college ready skills so that they obtain educational goals equal to that of students that are not in need of development. Therefore, developmental education serves an important role in higher education by providing more than one pathway to success for many students. Currently, there are two avenues for colleges to implement developmental programs. These options are mainstreaming (stand-alone courses) and centralization (all remedial course in one developmental department) (Perin, 2002). Colleges that mainstream developmental courses offer course in their corresponding English and math departments. Here, reading and writing developmental courses are in the English department, and developmental math courses are offered through the math department. Colleges that practice centralization house all developmental courses in a separate developmental department that is focused only on student development and preparing students for college. Therefore, community colleges have two options to provide developmental subjects for students.

For an idea of what kind of content development education includes, consider Levinson's book, *The Seasons of a Man's Life*, where four psychological development stages are determined and explicitly explained in order to research adult psychological development (Levinson, 1978). Levinson's perspectives on psychological development demonstrate that important aspects of life and development are found within individuals' sociocultural world, aspects of self, and participation with the available world or community. Also consider, *The Seasons of a Woman's Life,* where Levinson states that development is definitely extended into adulthood (Levinson, 2011). Adults construct reality and integrate their ways of knowing and learning into educational contexts. In particular, developmental education's material and instructional methods intentionally appeal to students' previous learning experiences as much as possible (Belenky, 1986). Implications and conclusions discussed by adult development research are applicable to the psychological development of students anticipated to take place in community college developmental courses. A student's beliefs and values concerning topics such as mathematics often indicate their psychological stance toward accepting success. For example, in order to raise student self-efficacy and actually develop students enrolled in developmental courses, individual's sociocultural worlds, aspects of self, and participation with available resources are considered very important aspects of the curriculum that encourage development. With this in mind, developmental courses' content ranges from subject specific research and content, to standard homework, to college-life skill development, to financial literacy (Pitt, personal conversation, March, 2017). Therefore, developmental math education in community colleges provide students with more than just math skills (Kalbaugh, personal conversation, September, 2017). Reasons behind the wide range of material presented in developmental education relate to a statement about life after college made by Dallas Herring in his book titled "What has Happened to the Golden Door?" (Herring, 1992).

> "A system of study that emphasizes applied basic educational experiences and relates them to occupational education … so that students that desire 1. To become aware of 2. To explore in a general way 3. To become skilled in a certain occupation, may acquire a better understanding of the importance of basic education to their occupational goals and may be motivated to increase their understanding of basic education in preparation for adult life."

Therefore, developmental education not only provides math/English content that prepare students for college course success, but provides content that prepares students for overall life success and successful life experiences to come.

Developmental Math Programs

Community college developmental math education and programs are particularly elaborated on in this section. A large responsibility of community colleges is to accept students into a college environment and determine a program of study. In addition, developmental math programs have become an integral part of students' acceptance and overall college success (Perin, 2002). So, what is developmental math? Developmental math, in community college contexts is post-secondary remedial education with special attention being given to remedial mathematics course work (Bahr, 2008). College developmental math content is also referred to as high-school algebra. So why is developmental math important? The importance of mathematical material found in developmental math courses to college success and advancement is substantially researched (Horn, 2000). A study that researched over 85,000 first year community college students in 107 colleges with intentions to understand the influence of remediation, concluded there is a direct relationship with successful remediation and long-term college attainment (Bahr, 2008). Therefore, research concludes a strong correlation between eighth-grade algebra skills possessed by college students and enrollment success in advanced mathematics courses at four-year colleges.

College institutions experience curriculum and policy adjustments to programs in attempts to accommodate to low mathematics literacy and self-efficacy of incoming students. Policy changes influence instructional applications and manipulate student experiences in crucial developmental courses. Constant changes in college policies and student demographics creates a variety of formats for developmental math courses and programs that are discussed here to provide information behind an educational environment many college students encounter. Developmental math program design and impact on student outcomes is a focal point that aids student success at community colleges in recent years (Jackson, 2014). Developmental math programs thought to be “highly effective at resolving skill deficiencies”, but the process of implementing programs and identifying which skills are deficient is debatable (Bahr, 2008). Different developmental programs provide a variety of different developmental courses that are presented in multiple formats. For example, in a study on developmental math courses, colleges use a lecture format, an individualized format with tutors assisting teachers, computer aided instruction, and both lecture and computer aided instruction in developmental math course formats (Aycaster, 2001). All of these formats were used at a single community college. In addition, typical developmental math programs have sequenced courses associated with student completion before college course enrollment is allowed (Pitt, 2017; Kalbaugh, personal conversation, March, 2017; NC Community College Creating Success, 2017). Sequenced courses in developmental math education consists of taking multiple, smaller, modularized, condensed, and more detailed mini-courses. These mini-course cumulatively build students’ skill set one mini-course or module at a time in order to complete a total sequence of courses. Therefore, developmental math course content and format vary according to policies, resources, and individual college environments.

Results of Developmental Programs

To start, a direct result of implementing developmental programs into community colleges is the assumed need for an initial student knowledge assessment. Initial student knowledge assessments take the form of placement tests within community college environments. There are two placement exams primarily adopted and widely used by community colleges in United States, Compass and Accuplacer (Fields & Parsad, 2012). In 2012, sixty one percent of community colleges used Compass, while 39 percent used Accuplacer, and very few used the SAT, ACT, or other tests to determine student placement. Community colleges typically require a placement exam prior to student enrollment and acceptance to determine how many, if any, developmental courses students are required to enroll in. Recent 2014 policy adjustments allow states to create state specific placement exams mandated for all community colleges in a particular state (Kalbuagh, personal conversation, September, 2017). Therefore, Accuplacer and Compass are slowly being replaced with population specific and state specific placement exams.

More importantly, student outcomes from developmental course programs have mixed reviews with varying performance levels associated with student success and the appropriateness of developmental course work in colleges. For example, within recent reforms, students can be referred to eight different levels of developmental course work. This requires students to navigate through multiple semesters of courses before being considered prepared for college course work to begin (Baily & Cho, 2010; College Board, 2017; NC Community College Creating Success, 2017). In addition, research on developmental math reform questions the existence of positive outcomes for students that enroll in developmental math courses (Martorell & McFarlin, 2012). Researchers state that the key to appropriately assisting a student in need of remediation is to identify those in need well in advance (Clayton, Crosta, & Belfield, 2012). However, this may not be taking place for many community college students. Therefore, community college students may be hindered rather than assisted by developmental curricula that is intended to help them succeed (Bahr, 2008).

Currently, student success in community college developmental math courses is a direct avenue to the improvement of graduation rates for a large number of community college students. Developmental math student success opens up career opportunities for many students previously hindered by low cognitive or affective math skills. In contrast, students' failure in developmental math during a first-year of community college highly influences nearly all future course choices and extends all college pathways. Therefore, research depicts the effectiveness of developmental math courses and programs to be unclear. Despite inconclusive evidence, low mathematical competencies of first-year college students creates a large and diverse investment into developmental college math programs (Bryant, 2001). However, strategies implemented and maintained in the past that are meant to promote student success in what are critical developmental college courses are inconsistent at best (Aycaster, 2001). Another example of this appears in research about helping developmental students within Tennessee's recent developmental course redesign. Results demonstrate that potential effects of remediation are determined not to be statistically significant on student outcomes after two years (Boatman, 2012). In addition, the National Center for Postsecondary Research (NCPR) report concludes that developmental course work results and effectiveness vary according to the level of students' academic preparation (Boatman & Long, 2010). Therefore, the large and diverse investment into developmental math programs may or may not be effective at developing skills students need to be successful in college (Baily & Cho 2010; Clayton & Rodrigues, 2012).

Developmental Math Students

Statistically speaking, 30 percent of all freshmen entering college take at least one developmental course, and this statistic does not consider students who are required to take developmental course, but don't enroll (Boylan & Boone, 1995). Developmental math courses primarily enroll first-year college students (Puaa, 2011). Basic advising standards and guidelines suggest that students enroll in reading, math, and English courses each semester until they no longer need each subject to graduate. A result of this advising standard is a first-year student majority in developmental courses (Pitt, personal conversation, March, 2017). Only after completion of developmental courses, can students enroll in college level courses. Since developmental courses become prerequisites for many college level courses, many first-year students start their enrollment in developmental math course work.

Community college first-year student populations contain a majority of recently graduated high-school students (Pitt, personal conversation, March, 2017). High-school students as well as first-year college students demonstrate strong correlations between performance and self-efficacy levels related to math (Hackett & Betz, 1989). In fact, many students possess extremely low levels of math self-efficacy exiting high-school, which translates to poor performance with the subject. In general, developmental math students are not happy with or familiar with the idea that they can know or need to know mathematics (Fowler, 2010). The word choice of "not happy with", implies there are certain emotions behind developmental math students' actions and perceptions. This is because students in developmental math are accustomed to and have been forced to accept that they typically do not do well with math oriented educational material. Students entering developmental math courses do possess situated cognitive skills using the math material presented in these courses, but typically lack self-efficacy in math learning environments such that material is not viewed as familiar or even possible (Choi & Hannafin, 1995). Situated cognition can be conceptualized as the ability to perform a cognitive task, but only in certain situations. Unfortunately, for developmental math students' situations of using cognitive math skills are not associated with developmental math course environments. Compounding this disassociation between material and experience, students' perceptions of their cognitive skills affect self-efficacy levels and motivation associated with completing mathematical content (Jackson, 2014). If students share initial feelings of success, or feelings of potential success related to mathematical material presented in developmental math courses, then they are substantially more likely to accept success as an unfamiliar option. This means that students' perceptions of math alter their interactions with the material, and alter their motivation to succeed or try, which can lead to failure. In addition, low math self-efficacy levels of high-school students impact overall college aspirations and goals, and poor performance is exposed during first-years of college. Therefore, negative impacts of low math self-efficacy levels appear in student performance, perceptions, and college experiences of today's students, and especially in today's developmental math students.

Also, first-year students encounter a variety of changes and transitions during enrollment into higher education that influences potential career paths and overall college experiences. Therefore, current literature emphasizes the importance of first-year college experiences for students, and in particular the importance placed on expected amount of time until graduation (Choy, 2002). Students that attend community colleges allow expected amount of time until graduation to influence their important first-year decisions. Note that remedial course work is not just for recent high school graduates, and that "over one-quarter (27 percent) of entering freshmen in remedial courses were age 30 or older and only half (56 percent) of students enrolled in remedial courses are freshmen (National Center Education Statistics, 2016). When researching how to access and improve the chances of success with such dynamic student demographics, a clarification of personal aspirations and an increased commitment to college drastically increases students' positive outcomes (Karp, 2011). Therefore, students that enroll in developmental math courses are determining aspirations, goals, and expectations during their first year of college, and developmental education highly influences all of developmental students' choices.

To help understand how developmental math students perceive success, consider the following dissertation. In 2014, four groups of students divided according to expectations and values associated with a new community college developmental math computer based curriculum are revealed to understand developmental math student populations further (Jackson, 2014). New state level requirements concerning developmental math curriculum affected 58 local community colleges, and large numbers of first-year students. Groups created from this research are commitment, confidence, and resource; communication and understanding; access and mastery; access and strategy. The groups are based on student perceptions of what academic success is, how it is obtained, and why students think academic success is important. The first group values commitment and confidence as a means for expecting success to occur. The second group associates communication and understanding with success within the developmental math environment. The third group believes mastery of mathematics and applicable use of and access to resources is crucial for success to occur. The fourth group approaches success with certain strategies and uses resources for expectations of success. The research articulates that a large number of developmental math students expect and value success. The research goes further to discuss that students' expectations and values are directly associated with students' identity and motivation to succeed in this type of academic environment. Therefore, students expect and value success, however understanding why they expect and value success is more closely related to the dynamic identities of developmental students.

Developmental Math Student Abilities

After a discussion of student identity and perceptions, mathematical literacy and abilities of students that enter college is explored here. Developmental math is chosen for elaboration in this section, and this discussion intentionally excludes developmental reading and English skills. So, what level of mathematics proves difficult to developmental math students, and why? What are student's experience with mathematics and is it positive, negative, successful?

Placement exams that refer students to specific developmental courses determine the mathematical literacy of first-year community college students. The exams are either the Compass, Accuplacer, or state created placement exams. Potential exemptions to placement testing were discussed in previous sections. Importance and impact of placement exam results are highly acknowledged by developmental math instructors and department chairs at community colleges (Pitt, personal conversation, March, 2017). For example, a community college department chair of math demonstrates interesting facts about the process by which students enroll in developmental math courses. The chair explained how their faculty reviews all placement test scores and students' information immediately after students takes a placement exam. Community college faculty are well informed of what high-school students are capable of and initially consider if students rush through the exam according to the amount of time spent on it. Therefore, if students are close to passing all developmental math requirements or faculty suspects the students can do better then faculty personally reach out to students immediately after the exam. Conversations with students include encouragement, information about tutoring services, computer availability, and information about practice placement exam problems. This example demonstrates the importance and significance associated with students' knowledge assessment by critical placement exams, and the large amount of encouragement that takes place in order for students to avoid as much developmental curricula as possible.

In addition, research has found that United States' high-school students are underprepared for college level mathematics (Boylan & Boone, 1995). Alarming amounts of high-school graduates possess a level of mathematics comprehension when they exit high-school not sufficient to continue on to higher education's curricula (Puaa, 2011). Yet, large numbers of underprepared high-school graduates enter college which increases the number of students influenced by developmental college curriculum (Aycaster, 2001). Therefore, many first-year student populations at community colleges are not equipped with the math skills they need to be successful in college. Personal experience has shown that these students need support, need time, were left behind, and often cannot control their circumstance with the subject of math (Pitt, personal conversation, March, 2017). Consequences of low levels of mathematical literacy from incoming college students appears in many areas in many levels of college. According to research in 1995, nearly one quarter of students (23 percent) are exposed to developmental education in any given academic year, yet only 5.9 percent of the professional faculty in American higher education works with developmental students (Boylan & Boone, 1995). Reasons behind poor levels of performance are directly linked to mathematics and test anxiety correlated to student variables such as ability, school grade level, and undergraduate field of study (Hembree, 1990). To address low performance of students in the area of mathematics anxiety around the subject must be reduced and accounted for in developmental instruction. There are multiple types of treatments for math anxiety created to assist students. These treatments are classroom interventions, behavioral modes, cognitive treatments, and cognitive-behavioral treatments that developmental environments explore to assist students that are underprepared for college level curricula.

Students enrolling in developmental math do not have math quiz or test taking skills (Fowler, 2010). However, students more than likely possess mathematical cognitive skills the quiz and test require. These skills that students do possess are situated in contexts they do not associate with learning mathematical material or taking quizzes. Therefore, developmental math students typically do poorly on common math environment assessments. The math material presented in developmental math courses is material that public school students are exposed to in grade three, so the material is familiar yet students do not associate it as such. Also, the interactions of people in learning environments often determine what is learned and how it is learned. Past interactions associated with learning math for students who are placed in developmental math courses are typically not positive. Students who enter developmental math courses have learned that they cannot do math due to their past experiences in math environments. Exploration of beliefs students house in relation to success in developmental math can guide the creation of a justifiably significant “factor structure for foundational theoretical perspectives in developmental math” curricula (Jackson, 2014). So, current research also justifies the exploration of student beliefs and perceptions related to math. Since these students create a self-perception of not being able to learn math, any situated cognitive skills related to the material is neglected or ignored. The situated cognitive skills are being neglected due to students’ lack of self-efficacy in relationship to math. Research such as Kitchens in 2014 aims to understand student beliefs and values formed through previous experiences (Kitchens, 2014). Kitchens’ research is an example that creates a new approach to introducing success, potential, and value to a developmental student population that doesn’t necessarily associate success, potential, and value with mathematics (Kitchens, 2009).

Demographics of North Carolina Community Colleges

The General Assembly of North Carolina first decided to fund community colleges in 1957 (Get the Facts, 2017). In 1961, 12 community college were available for North Carolina’s adult student population, and by 1969 there were 54 North Carolina community college institutions servicing nearly sixty thousand students. Recently, North Carolina’s public two-year institutions enrolled 223,140 students in 2015 (National Center Education Statistics, 2016). North Carolina is also the third largest community college system in the United States. The system's mission is to provide accessible educational opportunities with minimum barriers to post-secondary credentials to maximize student success (Get the Facts, 2016; NC Community College Creating Success, 2016). Interest in community college student success from large educational organizations such as Achieving the Dream produced the North Carolina Student Success Center funded by the Gates foundation, Belk endowment, and Kresge foundation. The North Carolina Student Success Center (NCSSC) provides a current definition of student success and explains SuccessNC as a strategic plan to accomplish organizational goals and initiatives (NCSSC, 2017). NCSSC considers student success to occur when,

> 1. Students make informed decisions.
> 2. Students' progress through programs that lead to valuable credentials, without unnecessary detours.
> 3. Students are provided integrated, targeted supports and interventions when these are most effective. (NCSSC, 2017)

In addition, Success NC is the Success Center's strategic plan to accomplish three main goals. The three goals are to improve student success, increase student access, and ensure program excellence. The strategic plan elaborates on what is meant by each goal's title, and in particular here the "increase student success" goal is elaborated on due to its relevance for this literature review. The plan considers increasing student success to be the act of increasing the number of students that leave institutions with credentials that allow them to become successful employees or employers. Also, increasing student success is attributed to providing students with better skills, better jobs, better pay, and continued educational attainment. Therefore, North Carolina invests substantial time and effort into student success initiatives. Results are a baseline of 35.9 percent of students either graduate, transfer, or persist with at least 36 credit hours after one hundred and fifty percent of time expected for completion (NC Community Creating Success, 2016).

In addition, in 2011 69 percent of all recent high-school graduates placed into a developmental course during their application process to a North Carolina community college (NC Community Colleges Final Report, 2013). In comparison, a national study concluded 67 percent of high school graduates placed into a developmental course (Smith, 2017). Due to a high percentage of students being placed in to North Carolina's developmental courses, approximately 10 percent of North Carolina's community colleges' budget is dedicated to facilitating developmental programs. North Carolina community colleges currently receive attention and experience program reform to help further promote students' success (Squires, Faulkner, & Hite, 2009). Current reforms in North Carolina community colleges focus on large-scale institutional structures and curriculum modifications to developmental math programs (Santikian, 2015). The result of current reform is a particular developmental math curriculum implemented in North Carolina's community colleges since 2013. North Carolina's community college system currently enrolls approximately 73,500 new higher education students each year, so the new curriculum influences many new college students (Get the Facts, 2016). Also, all of North Carolina community colleges utilize developmental programs. In addition to developmental math courses being present, institutional reform and program changes highly influence the developmental math environments and many first-year college students experience these changes (Hodara, Jaggers, & Karp, 2012). Therefore, North Carolina community college demographics, graduation rates, and student preparedness are comparable to national statistics on community college institutions. In addition, many first-year North Carolina community college students experience the ever changing influences of new developmental programs.

North Carolina Developmental Math Education

North Carolina is one of four states to initially participate in the national Completion by Design student success initiative in 2011 (NC Community College Final Report, 2013). Part of the Completion by Design initiative includes the creation and implementation of the Developmental Education Initiative to understand successful policies and practices in community college developmental environments (Achieving the Dream, 2017). The Developmental Education Initiative kicked-off the creation of and implementation into policy of a program titled *Developmental Math Modular Curriculum* (Kalbaugh, personal conversation, September, 2017). The Developmental Math Modular Curriculum is the current developmental math course policy reform used in North Carolina's community college system since 2013 (Santikian, 2015). Motivation for the 2013 redesign includes developmental curricula that contains development of the student for college life (Kalbaugh, personal conversation, September, 2017). The basic format of the reform requires all North Carolina community colleges to implement a standard eight course modularized curriculum for their developmental math offerings (Developmental, 2011). Other aspects of the redesign include developmental math courses counting as financial aid credit hours of course work. However, developmental courses do not count as college credit hours earned for students' time spent on them. Currently, the developmental math program redesign contains eight developmental math courses students may be required to enroll in before taking any requisite college level math courses. The courses are titled DMA 10, DMA 20, through DMA 80, where DMA abbreviates developmental math.

Since creation of the Developmental Math Modular Curriculum in 2013, there have been two substantial changes to the initial North Carolina policy and new curriculum (Kalbaugh, personal conversation, September, 2017). The first change centers on adjustments made to the use of results produced by Accuplacer placement tests. These changes are important because they influence procedures for students' placement into developmental courses and influence the placement tests students are required to take. The new program initially included one large three-part module with the first five DMA courses being smaller than the sixth last three part module. The initial intention was to accelerate students at the end of their remediation by creating one module with more content. However, the Accuplacer placement test includes eight modules of material, so there was confusion about where and why students placed into each module, especially the last larger module. Therefore, the first change to policy is that eight DMA courses were created and offered to correspond to the eight sections in the Accuplacer placement exam.

Going further, developmental faculty and students started to question the validity and usefulness of current placement exams for assessment of their state's particular student demographics. The result is another adjustment made to North Carolina's developmental math curriculum design. States are now allowed to create and implement their own state specific placement exam. Therefore, North Carolina created and fully implemented in 2015 the North Carolina Diagnostic and Placement Test (NCDAP) which is specialized just for North Carolina's community college student population (NC Community College Creating Success, 2017). Aspects of both the Accuplacer and NCDAP are discussed in the following paragraphs.

An additional policy adjustment took place in 2016 and concentrates on which students need to take placement tests. Reports from Completion by Design concluded that the best measure of a student's college readiness is their high-school grade-point-average, however results do not indicate an ideal GPA to reference. The report goes further to show that students with 3.0 GPA's do fine in college when compared to students with 2.5 GPA's. Therefore, North Carolina policies surrounding the Developmental Math Modular Curriculum adjusted to include a cut-off high-school GPA that allows students to be exempt from taking the NC DAP. The cut-off high-school GPA North Carolina community colleges use is 2.6. Therefore, if students exit high-school, within the last 5 years, with an unweighted grade-point-average of 2.6 or better, they are not required to enroll in any developmental course work entering community college. Future policy adjustment discussions include changing the cut-off GPA to 2.8 to require more students to take the NCDAP, and potentially require more students to take developmental courses. In addition, national policy adjustments and conferences discuss removing placement tests completely by introducing the use of co-requisite courses. The use of non-credit co-requisite courses is more subject specific and requires students to enroll in an assistive co-requisite course. These co-requisite courses contain independent goals and student outcomes separate from the requisite college level course. Therefore, policies concerning North Carolina’s community college developmental math curricula has undergone substantial changes and reform in efforts to better serve the student population and future adjustments are likely.

Policies in place after 2016 include a hierarchy of measures established for North Carolina community colleges to use and assess students’ level of readiness for college (NC Community College Creating Success, 2017). The hierarchy is as follows, high-school graduate in last 5 years with acceptable GPA, followed by ACT or SAT subject specific exam score, then followed by a potential placement test. North Carolina students are required to take the NCDAP as of 2015 to assess their readiness for community college math during initial enrollment (Kalbaugh, personal conversation, September, 2017). However, students can be exempt from taking the NCDAP according to this hierarchy of measures (NC Community College Creating Success, 2017). Students are exempt if they have graduated high-school within the last five years with a grade point average of 2.6 or better, have scored a 530 or more in math on their SAT, have scored a 22 or more in math on their ACT, or have enrolled in college-level math courses in the past (Developmental, 2011; Kalbaugh, personal conversation, September, 2017). The assessment of students' knowledge uses results from the NCDAP. The NCDAP is presented to students within the Accuplacer placement exam software platform created and implemented by College Board (NC Community College Creating Success, 2017; Pitt, personal conversation, March, 2017). Therefore, this hierarchy of measures is used to determine if North Carolina's incoming college students are required to take the NCDAP or are exempt and ready for college level material.

Outcome of Recent Developmental Math Program Reform

Since the Developmental Math Modular Curriculum redesign was implemented into North Carolina community colleges developmental math course environments primarily include computer guided activities and self-paced modularized material (Santikian, 2015). In order to progress through modularized courses developmental math students must "achieve mastery" of the material presented in each module (Developmental, 2011). Mastery of the material is considered to be when students successfully score 85 percent or more on end of module tests. Module tests are completed through a variety of developmental math computer programs. North Carolina uses software created by College Board, a college software developer. All course activities and check-points are primary accomplished on computers. In addition, new developmental math environments require students to work on computers outside of designated class times as well as attend classes to work on computers. So there is required classroom attendance to promote interactions with other developmental math students and developmental math instructors, but courses are completed through online testing and software. In fact, some community colleges require attendance from students during the first two days of class before continuing enrollment, and if students are absent for the first two days they are dropped from course enrollment (Pitt, personal conversation, March, 2017). Therefore, course formats are a combination of computer homework, group work, lecture sessions, workbook sessions, college preferences, and computer sessions.

In addition, student progress in North Carolina developmental math course is tracked through the use of the software programs instructors have access to. Developmental math instructors are allowed to control much of what takes place in developmental math classrooms and the computer sessions provided to students. Often, instructors' decisions are based on software results and reports on student progress. The software programs allow instructors of these courses to utilize real-time student and class progress reports to identify areas or course topics that multiple students struggle with. Instructors are then able to give concentrated small group lectures to students on specific areas and topics of need while other students continue to work on their required computer course work all in the same classroom.

Influence on College Student Experience

To start, North Carolina's community college level developmental math courses are expected to take students one quarter of a semester, or four weeks to complete (Developmental, 2011). Therefore, students that need all eight remedial courses are anticipated to receive up to one full year of remediation if all courses are completed on schedule. However, in order to assist students through remedial curricula the redesign allows developmental math courses to be completed at personal paces and therefore potentially accelerated rates (Pitt, personal conversation, March, 2017). In conjunction with the redesign's format and policies, community college faculty design and implement multiple methods and approaches to facilitate accelerating rates of completion in developmental math courses (Kalbaugh, personal conversation, September, 2017). Therefore, there are variations on how the redesigned Developmental Math Modular Curriculum is being presented and offered to students from college to college in North Carolina.

Examples of how two North Carolina community colleges present and offer developmental math courses are provided here for comparison and contrast. To assist with accelerated paces, the first example, College A, allows students to sign up for all their developmental math courses for one semester at one time at the being of the semester. A maximum of four developmental math courses can be enrolled in per semester at College A. In addition, students remain enrolled in developmental courses from semester to semester if they do not complete them before the term ends. So there is enrollment roll-over. Also, students must complete each course in its' appropriate sequence in North Carolina's curriculum, so DMA 50 comes after DMA 40, which is after DMA 30, etc. Therefore, the curricula redesign expects students to follow a very structured format for course progression and course content completion with the only leniency being rate of completion. College A mandates no time limits or enrollment maximums for developmental math courses, so students stay enrolled until they complete their developmental course work. However, College A does not restrict students from completing all of their required developmental math course work in one semester, if possible. Even though they only enroll in four DMA courses at the beginning of the semester, they can complete as many as possible. Therefore, students can enroll in a semester of developmental math courses and complete all eight, seven, six, five, or four developmental math modules as quickly as they can. The next example college, College B, has similar characteristics to the first. However, it is worth noting there is a much larger developmental math student population at community College B. College B offers developmental math "Shell" courses, DMS courses not

DMA courses (Kalbaugh, personal conversation, September, 2017). There are three shell courses developmental students can enroll in, DMS 001, 002, and 003. Students still complete the North Carolina community college system's required eight modules via computer software programs in these shell courses. Also, students are referred to semester long shell courses, DMS 001, 002, or 003 according to results from their NC DAP. If students do not pass any of the first three levels of the NCDAP, they are referred to DMS 001, if they do not pass the fourth, fifth, or sixth level they are referred to DMS 002, and if they do not pass the final two levels of the NC DAP, then they are referred to DMS 003. Similar to the first example, this college allows students to complete as many developmental course modules as possible while enrolled in one of the DMS courses. However, at College B, if students do not pass all their required developmental courses, then they must enroll in another semester long developmental shell course. Ideally, results of students going through developmental curricula are the production of students that are college ready and can be successful in college. However, the amount of time and effort for students to become college ready through developmental course work dramatically varies and hinders some students' overall success. Some variation in student performance and experience is related to how the Developmental Math Modular Curriculum is presented, required, and offered to students uniquely at different North Carolina community colleges.

In addition, developmental courses' position in community college curriculum influences many students' enrollment experience and completion of higher education programs. Direct results from reduced acceptance requirements are a reduction in program completion rates, prolonged college enrollment periods, and extended college graduation rates (Jenkins & Cho, 2012). Some developmental math students do not acquire basic developmental skills and insights as significantly or quickly as others (Herring, 1992). Therefore, these students' progress is seriously hampered and education becomes a discouraging and frustrating experience. The impact of developmental courses' position in college curricula highly contributes to overall student outcomes and persistence. Success from students in what are critical courses for a large portion of the community college population is essential for positive college experiences at all levels to take place (Jenkins & Cho, 2012).

Going further, developmental students possess a strong connection between performance and self-efficacy levels, and this connection is well established within current literature. In fact, many students possess extremely low levels of math self-efficacy exiting high-school (Hackett & Betz, 1989). Low math self-efficacy levels of high-school students impact overall college aspirations and goals, and are exposed during their first-year of college. Negative impacts of low math self-efficacy levels appear in student performance, perceptions, and college experiences of college students. Higher education in areas such as science and math require basic algebraic skills and the ability to complete basic numerical manipulations. Therefore, low success in developmental math courses contributes to students that avoid science and math college curricula (Choy, 2002).

To summarize developmental math's influence on student experiences, developmental programs are currently "gatekeepers" for students with low mathematical abilities and for students that require math remediation before attending college level courses (Jenkins, Jaggers, & Roksa, 2009). In community colleges, if students are required to take, but do not pass developmental math curricula they cannot enroll in college level requisite courses, especially math and science courses. Therefore, many community college students are sidetracked in their first-year by developmental courses that do not receive college credit, and in particular are sidetracked by developmental math courses (Jenkins & Cho, 2012). As a result of the current situation, developmental math curriculum in North Carolina's community college has become a physical barrier that prolongs and extends many college students' experiences.

Student Success in Developmental Math

The idea of student success for community college developmental math students takes multiple forms within current literature, policy, and research. A particular example of this is within current policy that concerns community college system's performance measures for student success in 2017 (NC Community Colleges Creating Success, 2015). The performance measures are part of a review process scheduled every three years that was enacted in 2012 by General Assembly in North Carolina. There are multiple measures of student success, however measures appropriate to consider for developmental math student success include First Year Progression, Curriculum Completion, and Developmental Student Success Rate in College-Level Math Courses. This example immediately depicts three institutional views of student success that developmental college students hopefully encounter. These views of success along with others are discussed in great detail within the following sections of the literature review.

Due to developmental math's influence on many first-year community college students, consistently knowing how to measure and judge success of developmental programs becomes highly important to determine program effectiveness and to measure student outcomes. The definition of student success is very important in college level developmental math environments because different perceptions of student success lead to different environments and student considerations being made. Personal experience has demonstrated that certain perceptions of student success correlate to different student-instructor relationships, different types of student support being provided, and better long-term student outcomes. The following sections provide examples of how literature defines student success in college level developmental environments.

The first four examples are presented in chronological order for students that enroll in developmental math education at a community college and complete their degree or certificate. The last two examples do not necessarily take place in any particular order, so they are reserved for discussion after the chronological order of students' experience to degree or certificate completion is presented. The order in which the six examples of student success are discussed implies no preference to one perception over another. The order is chosen for ease of discussion.

Developmental Course Completion

In order to compete a course, students must first enroll in the course. Developmental courses and in particular developmental math courses have higher referral rates than actual enrollment rates (Boylan & Boone, 1995). For example, 30 percent of all freshmen that enter college take at least one developmental course, and this statistic does not consider students who need to take remediation but don't enroll. In addition, in 2013 a study determined that between 35 and 40 percent of all freshmen enroll in at least one developmental course, however 69 percent of high school students place into at least one developmental math course (Bettinger, Boatman, & Long 2013; NC Community Colleges Final Report, 2013). Therefore, a key aspect to student success is developmental course enrollment. Developmental course enrollment by students referred to them is a success in of itself.

With that said, the first solid example of student success in current literature about developmental math equates student success in developmental environments to completion of that single course the student enrolls in. This perception of success is generic and applies to any educational environment that requires course completion as a cumulative credential. An example of research that holds this perception was conducted in 2001 where developmental math student success is expressed as when students complete the developmental math course they enroll in

(Aycaster, 2001). In a study of 15 instructors at five different colleges Aycaster determined that anywhere between 29 percent and 64 percent of students that enroll in developmental courses complete the course they enrolled in. Aycaster's research is a direct example of today's literature applying a generic definition of success to developmental math student research.

In addition, an analysis of Achieving the Dream's dataset in 2010 determined that one half of all students researched complete the single developmental course they enrolled in (Bailey, Jeong, & Cho, 2010). The percentages vary according to how many developmental courses students are referred to. The more developmental courses students are referred to, the less likely students are to complete their very first one. Also, it was determined that 49 percent of community college developmental students complete all the developmental courses they enrolled in 2004 (Chen, 2016). Therefore, how many students that actually pass the developmental course they enroll in is a main focal point in current literature and research.

Developmental Course Sequence Completion

North Carolina's community college developmental math curriculum contains a sequenced modularized developmental math course program. Many states have similar sequenced remedial course work for developmental math students. Therefore, research on developmental math student success includes students' progress through all sequenced developmental course work (Bailey, Jeong, & Cho, 2010). In 2010, research reviewed student success as completion of all developmental math sequenced courses with an analysis of the Achieving the Dream dataset. This research calculated student progression in course work and students overall sequence completion rates. Results show that between 31 and 44 percent of students referred to developmental course sequences actually complete all the sequenced courses within three years of enrollment as freshmen.

More recently, the 2017 report on North Carolina's community college performance measures includes the measure of Basic Skills Student Progress (NC Community College Creating Success, 2017). This measure is the percentage of Basic Skills students who achieve an educational functioning level gain. Basic skills students are students that take placement exams and are not ready for adult secondary education and this includes all developmental math students. An educational functioning level gain is the accumulation of 12 or more contact hours across all courses during a program year. Therefore, developmental math contact hours count toward this performance measure and North Carolina community colleges are interested in developmental student progression through the sequences of course work.

Another performance measure that captures developmental math students' progression through developmental course is First-Year Progression. The North Carolina Student Success Center's definition of First-Year Progression is the percentage of students attempting 12 or more credit hours (students that enroll full-time) that complete 12 or more credit hours that academic year. An accumulation of multiple credit hours takes place during developmental math course sequences. Therefore, North Carolina's performance measure of Basic Skills Students Progress and First-Year Progression includes measures of students' progression through sequenced developmental math courses. The report demonstrates that North Carolina community colleges possess a Basic Skills Student Progress baseline of 34.5 percent and average percentage of completion around 59 percent. Also, First-Year Progress has a baseline of 54.1 percent and an average or 69.7 percent for North Carolina's community colleges. North Carolina's Student Success Center's report is an example of how current policy considers student progress important enough to invest time and interest into understanding. The performance measures mentioned here depict important information not about weather students pass a course or graduate but about how students progress through developmental programs and sequences of required developmental courses.

Requisite College Course Completion

Literature's view on student success in developmental math environments includes the perception that developmental success occurs when students pass requisite college level courses (Bailey, Jeong, & Cho, 2010). Therefore, a particular perception is that developmental math students experience a successful developmental math experience if they complete the college level course remediation was intended to prepare them for. Research in 2010 concludes that 37 percent of students that enroll in developmental courses, go on to pass the requisite college level course remediation was for. Therefore, research extends to include developmental math student success in their following college level courses. Intuitively, developmental programs possess goals and anticipate positive student outcomes associated with performance in students' following college level courses. Therefore, this research demonstrates how developmental math program outcomes are related to and researched as potential student success. In this case, a desirable developmental math program outcome is that students pass requisite college courses. Additional research in 2001 provides another example of how course completion after remediation is considered important (Aycaster, 2001). Aycaster's research creates a table of percentages that depict college course completion immediately after developmental course completion. Therefore, current literature and research has high levels of investment to understand developmental math student success after completion of required developmental math courses.

In addition to literature's findings on developmental math students that pass requisite college courses developmental environments experience this perception in practice and policy. The North Carolina Community College student success performance measures includes "developmental math student success rate in college-level math course" (NC Community Colleges Creating Success, 2015). Therefore, community colleges receive performance evaluations on their developmental math students' ability to pass requisite college courses. The NC Community College Performance Measure (NCCCPM) report determined that a baseline of 10.1 percent of students passed their first college level math course. Results from the NCCCPM report are very important for decision making and community colleges highly refer to these performance measures for future decisions (Pitt, personal conversation, March, 2017). The NCCCPM is a large part of how North Carolina's community colleges learn about college and department performance. This is especially the case with developmental math students, and determining if these students do well in their requisite college courses. This example of student success directly relates to students passing requisite college level courses. Like the other examples, this idea appears in current literature and influences current policy and practice.

College Degree or Certificate Completion

Current literature on developmental math student success states that student success happens when students actually graduate college or receive a higher educational credential (Bailey, Jeong, & Cho, 2010). Developmental programs and curricula are meant to accept and graduate students that would typically not be able to enroll in or attend due to poor entrance credentials. Desirable outcomes of developmental math programs are that students that do not have skills for college, attend, succeed, and graduate college. Current research is structured to understand if students actually benefit from developmental math programs that allow them to enter college. Therefore, research considers student success to take place when developmental math students graduate college or receive higher educational credentials. In addition, the North Carolina Student Success Center's strategic plan aims to improve student success by increasing the number of students that obtain a job-ready credential (NC Student Success Center, 2017). Therefore, current research as well as North Carolinas Student Success Center's current strategies demonstrate how positive developmental math student outcomes such as credential obtainment relates to and is researched as developmental math student success.

In addition, community college faculty expect their developmental math students to graduate college and become successful college graduates (Pitt, personal conversation, March 2017; Kitchens, personal conversation, August, 2016). Again, this perception is generic across any college domain because students typically enroll in college to graduate college. Therefore, success in any college atmosphere naturally relates to graduating college with a higher educational credential. An example of this is in 2006, when research determined 28 percent of students that were required to enroll in developmental course work graduated college in 8.5 years (Attewell, Lavin, Domina, & Levey 2006). Another example comes from research conducted in 2016 and demonstrates that in 2003 43 percent of students that enrolled in remedial course work graduated with a certificate or degree within 6 years (Chen, 2016).

North Carolina's performance measures also includes the number of students who graduate. In the 2017 report, a baseline of 35.9 percent and an average of 44 percent of students either graduated, transferred, or persisted with at least 36 credit hours complete after 6 years of enrollment (NC Community College Creating Success, 2015; NC Community College Creating Success, 2017). For comparison, a review of United States Department of Education's dataset concludes that 21 percent of students completed community college programs (Juszkiewicz, 2015). In addition, a review of the National Student Clearinghouse dataset concludes that 39 percent of students graduate community colleges. Therefore, substantial time, money, and interest goes into understanding if community college students graduate with a credential. One-third of the community college student population is a developmental math student their first-year of enrollment. Therefore, research dedicates substantial time, money, and effort into understanding community college completion rates and overall outcomes.

Students Acquire Desired Skills and Knowledge

A significant perception that appears in literature about college level developmental curricula focuses on instructors' and programs' intentions to teach students certain skills they are expected to use in college and life to be successful (Bahr, 2008). Again, this perception is naturally held and generic for any type of course because all educational environments have certain skills and knowledge students are expected to obtain. With this in mind, a 2008 publication expresses student success in college level developmental math courses as accomplished if appropriate skills are learned, utilized, and transferred to students as a result of enrollment in the developmental course. Similarly, the first item on North Carolina Student Success Center's list of three occasions of when student success occurs is "students make informed decisions" (NC Student Success Center, 2017). Here, neither college completion nor course completion are required to potentially conclude student success in developmental math environments.

Developmental education is known for improving and developing students' basic skills (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). College developmental education improves students' ability to move on through the acquisition of these basic skills and be successful in life. The basic ability for students to move on with skills learned and either benefit financially or mentally from a developmental course is a very important and desirable outcome for students that enroll. For example, certain percentages of students enroll in developmental math course work with intentions to learn enough math skills to pass required math tests associated with employment obtainment (Pitt, personal conversation, March, 2017). This may be a small percentage at some colleges and larger at others. Either way, these students' successful experiences with developmental course work is oriented around skill obtainment. Therefore, in areas where there are large and numerous factories the percentage of students with intentions to enroll in college level math decreases, while developmental course enrollment increases with the need for local skilled entry level workers. In fact, some organizations and programs activity pursue and enroll potential employees in community college developmental math education for the purpose of future hiring. Therefore, students that enroll in developmental education do not necessarily strive to pass the course, graduate college, or even learn all the material. More importantly, these same students are able to use the information they were exposed to and move on with certain skills acquired to benefit their life and become successful. If skills learned in an educational environment are used outside of the classroom in students' real-world scenarios such that students' lives and employability are improved then a success has taken place. Students in this example may not appear within the success rates and calculations of institutions' progress and effectiveness, however they do benefit and succeed just as much if not more as those included in such reports.

In addition, the idea that certain skills constitute student success appears within current developmental practice. For example, community colleges commonly include financial literacy as part of final developmental math course work for their developmental students (Pitt, personal conversation, March, 2017). However, financial literacy is not a part of the required developmental math course content. Financial literacy is a certain skill and area of knowledge that instructors and administrations at colleges decided developmental math students should take away from developmental courses. This is even if the students do not continue their education or use the information about financial literacy to complete a computer module. Instructors want concepts to transfer to other scenarios, so the mathematical material students learn intentionally applies to real-world situations. Therefore, perceptions of student success associated with students learning particular skills appears throughout current literature and practice.

Goal Completion

Developmental math student success related to completion of a goal is the final perception that appears in literature. Students that complete personal goals associated with enrollment in developmental environments are considered successful (Crews & Aragon, 2007). Similarly, there are institutional goals associated with developmental math student enrollment and success. Therefore, student goals and institutional goals completed or accomplished as a result of enrollment are highly related to student success in developmental education. Students can complete goals and become successful any time after enrollment despite course completion, college completion, or skills learned. Therefore, goal completion is a very important potential result of developmental math environments and programs.

Student goals vary according to personality, demographics, disposition, and many other factors. Either consciously or sub-consciously students create personal goals associated with the act and process of enrolling in developmental college courses. Therefore, research on student goal completion and overall success in developmental environments appears in literature. An example that expresses student success this way is demonstrated in 2013 about student goals and motivation in college (Kee, 2013). Today's higher education's students take college courses with intentional goals and aspirations set forth and students that take developmental math courses are not different. This research expresses student success to take place when student's goals and aspirations are accomplished. Therefore, if developmental math students' goals are accomplished as a result of enrollment in developmental math courses, then that student achieved success. For an abstract example, consider a student with the goal to not fear college math anymore or even that they want to prove they can do math, so they enroll in developmental math curricula advised to do so or not. If that student learns to not fear college level math or that they can do some level of math, then that student is successful despite course completion, college completion, or any skills learned. Literature that supports goal completion similar to this example is a particular book titled *Yes You Can!* (Kitchens, 2009). Kitchens' book allows developmental math students to understand how beliefs influence what they think, influence their study skills, and influence overall mindsets associated with the subject of math. Content and math related material in this book allows developmental math students to understand they can be successful at math. Interesting, the developmental math text book contains very little content that references particular math skills, math problems, or math practices required to pass a developmental math course or test. Therefore, literature provides examples of how developmental math student success is acquired when students accomplish personal goals or intentions they associate with their enrollment into developmental math environments.

Institutional goals associated with developmental math program goals and outcomes are typically expressed through performance measures similar to those mentioned in previous discussions of perceptions of student success. Typical goals and outcomes for community college institutions correlate to course enrollment rates, course pass rates, course progression, and program completion rates. However, institutional goals associated with developmental courses and developmental student enrollment expand to include being cost affective, counting developmental student as full-time equivalent, students that become familiar with college environments, and students that are prepared for college life. To start, an institutional goal to offer any program is to be cost effective, however the process to determine the cost effectiveness of developmental education is not clear and obvious (Pretlow & Wathinton 2012). Recent research demonstrates that the cost of developmental education has remained relatively the same for the last few decades. However, larger numbers of developmental students count as full-time equivalent students. For example, North Carolina's community college system recently recorded over 15 thousand basic skills full-time equivalent students (NC Community College Creating Success, 2017). Therefore, institutional goals associated with developmental education expand to include successful student enrollment outcomes that support institutions.

Instructional Practice in Developmental Math Environments

Many very particular instructional practices are developed and implemented into community college developmental math environments. Dynamics of particular instructional practices include, but are not limited to, instructional strategies, instructors' attitude, beliefs, actions, and classroom experiences. Current literature contains numerous practices associated particularly with developmental math environments (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). Developmental math instructors are typically handed material and software and told to teach to developmental math students (Pitt, personal conversation, March, 2017). Instructors' practice consists of adapting to materials, software, and resources available in order to teach to developmental students. The role of many community college developmental math instructors is to monitor software that tracks developmental math student progression and to instruct students on material that is determined by software to be holding students back from progression through lessons. In brief, these instructors assist students through computerized modules of mathematical material as quickly and efficiently as possible. Therefore, developmental math instructors' instructional practice is very unique.

Particular instructional practices discussed here originate from the most recent information available on effective and evidence based research for developmental math environments. To start, BSIII, Basic Skills Insights Information Innovation is a project that addresses student access and success in community college systems (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). In 2007, BSIII published a list of ten effective instructional practices that instructors have control over. The list is accompanied by a complete discussion of each practice found to promote developmental math students' success. The list contains practices and strategies such as "A high degree of structure is provided", "Routinely share effective instructional strategies", "Faculty and advisors closely monitor student performance", and provides twenty-six different important practices for developmental math environments to include. Additional instructional practices associated with developmental environments mentioned by BSIII include course content that is linked to college level requirements, attention paid to students' social and emotional growth, instructors routine to share effective strategies, and faculty that closely monitors student performance. These particular practices are provided here because of developmental math instructors' ability to control and use them. This is opposed to other instructional practices BSIII list that instructor have little to no influence/control over. For example, the instructional practice of having "developmental education widely accepted and embraced by institutions in multiple ways" is not necessarily controlled by developmental instructors. Therefore, this dissertation focuses on instructional practices that instructors have control over, can think about, and can do in order to further understand instructors' particular influence on the developmental math environment.

Additional research on developmental instructional practices comes from the Australian Society for Evidence Based Teaching article titled *Top 10 Evidence Based Teaching Strategies*

(Killian, 2015). The list contains strategies supported by research to have a substantially high effect on student results. Strategies within their list include clear lesson goals provided, student feedback, to check that students understand, graphically depict content, require students to practice, require students to work together, and require students to use metacognition. Therefore, current literature and research expends substantial time and effort into understanding and embracing effective instructional practices.

Another contribution to further understand instructional practices for developmental math students includes research on best practices (Caffarella, 2014). In 2014, Caffarella conducted a case study on one community college developmental math instructor faculty. Important results and conclusions from Caffarella's research show a variety of effective instructional practices used in college level developmental math courses. Multiple best practices are described by Caffarella's research. These best practices are found directly from interviews and observations of many community college developmental math instructors. These best practices are to create effective communication, be aware of students' academic status, detailed notes taken/given, create collaborative activities, provide pair and share activities, use math journaling, provide low-stakes exam and quizzes, promote coaction reflections, use manipulatives, use visuals of concepts, and use real-life applications. Therefore, multiple important practices are established to improve student success in college level developmental math environments.

Summary of Effective Instructional Practice Literature

The three previous examples of literature that portray current research on instructional practice directly link to community college developmental math environments. In addition to the examples, large amounts of research describe other best practices particularly for developmental students, developmental environments, developmental instructors, and institutions that provide developmental education. The process of categorizing and understanding the massive amount of literature on developmental best practices is a huge undertaking. Thankfully, in 2007 the California Community College System office funded a review of the literature pertaining to effective practices for basic skills (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). This is my first example of research that aims to understand successful college level developmental practices (BSIII). I elaborate further on this resource since it summarizes all research on developmental practices. This literature review and research study is titled *Basic Skills as a Foundation for Student Success in California Community Colleges.* This research includes an extensive review of all related literature and combines those results with current practices utilized by thirty-three California community colleges and nine other out-of-state community college institutions. BSIII's literature review considers 250 publications that span over 30 years of literature on basic skills and developmental education. Results from the extensive review conclude that there are 26 effective practices that fall into four main categories of instructional practice in developmental education literature. BSIII's findings are provided in Appendix I. Examples of the 26 effective instructional strategies are that developmental education is a clearly stated institutional priority, developmental education is centralized or highly coordinated, orientation, assessment, and placement are mandatory for all new students, administration encourages and supports faculty development in basic skills, and a high degree of structure is provided in developmental courses. The four categories these 26 effective practices are placed in are organizational and administrative practices, program components, staff development, and instructional practices. Organizational and administrative practices are choices that colleges make to influence the overall effectiveness of developmental education programs. For example, policies and procedures community colleges follow and mandate during their initial enrollment process. The program components category contains practices and characteristics of effective developmental programs. Characteristics include placements practices, improvement agendas, student support or services, or financial aid implications. The staff development category includes practices that train faculty for specific developmental education environments. Examples of this category include administrative support for faculty development, faculty maintains a role in support of basic skills courses, and faculty development that is connected to a reward structure. The final and most robust category is instructional practices. This category includes developmental education strategies that have proven effective in practice to achieve desired student outcomes. This category includes strategies such as sound principles of learning theory applied, a high degree of structure provided, faculty closely monitoring student performance, and that programs address holistic development of all aspects of students. A large portion of the instructional practices mentioned by BSIII are outside the control of typical developmental math instructors, however the information they produce to summarize all effective practices represents the large amount of effort that goes in understanding effective developmental education.

Personal Qualitative Research on Instructional Practice

In 2015, I personally conducted research to understand instructional practices in college level developmental math courses. My research is titled *Developmental Math Instructors' Impressions of a Successful Student's Experience,* and I previously mentioned this in chapter one. The focus was to understand what instructors' thought successful student experiences are and how they thought success is accomplished in developmental math environments. Research questions for this research relate to potential descriptions of successful students, strategies to promote success, and physical requirements for success to take place. To answer these questions, a qualitative study that consist of two instructor interviews and one observation was conducted. Data was collected and entered into qualitative data software called “Quirko”. Data collection consist of two one hour long semi-structured interviews of two developmental math instructors. Instructors’ responses to interview questions were recorded and transcribed at a later date. In addition, data collection consists of an observation of a two-hour long class that produced multiple pages of notes and day-after reflections for analysis. Data analysis focused on horizonalization and clustering of meaning found in data produced. After extensive review within the qualitative software, three major categories appeared to help answer the research questions asked. After further refinement, three categories became five clearly defined categories. The five categories are required components, instructor student interaction, instructors’ personal actions, physical actions from the student, and mental actions from students. These five categories are the results of my previous qualitative research.

The five categories are explained in further detail here so that each category’s meaning and content is further understood. To start, required components consists of environmental components such as classrooms, texts, and student interactions. Components such as these are found to be essential for successful developmental math environments. Instructor student interactions are any experiences that involve instructors’ direct communication with students. This pilot research’s data demonstrates the importance of a personal mentor type relationship between students and instructors. Additional research also values and relates instructor student interactions with student motivation (Brush, Bargeron, Grudin, Borning, & Gupta, 2002). The instructor personal actions category contains internal actions and conversations that instructors have that concern students and how to promote students’ success. Therefore, instructors’ personal actions are actions that are intended to promote success absent from students. This category also includes how instructors think about student success in their practice and ideas of how to promote student success. For example, preparation for class, preparation for semester, positionality toward student capabilities, conversation about students, and potential professional development. The physical actions from students category contains actions such as classroom attendance, homework completion, and class participation. Qualitative pilot data demonstrated that a successful student's experience requires multiple physical actions to be performed by the student. A particular example within data is that students should "do their math assignments right after a lecture". Important additional student physical actions include students helping other students (Ender & Newton, 2000). The final category, mental actions from students are changes in thinking, perceptions, and attitudes toward the subject of mathematics. This important finding, also includes how students relate to other students in similar developmental math situations. Student self-efficacy highly influences academic motivation (Schunk, 1991). Successful students are required to mentally acknowledge that they can succeed in mathematics, accept their current position that they typically do not succeed, and accept that resources are available for them to succeed (Kitchens, 2009).

Findings from my qualitative research directly address its research questions. The first sub-question asks, "How do developmental math instructors describe current students who have successful experiences in their classrooms?" This is answered through a variety of students' mental and physical actions. The instructors have certain expectations of how a successful student act and think. A successful student is willing to change, show up, accept, and work at their mathematical skills. The second sub-question asks, "What are strategies that are implemented into developmental math courses to promote successful experiences for the students?". This is answered through the categories of required components, instructor student interactions, and instructor actions. The use of textbooks, lectures, labs, one-on-one time, use of concern, questioning past, bringing curriculum into personal lives, creating a relationship, and holding expectations are many strategies revealed through data analysis. The third sub-question asks, "What is required to provide successful developmental math student experiences and how can instructors ensure successful experiences take place?". This is answered through the categories of instructor student interactions and instructor personal actions. Instructors help ensure the success of their students through a personal, caring, mentoring relationship with them. Results from this question imply that the instructors' actions are responsible for successful experiences in developmental math environments. The main research question asks, "What are development math instructors' impressions of current first year college students' successful experience and the strategies in the classroom that lead to the successful experience?". This is answered through the combination of the previously discussed questions. A successful student's experience consists of an acceptance of their current abilities, acceptance that their perceptions and actions are required to change, instructors who are concerned about their perceptions, mentors as instructors, and learning how to think about mathematics appropriately. The combination of five categories discussed in this pilot research cumulate to depict a categorization of all instructional practices for successful developmental math student experiences.

Available Research on Community College Developmental Math Instructors

Current college level developmental math research and literature focuses on student knowledge, student demographics, institutional changes, particular developmental math programs, and developmental math strategies (Bailey, Jeong, & Cho, 2010; Caffarella, 2014; Edgecombe, 2011; Hodara, Jaggers, & Karp, 2012; Kee, 2013; Sivley, 2013). Instructors of developmental math courses possess first-hand knowledge and realistic perceptions of what student success is, what successful experiences are, and what successful strategies are for students that enroll in these courses (Caffarella, 2014). Therefore, developmental math instructors experience and know about the student success current literature and research aim to understand.

Multiple databases search results for information about developmental math instructors and literature were conducted during preliminary research for this literature review. Initial results from database's available support the fact that little research on developmental math instructors exists. In addition, information about developmental math instructors' demographics for systems, states, or colleges is not available through online searches due to how they do not exist for public reference. For example, a 2015 system wide statistical report for North Carolina's universities and colleges does not disaggregate developmental or math instructors (University of North Carolina, 2015). This example's report provides gender, level of education of professors, associate professors, assistant professors, and the numbers of instructors for each college, but does not include any relevant information about developmental math college instructors.

To elaborate further, consider the following three database search results. The first example is Google Scholar connected through the NCSU library system. The connection with a university library allows Google Scholar to access additional articles that would otherwise have public access denied due to copyright laws. A search through this database with the words *developmental math instructors* produces hundreds of thousands of results. This search's' return was highly analyzed, however realistically only the top 300 articles were reviewed for relevance. Many of the top results in this Google Scholar search have been previously mentioned. However, the overall search result demonstrates large amounts of information on developmental math environments, with few examples that utilize developmental math instructors' knowledge or information.

An additional search used the Community College Research Center of Columbia's database. Keywords *developmental math,* return 180 articles for review. Once again, the search produces a lot of appropriate material about student success, however no publications within this search consider instructors' expertise or information to assist with drawing conclusions.

The most fruitful database search example is the ERIC database. ERIC returns 80 results for a search with keywords *developmental math instructors.* After a complete review of the 80 results, three recent publications consider instructors' perceptions within developmental math environments as important foundational information. The three recent publications are elaborated on in the following section. These examples consider instructors' knowledge valuable, however they still align with previous research topics and interest that investigate developmental math environments. Conclusions and implications refer to instructional best practices/strategies, institutional reform, and instructional frameworks that should follow the research presented (Caffarella, 2014; Kee, 2013; Sivley, 2013). Therefore, while these publications utilize instructors' knowledge, they provide little to no reference to the importance of developmental math instructors' perceptions of student success.

Relevant Research on Developmental Math Instructors' Perceptions

Relevant publications found through database searches are discussed here for their specific content and relationship to this research. In particular, three articles are discussed here due to their relevance and similarities to my research (Kee, 2013; Sivley, 2013; Caffarella, 2014).

The first example is a dissertation by Kee that is referred to in previous discussions (Kee, 2013). Kee considers attainment of student's educational goals to be student success. Therefore, student success is accomplished if students achieve personal goals, and they do not have to graduate or pass courses to be considered successful. In particular, Kee's research is a case study of all developmental math instructors at a single community college. The purpose of this research is to identify instructional practices that increase student engagement that originate from interviews conducted with instructors. Kee's research focuses on developmental math instructional practices that increase the use of the particular strategy of student engagement. This strategy to increase student engagement hopefully promotes student success. Therefore, Kee's research structures the research on instructional practices and strategies, and not on understanding perceptions of student success. This dissertation explores student success differently by questioning what is student success, rather than how to promote strategies that are known/thought to lead to student success. Therefore, Kee's dissertation does not address perceptions of student success that influence student success and practice, but does utilize instructors' knowledge.

Another example of community college developmental math instructors referenced as a source of valuable information is Caffarella's 2014 research (Caffarella, 2014). Caffarella recently analyzed 20 developmental math instructors' practice for current best practices that enhance student learning. Conclusions are drawn from pre-interview documents and interviews with developmental math instructors. Caffarella concludes there is a current need to increase student communication with instructors, develop students' organizational skills, consider class demographics, and increase instructors' administrative support. Again, this example focuses on community college developmental math best practices and strategies. Caffarella's work does not consider instructors' perceptions of student success that influence the developmental environments, practices, and strategies implemented or chosen.

The final example of current research that utilizes instructors' experience to draw conclusions is Sivley's 2013 dissertation (Sivley, 2013). Sivley's mixed method research contains surveys, interviews, and focus group meetings to determine if instructors follow best practices for developmental math education. The research's ultimate purpose is to raise student attainment levels by understanding if instructors follow best practices. Overall research findings suggest a need to improve student services, update testing procedures, promote faculty development on specific needs of students, and execute best teaching and learning practices for developmental math education. The dissertation is mentioned here because Sivley's conclusions do expertly utilize developmental math instructors' experiences in the developmental math environment. The utilization allows for Sivley's research conclusions to focus on institutional changes, instructional strategies, and instructional practices associated with community college developmental math courses. However, notice that Sivley's research does not analyze what student success is according to instructors in developmental math environments.

The three examples mentioned here do acknowledge developmental math instructors as valuable sources of information, however they still focus on how to reach or achieve student success rather than what is the student success that is being strived for to begin with.

Discussion

An anticipated 60 percent of jobs will require post-secondary education by 2020 (Carnevale, Smith, & Strohl, 2017). Currently, 40 percent of North Carolina's workforce has attended a 2-year institution in the last 10 years (Get the Facts, 2016). Community college educational pursuits are increasing and student success initiatives are mandated. Budget and policy reform highly influence community college educational environments. The combination of current challenges such as policy changes, budget constraints, and student success agendas creates a dynamic situation in North Carolina's developmental math curricula. Significant portions of the community college success initiatives are associated with developmental education. As a reminder, there are approximately 30,000 North Carolina community college students referred to enroll in developmental course work each year (McCabe, 2000; Get the Facts, 2016). Currently all of these students have their college experiences influenced by developmental courses' position in higher education's curricula. The current developmental math program was implemented by North Carolina's community college system in 2013 in efforts to accept and progress students in need of developmental education and better prepare them for college level math course work. However, many changes have taken place since then and results are not conclusive or reassuring. Unintended consequences of reform that have the best intentions highly influence students' experiences. Literature and research associated with developmental math student success include multiple perceptions of what student success is. Multiple perceptions of student success are the result of the large and dynamic system that creates, impacts, influences, and implements policies that must be followed in these critical developmental environments. Efforts to remedy confusion about developmental student success produces a variety of best practices and strategies associated particularly with developmental math environments. Current research on developmental math instructors is sparse at best. Research that is available does not utilize instructors' knowledge to question or understand what student success is. My previous qualitative research provides valuable information about developmental math instructional practices in the form of five categories required for student success to take place. This research utilizes instructor's knowledge to potentially understand how different perceptions of student success relate to their personal instructional practice using a unique new approach previously not considered my current research.

CHAPTER 3: METHODS

Introduction

This dissertation generated meaningful, direct, and applicable knowledge about North Carolina community college developmental math programs by investigating instructors' perceptions of successful students and their personal instructional practice. More specifically, I sent a survey to North Carolina community college math instructors who personally experience student success. The survey instrument measured individual perceptions of student success and personal instructional practices. To create and refine the survey instrument is to address my dissertation's main research question about how to accurately measure the relationship between instructors' perceptions of student success and their instructional practice.

Summary of Methods

I first created a set of variables related to *instructors' perceptions of student success*. To do so, I used current research literature to provide six examples of different perceptions of student success (Boylan & Boone, 1995; Bettinger, Boatman, & Long 2013; NCCC Final Report, 2013; Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Chen, 2016; NCCCCS, 2017; NCCC Performance Measures, 2015; NCSSC 2017; Kitchens, 2009; Attewell, Lavin, Domina, & Levey, 2006; Chen & Simone, 2016; Juszkiewicz, 2015; Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Crews & Aragon 2007; Kee, 2013; Pretlow & Wathinton, 2012; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). I also created five additional variables that relate to instructors' personal instructional practice. To create these variables, I relied on results from my previous qualitative study about developmental math instructors' impressions of successful student experiences, as well as multiple research articles related to best college level developmental practices (Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014; Crews & Aragon, 2007; Killian, 2015; Kitchen, 2009; NC Student Success Center, 2017; Winkler, 2015). After defining all research's variables, I developed a survey to accurately record and account for each variable. The survey is part of a NCSU eIRB that is submitted for approval before any participants are contacted. With the use of the approved survey, I gathered data about instructors' perceptions and instructional practice. To gather the desired information, the survey is transferred into an online survey implementation software (Qualtrics). After I directly transferred the survey, I used the online survey software to email potential participants an announcement and link that allows them to complete the survey for this research. Reliability and correlation tests as well as variable constructs were analyzed with the use of Stata, a data analysis software. In addition, findings from data analysis revealed necessary revisions meant to improve the quality of the survey instrument and the information it gathers. Therefore, all methods accumulate to produce one final refined version of the developmental math survey instrument. The survey instrument produced accurately reflects the literature, accurately measures variable constructs, and reveals new relationships between perceptions of student success and practice that impact many college students' experiences.

Research Questions

Methods taken to create and validate the quantitative instrument presented here answer the following research questions. Therefore, this main research question and three sub-questions guide all methods followed.

1. What instrument can be created to measure the relationship between community college developmental math instructors' perceptions of student success and their instructional practice in classrooms?

a. What is the reliability and validity of the survey's measure for instructors' perceptions of community college developmental math student success?
b. What is the reliability and validity of the survey's measure for instructors' personal instructional practice in community college developmental math environments?
c. What is the relationship between the measure of the instructors' perceptions of student success and instructors' personal instructional practice?

Research Procedures

Instructors' Perceptions of Student Success

Different perceptions of student success appear in current research and literature about community college developmental math (Boylan & Boone, 1995; Bettinger, Boatman, & Long, 2013; NCCC Final Report, 2013; Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Chen, 2016; NCCCCS, 2017; NCCC Performance Measures, 2015; NCSSC 2017; Kitchens, 2009; Attewell, Lavin, Domina, & Levey, 2006; Chen & Simone, 2016; Juszkiewicz, 2015; Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Crews, Aragon, 2007; Kee, 2013; Pretlow & Wathinton, 2012). From the research literature, I defined six different variables that represent six different perceptions of student success. These are: (1) Developmental Course Completion (DCC), (2) Developmental Sequence Completion (DSC), (3) Requisite College Course Completion (RCCC), (4) Degree or Certificate Completion (DC), (5) Student Acquires Skills and Knowledge (SASK), and (6) Goal Completion (GC).

Each variable represents a different perception of student success that appears within current literature. The Developmental Course Completion (DCC) variable measures how much participants perceive student success to be completion of developmental math courses, and how much this perception influences their practice. Similarly, the Developmental Sequence Completion (DSC) variable measures how much participants perceive student success to be the completion of all sequenced developmental math courses, and how much this perception influences their practice. The Requisite College Course Completion (RCCC) variable measures how much participants perceive student success to be completion of following requisite college courses developmental math courses are meant for assisting students with, and how much this perception influences their practice. The measure of how much participants perceive student success to be completion of a degree or certificate program and how much this perception influences their practice is the variable of Degree or Certificate Completion (DC). Also, the Student Acquires Skills and Knowledge (SASK) variable measures how mush participants perceive student success to be when student acquire required developmental math course skills and knowledge, and how much this perception influences their practice. The final sixth variable is Goal Completion (GC). This variable measures how much participants perceive student success to be when students complete personal goals, and how much this perception influences their practice.

To measure each of these six variables, I developed survey questions that quantify and operationalize each of them using participant responses. Within the survey, the first two questions are about the six different perceptions of student success. The two questions focus on ranks and weights of the six different perceptions of student success. The ranks and weights of each perception represents how much instructors think about each perception during their personal practice and how much each perception impacts their classroom environment. In the first perception question, instructors are asked to rank each perception of student success 1 through 6. One indicated they think about that perception of student success the most, while a six indicated they think about that perception the least. Therefore, the six student success variable values are assigned 1-6 by each participant in question one of the survey. The second survey question asked participants to weigh the six perceptions. To do so, participants were asked to assign percentages of time to each of the six perceptions. The percentage participants assign to each perception represents the amount of time they spend on each perception during their practice. The second perception question allows participants to weigh the list of six perceptions according to time spent on each perception. For example, if a participant perceives student success to only take place if students pass the developmental course, then that participant would rank the perception variable associated with completing a developmental math course a 1. In addition, this perception would receive a weight of 100% in the second question by this participant. In this example, all other perception variables would receive a 2, 3, 4, 5, or 6 in question one and 0 percent weights in question 2 of the survey instrument. Therefore, all six perception variables received two numerical values from instructors. A rank that represents how much each perception is thought of in, and a weight that represents how much time in practice is dedicated to each perception.

Instructors' Personal Instructional Practice

Current literature explores instructors' personal instructional practice through many lenses, however few researchers particularly explore community college level developmental math instructors' practice. To create variables that accurately represent developmental math instructors' current practice, I used findings from my previous qualitative research in 2015 to structure and understand available literature. The qualitative study's findings produced five categories that successfully depict aspects of personal instructional practices. These five categories represent what developmental math instructors are thinking, doing, and practicing in their profession's environment. The five categories of instructional practice are my instructional practice variables, and they are Required Components (RC), Instructor Student Interaction (ISI), Instructors' Personal Actions (IPA), Physical Actions from the Student (PAS), and Mental Actions from Students (MAS).

The Required Components variable measures how each participant agrees or disagrees with instructional practices associated with facilitating physical components of instruction that current literature states is required for student success to take place. Similarly, the Instructor Student Interaction variable measures how much each participate agrees or disagrees with instructional practices that are associated directly with effective instructor student interactions that current literature supports. The Instructors' Personal Actions variable measures how much participates agree or disagree with instructional practices associated with how to prepare, what to do outside of class, and ways to think when instructing. Also, the variable Physical Actions from the Student measures how much participants agree or disagree with instructional practices that facilitate particular physical actions from students that current literature states are required for success to take place. To finish, the variable Mental Actions from Students measures how much participants agree or disagree with instructional practices associated with promoting successful mental actions or changes from developmental math students.

All instructional practices mentioned within this dissertation's literature review and introduction that relate to what developmental math instructors think, do, and have control over have been compiled into the following Table 3.1 *Five Categories of Instructional Practice*. Thirty-seven of the instructional practices previously mentioned in this dissertation are located within this table. Column headings break the 37 practices into these five categories. The five categories' titles are based on results from my qualitative research in 2015 on developmental

Table 3.1. Five Categories of Instructional Practice

Required Components	Instructor Student Interactions	Instructor Personal Actions	Student Physical Actions	Student Mental Actions
Clear lesson goals are provided (Killian, 2015)	Use math journaling (Caffarella, 2014)	Routinely share effective instructional strategies with faculty (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007)	Students are required to work together (Caffarella, 2014; Killian, 2015)	Students routinely think about options, choices, and results (Killian, 2015)
Detailed notes given out (Caffarella, 2014)	Instructor and student discuss goals (Crews & Aragon, 2007)	Instructors and faculty closely monitor student performance (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007)	Students are required to get plenty of practice (Killian, 2015)	Promote student reflections (Caffarella, 2014)
Low stakes exams and quizzes (Caffarella, 2014)	Questioning to check for understanding (Killian, 2015)	Graphically depict lesson content (Caffarella, 2014; Killian, 2015)	Students take detailed notes (Caffarella, 2014)	Students acknowledge personal goals for course (Crews & Aragon, 2007)
Utilize a content specific text book or work book (Kitchens, 2015)	Provide students with feedback in person (Killian, 2015)	Be aware of students' academic status (Caffarella, 2014)	Use manipulatives (Caffarella, 2014)	Student acknowledges past experience (Kitchens, 2009)
Course content linked to college level performance requirements (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007)	Effective communication is created (Caffarella, 2014)		Students help other students (Ender & Newton, 2000)	
			Whole class activities (Kee, 2013)	

Table 3.1. Continued

Required Components	Instructor Student Interactions	Instructor Personal Actions	Student Physical Actions	Student Mental Actions
Provide transferable skills students can utilize (Bahr, 2008) Provide life skills material and content (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014; NC Student Success Center, 2017; Pitt)	Instructor discusses students past experience with math (Kitchen, 2009) Interact outside of class time (Brush, Bargeron, Grudin, Borning, & Gupta, 2002)	A high degree of structure is provided (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014) Attention is paid to social and emotional development of students as well as cognitive growth (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007) Expect students to graduate college (Pitt, Kitchens)	Students are motivated to attend classes in person (Pitt)	Student acknowledges current position (Kitchen, 2009) Students relate to other students (Schunk, 1991) Students accept they can do math (Kitchens, 2009)

math instructors’ impressions of how to facilitate successful student experiences. These categories of required components, instructor student interactions, instructor personal actions, student physical actions, and student mental actions provide a means to divide and research the 37 instructional practices from current literature into temporary groups that they intuitively belong to. Participants were asked to provided 1-7 Likert scale responses to each of the 37 best practices. A one indicates participants strongly disagree, while a seven indicated participants strongly agree with that practice. The actual variable value for each instructional practice variable construct is the average Likert scale response for each corresponding category.

Therefore, all five instructional practice variables are constructs from the Likert scale responses to the 37 statements. In addition, all the instructional practices content derives from literature directly related to best practices in community college developmental math environments.

In order to operationalize the five instructional practice variables, each of the 37 instructional practices found in the table were changed into statements about instructional practice. Statements contain the same meaning and content as the instructional practices, however they are phased such that participants can either agree or disagree with them. For example, an instructor's personal action of being aware of students' academic status is re-worded in a statement like, "I am highly aware of all my developmental math students' academic status". After all 37 instructional practices were changed into statements like this example, participants were able to agree or disagree with them. In order to gauge participants' level of agreeing or disagreeing with each statement, they rank all 37 instructional practice statements that align with the five instructional practice categories according to a 7-item Likert scale that ranged from strongly disagree to strongly agree. Therefore, participants responded to a 7-item Likert scale for 37 statements directly related to developmental math instructional practices. The survey contains seven statements for the Required Components variable, seven statements for the Instructor Student Interactions variable, nine statements for the Instructor Personal Actions variable, seven statements for the Students Physical Actions, and seven statements for the Students Mental Actions variable. A combination of exploratory factor analysis (EFA) and Cronbach's alpha tests were used to determine the reliability of these five constructs related to the organization of all 37 instructional practice statements.

Survey Creation

I divided the survey into three parts for discussion. The first section of the survey gathered quantitative data on the six different perceptions of student success (2 questions) The second section gathered quantitative data on effective instructional practice (37 questions). The third section gathered information about participants and colleges' demographics (10 questions). Demographics include age, gender, employment status, years of experience, number of courses taught at a time, college size, and if they also instruct college level math. I also asked participants about their community colleges demographics such as class size, college size, number of instructors per class, and college location. Due to the potential sensitive nature of some of these questions and in order to avoid the risks of respondent identification, all demographic question responses included ranges to choose from instead of exact numbers. For example, the question that asks for years of personal experience instructing developmental math has response options in ranges: 0-2 years 3-5 years, 5-10 years, 10-20 years, or 20 or more years.

All survey questions are entered into the electronic platform Qualtrics for distribution. Appendix II contains the initial survey instrument with all three sections.

Content Validity

Survey content is supported by current literature and research about community college developmental math environments (Boylan & Boone, 1995; Bettinger, Boatman, & Long 2013; NCCC Final Report, 2013; Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Chen, 2016; NCCCCS, 2017; NCCC Performance Measures, 2015; NCSSC 2017; Kitchens, 2009; Attewell, Lavin, Domina, & Levey, 2006; Chen & Simone, 2016; Juszkiewicz, 2015; Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Crews & Aragon 2007; Kee, 2013; Pretlow & Wathinton, 2012; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). The process of ranking perception variables' forces selection of one perception over another, therefore variations in perception variable responses were assured and analyzed. In addition, there are no other perceptions of student success in current literature other than these six to consider as possibilities, so there is inclusion of all possibilities. Therefore, all content within this initial survey pertaining to perception data is highly supported by current literature. Information about the perception data's reliability tests is discussed in following sections.

The instructional practice variables' validity comes from my previous research on developmental math instructors' practice. Results from my qualitative research provides a five category representation of current developmental math instructors' personal instructional practice. In order to research variable constructs' reliability, the survey uses a Likert scale to determine how much each instructor agrees with each of the instructional practice statements actually taking place in their personal practice. The Likert scale is intentionally used for statement responses due to this scales' ability to conduct exploratory factor analysis on all data gathered. Exploratory factor analysis is conducted on the data to understand each variable construct's content reliability for the measure created. Results from exploratory factor analysis allow data to be grouped and bond together in as natural a way as possible according to the data. Therefore, the reliability of creating and using five instructional practice variables within the measurement instrument is depicted using common data analysis techniques on information gathered about all instructional practice statements. In addition to factor analysis, a Cronbach's Alpha test for the data's internal consistency and reliability is provided. Therefore, content reliability of the survey instrument is demonstrated from two sources, literature based research and common data analysis techniques. Literature and current research highly support all content and ideas housed within the initial survey instrument.

Pilot Survey/Gather and Prepare Data

A pilot survey was conducted to gather initial data for analysis. To do this, I transferred the survey's content found in Appendix II into a software program that allows email distribution of an online version of the survey. After the survey was manually entered into an online program, participants were prompted to volunteer anonymously through their community college email account. Data are gathered until at least 30 participants fully respond and successfully complete the online survey. More participants are used due to a large initial response. Secondary reminder emails were sent out to potential participants two weeks after the first email. After closing the survey for responses, I download the data set in an Excel file. The second and third rows within the Excel needed to be removed to allow the data analysis software to recognize variables correctly. This data set contains quantitative representations of all variables required to perform my dissertation's analysis. The number of data points gathered and overall results are discussed in the following Chapter 4: Results.

As a result of gathering data online and transferring it to Excel, then entering it into Stata, I was required to clean and prepare the data set created by the pilot. Cleaning data included reviewing information created for consistency, appropriateness, and functionality. To start, I removed variables created by the online software that are not of interest to me. I then renamed all variables created by the online software. The old names are question numbers and the new names represent questions' content. I then removed non-response data points. Non-response data points are participants that started the survey, but did not complete the survey sufficiently to use their data. I discuss this decision more in chapter four with the actual results. Therefore, complete surveys are only considered for data analysis. The Likert scale needed to be converted into numerical representations for analysis. The second perception question allowed non-responses to be calculated as 0’s, so all non-responses to question two had to be coded to zeros. This paragraph includes all the explanations of data cleaning required to prepare data for analysis. This process helps ensure consistency among questions asked and data gathered. Therefore, all measures function as intended and work together to accurately account for all desired variable constructs.

Data Analysis

Data analysis of all information gathered answered sub-research questions a, b, and c. Answers include measures of reliability and relationships between measures that represent perceptions of student success and instructional practice. Data analysis allowed the reliability of each measure to be quantified. The quantification/operationalization of each variable is different, and is described in the following paragraphs.

The reliability of perception variables’ measures were analyzed for response consistency. To do so, responses from both perception questions were compared to one another, questions one and two on the survey questionnaire. The comparison focused on understanding if ranks indicated by participants in the first question align with weights assigned in the second question. The first question allowed instructors to rank six perceptions according to how they think about each of them. The second question allowed instructors to indicate how much time they spend focusing on each perception during their practice. The process of understanding how the two question responses relate to one another depicts perceptions of student success’ important role in developmental education.

Reliability testing of the instructional practice variable measure included two common data analysis approaches. The Likert scale was chosen because of benefits to completing an exploratory factor analysis on participant responses. Results of the factor analysis may conclude that the five current instructional practice variables are appropriate for use with the statements provided. On the other hand, results of the exploratory analysis may conclude a different number of groups/factors than five. The instructional practice variables were then modified or re-created to accurately represent the new groups/factors that present in analysis of participants' Likert scale responses. After the appropriate number of groups/factors and their titles were concluded from the exploratory factor data analysis, a Cronbach's Alpha test for internal consistency and reliability was completed for each group.

The final part of data analysis answers my research's sub-question c. Question c asks about potential relationships between variables and measures created by my dissertation's research. The relationship between perceptions of student success variables and instructional practice variables were quantified in a correlation matrix. All variable constructs created in my research are analyzed with the assistance of a correlation matrix. A correlation matrix quantifies on a scale of 0 to 1 how much each variable consistently varies according to how much all combined variables vary. A correlation of 0 to 0.1 has very little to no correlation between variables, while a correlation of 0.9 to 1 has very high correlation between variables. After the correlation matrix was created with data gathered, variables with strong and significant correlations are discussed in detail. Therefore, I created a correlation matrix to assess initial quantification of all variables created by participant responses. All steps taken in this part of data analysis answer my research sub-question c.

Revise Instrument

This portion of my research directly answers the main research question. The initial survey and instrument produced needs to be revised based on outcomes and implications from the pilot study and data analysis. Revisions of the instrument produced took a few forms based on pilot study data analysis. In some examples the actual questionnaire was adjusted and corrected for reasons such as clarification for participants, strengthening reliability, or clarification of data gathered. This step in my research answers the main research question by producing a valid and accurate measurement instrument that relates measures of instructors' perceptions of student success to instructional practice.

Participants and Precautions

Community college instructors that have experience instructing college level developmental math course students in community college environments were ideal participants for my dissertation's research. More particularly, at least 30 North Carolina community college instructors were my target audience. Precautions was used to ensure the safety and confidentiality of all participants. To do so, initial research procedures include submitting an Internal Review Board application for approval. Strict data storage procedures were followed. An eIRB from North Carolina State University was obtained to ensure that correct protocols and considerations were made, and to ensure human participants security and safety in this research. Nearly all North Carolina community colleges were contacted for disbursement of the online survey to gather data. In addition, all email addresses for each initial point of contact is obtained through online community college directories. If an email directory had the word "math" in the title of their college's online directory, then they received an announcement email to participate in my research. In addition to their participation, I asks recipients to disperse the link to any additional developmental math instructors. A copy of the email sent to math faculty at community colleges is provided in appendix IV. The email greeted potential participants, introduces myself, my research, and ask them for their help. The email then asks them to disperse the link or forward the email to other developmental math instructors. I contacted at least one faculty member from 57 of the 58 North Carolina community colleges. Therefore, all North Carolina community colleges faculty members with math in their title within their online college directories were contacted in hopes to obtain at least 30 useable survey responses.

Potential participants were emailed twice within two weeks. The announcement or email disbursement of this survey took place in two stages. The first stage contains 133 email contacts and the second stage contains an additional 470 contact to total 603 email announcements sent. The first stage focused on developmental math faculty listed in online college directories, while the second was more broad and focused on general math faculty listed in directories. After initial low response rates using only "developmental math" titled instructors, the second stage was required to obtain the larger participation numbers my research needs.

To further protect participants, strict data storage procedures was followed with data produced by online software. Any time the online survey software created a data set from responses, that data set was immediately placed on a thumb drive and erased from potential downloads folder of the computer used. I was the solo researcher for this dissertation and I maintain possession of the thumb drive for data analysis purposes. No copies of data was made at any time. Going further, no identifying characteristics or potential links back to participants were gathered during data collection procedures. I have no idea who completed the survey, and who did not. The combination of consent from internal review boards and strict data housing techniques were sufficient precautions for my research to protect participants. Ideal participants were North Carolina community college developmental math instructors. Therefore, the survey instrument's first question asks if viewers are or have ever been North Carolina community college developmental math instructors. These instructors' experience, expertise, and perceptions provide new valuable knowledge about student success through the use of the instrument created.

Initial Response

After the survey was distributed to potential participants' email addresses, a variety of events took place. Three community colleges that received the survey announcement reached out to me in efforts to assist in my research by going through their internal review teams/boards. I did go through two of the three internal review teams to gain access to additional participants. Also, three participants that received the email announcement contacted me during the month the survey was distributed and collecting data. In total, 124 participants opened the survey link; however, only 67 respondents completed the first question, only 63 completed the second question, and only 52 respondents completed all questions.

Missing Data

Due to participants not completing the entire survey instrument, approximately 57 percent of all data is missing. When missing data rates are high, there is potential for non-response bias due to large amount of missing information (Jans Heeringa and Charest 2008). Therefore, high percentages of missing data often results in observations being deleted or removed due to non-response (Soltysik and Yarnold 2010). Due to the nature of my research's constructs omitted or missing responses substantially impact variable construct values. There are two examples of why omitted or missing responses highly impact constructs within my dissertation. The first example originates from question 2's wording that states that any blank value left by respondents in this question will automatically receive a 0 percent as a response. In question two respondents determine the percentage of time spent on each perception of student success. If there is not a response, all values of percentage of time spent on each perception will be zeros and will skew results. The second example of how missing values impact variable constructs originates from question one's structure in the online Qualtrics survey. Question one is a six option interactive question that allows users to visibly move choices around to help determine each of the six perception's rank when compared to others. Perceptions that rank highest are moved to the top, while perceptions that rank lowest are moved to the bottom. However, if a respondent selects/clicks on one perception, but does not click-on/move any other perception, all perceptions' initial rank are recorded as their full response. That is to say, respondents' response to question 1 becomes ranks that mimic the original order of the perceptions presented in the question, if respondents are not fully completing questions. Therefore, respondents that do not take time to complete all questions and each question's individual components produce invalid information related to their perceptions of student success. The two examples demonstrate that missing data will influence and create inconsistent survey results if included in my analysis (McKnight McKnight Sidani and Figueredo 2007). Therefore, observations that contain missing values are omitted from my research, and I express summary statistics that include information only gathered from respondents that fully complete the survey instrument. Unfortunately, participants that did not complete the entire survey did not answer any demographic questions, so I am unable to examine demographic differences between those who responded to the full survey versus partial respondents.

In order to further understand potential non-response bias additional steps to data analysis can be taken. The additional steps include analyzing participants responses to compare early responses to later responses. If data from participants that responded earlier in the study is statistically the same as data from participants that responded later on near the end of the study, then no non-response bias can be concluded. If the two different samples are statistically different then non-response bias would be a clear issue. Since, no additional non-response bias tests were conducted in this research the impact of potential non-response bias in unknown.

Survey Response & Demographic Characteristics of Participants

I emailed 603 North Carolina community college developmental math instructors, encouraging them to forward the survey onto other potential respondents. In total, 124 opened the survey link, representing a 21 percent response rate. This rate may be high, as I could not capture the full number of respondents that may have viewed the survey invitation. Of the 124 that opened the link, 120 (97 percent) said they were developmental math instructors for at least one year in a North Carolina community college. Of these, 105 developmental math instructors consented to participating in my research. Only 52 out of the 105 participants completed the entire survey, which results in a 49.5 percent completion rate of those that consented to participate in the survey. Table 3.2 provides demographic information from the 52 participants that successfully completed the entire survey. Approximately 27 percent of participants were male while 71 percent were female, and one participant selected a "Non-response" item. The participant sample contained 81 percent full-time and 19 percent part-time working instructors. In addition, three quarters of the sample also instruct a college level math course (Table 3.2) and one quarter only instruct developmental math courses. Therefore, the sample of participants mostly consist of females, full-time instructors, and both college and developmental math course instructors. This participant demographic is likely a reflection of the actual developmental math instructor population. Community college instructor demographic statistics rarely disaggregate

Table 3.2 Participant Descriptive Statistics

Descriptive	Proportion
Male	0.27
Female	0.71
Full Time	0.81
Part Time	0.19
College Math Instructors	0.75
Only Developmental Math Instructors	0.25

instructor information to include developmental instructors. The same statistics do not disaggregate developmental instructor demographics further. Therefore, actual population parameters are unknown but are likely consistent with the sample gathered in this research.

Chapter 3 Summary

This dissertation's methods fulfill the purpose of my research and answer the research questions presented The purpose of all methods chosen are to create a valid and reliable survey instrument that captures information about perceptions of student success and instructional practice. I started by creating perception and instructional practice variable constructs along with quantitative representations of each. All variables' inclusion in my research are highly supported by current literature on community college developmental math education (Boylan & Boone, 1995; Bettinger, Boatman, & Long 2013; NCCC Final Report, 2013; Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Chen, 2016; NCCCCS, 2017; NCCC Performance Measures, 2015; NCSSC 2017; Kitchens, 2009; Attewell, Lavin, Domina, & Levey, 2006; Chen & Simone, 2016; Juszkiewicz, 2015; Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Crews & Aragon 2007; Kee, 2013; Pretlow & Wathinton, 2012; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007). After all variables were created, a survey was created to obtain desired information directly from North Carolina community college developmental math instructors. The survey was entered into an electronic platform (e g. Qualtrics), and piloted to gather initial data. Potential participants were emailed a message announcement that contained a link allowing them to complete the survey online. After an acceptable number of participants fully completed the survey, exploratory factor analysis, Cronbach's reliability tests, and further reliability data analysis was performed on data. In addition, correlation tests among all variables created was performed during data analysis to answer research question c concerning relationships between variables. After data analysis was complete, the survey and measurement instrument underwent revisions and improvements. All results and implications are in the following chapters.

CHAPTER 4: RESULTS

Introduction

The purpose of this dissertation is to create and validate a survey instrument that measures North Carolina community college developmental math instructors' perception of student success and their personal instructional practice. My main research question is, "What instrument can be created to measure the relationship between community college developmental math instructors' perceptions of student success and their instructional practice in classrooms?". In this chapter, I examine information related to the survey instrument, including variable constructs, reliability measures, and correlation results. Results for the first research sub-question addresses a measure for different perceptions of student success and the reliability of such a measure. Results for the second research sub-question includes a measure instructors' personal instructional practice and its reliability measures. Results for the final third research sub-question addresses the relationship between measures created for instructors' perceptions of student success and their instructional practice. The following sections contain information about how participants completed the instrument, and the construct reliability, descriptive statistics, and correlations that result.

Results for Research Questions 1a

In Research Question 1a I ask, "What is the reliability and validity of the survey's measure for instructors' perceptions of community college developmental math student success?". To measure instructors' perceptions of student success, I use participants' responses to the survey's first two questions. The survey's first question requires participants to rank the six different perceptions of student success, and the second question asks for the percentage of time spent on each student success measure during their instructional practice. In the first question, participants are able to rank each different perception of student success one through six. In this case, a six designates that participants perception of student success highly aligns with that particular perception, while a one designates that perception of student success to not align with their own. In Table 4.1 I report the mean and standard deviation for each of the six measures of student success. I also organize these from the highest to lowest. As evident from these results, these instructors rate completing a degree or certificate as the highest, followed by completing developmental course sequences, developmental course completion, requisite college course completion, students' goal completion, and students acquiring skills and knowledge. The ranking of the six perceptions of success demonstrate that instructors think of student success as being degree and course completion much more so

than when their students acquire appropriate math skills and knowledge (Table 4.1).

In question 2, participants are asked to record the percentage of time they spend on each measure of student success during their instructional practice. Therefore, responses to question two range from 0 to 100 percent. In Table 4.2, I report the mean percentage of time spent on each of the 6 measures of student success. I order of the table by each perception's mean, with the

Table 4.1. Perceptions' Rank (Question 1) Descriptive Statistics

Perception of Student Success	Mean (SD)
Degree or Certificate Completion	4.35 (1.52)
Developmental Sequence Completion	3.98 (1.21)
Developmental Course Completion	3.56 (1.54)
Requisite College Course Completion	3.48 (1.41)
Goal Completion	3.15 (2.54)
Student Acquires Skills and Knowledge	2.48 (1.84)

highest percentage of time being at the top and the lowest being on the bottom. This table suggests that North Carolina community college developmental math instructors spend the majority of their time helping students acquire skills and knowledge, and getting students to complete a developmental course. Instructors spend approximately 25 percent of their time on student goal completion and developmental sequence completion (Table 4.3). Also, instructors spend less than 9 percent of their time helping students pass requisite college courses and obtaining degrees or certificates.

In comparing Tables 4.1 and 4.2, it appears that community college math instructors measure success by degree completion; however, their work is focused on developing students' math skills and helping them complete the course. Therefore, developmental math instructors think of student success as being when students graduate and when student complete all their developmental courses (Table 4.1). Also, instructors spend most of their time focusing on student skill acquisition (Table 4.2). Thus, these results suggest that responding instructors think of student success as graduating college; however within the context of their job they focus on student skill acquisition during their practice.

Table 4.2. Perceptions' Percentage of Time Spent (Question 2) Descriptive Statistics

Perception of Student Success	Mean	(SD)
Student Acquires Skills and Knowledge	38.90	(30.28)
Developmental Course Completion	26.58	(24.11)
Goal Completion	12.40	(19.39)
Developmental Sequence Completion	12.31	(13.51)
Requisite College Course Completion	8.58	(9.06)
Degree or Certificate Completion	5.46	(8.23)

Results for Research Questions 1b

For Research Question 1b I ask: "What is the reliability and validity of the survey's measure for instructors' personal instructional practice in community college developmental math environments?" There are multiple tables and summary statistics in this section of the results. The first two tables provide information about survey question responses and instructional practice variable constructs. The following table includes factor analysis results of survey question grouping. The next two tables provide information about survey question responses and the factor analysis's new grouping and instructional practice construct results. Each table is discussed in detail within the following sections.

Instructional Practice Construct

Tables 4.4 through 4.8 provide information about the survey's 37 instructional practice statements and their corresponding five variable constructs. This information includes the means from Likert scale response for each statement, instructional practice variable construct means, and each construct's Cronbach's alpha test result. Likert scale responses for this survey range from 1 to 7, ranging from strongly disagrees (1) to strongly agree (7). All instructional practice variable construct values are the average of all Likert scale statement responses associated with that instructional practice construct/category. Therefore, all construct means in the following five tables represent the average Likert scale response for the statements in each table. Cronbach's Alpha test results are also provided and discussed for each construct.

In Table 4.3 I report the mean and standard deviation for the course components variable construct and the construct's corresponding seven statements. Each of the course component statements are provided (Table 4.3) along with the mean and standard deviation Likert scale response. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement "I routinely provide clear, obtainable lesson goals that are transparent and known to students" has the highest mean Likert scale response of 5.90 and is at the top of the table (Table 4.3). Also, the statements "The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications" and "My developmental math courses utilize a math text book or workbook of some kind" have means of 5.65, and are located at the top of the components construct table. In addition, the lowest mean of 4.96 for statement "During each class, I present and link course content to college level requirements" is located at the bottom of the course components construct table. The average Likert scale response for all course component statements is the construct value of 5.37 reported below. The Cronbach's Alpha test results produce a 0.72 for the course components construct. This alpha test result falls in the acceptable range of 0.7 to 0.8 for construct internal reliability.

In Table 4.4 I report the mean and standard deviation for the student instructor interaction variable construct and the construct's corresponding seven statements. Each of the student instructor interaction statements are provided (Table 4.4) along with the mean and standard deviation Likert scale response. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement "I create effective and meaningful communication with all of my students during the course." Has the highest mean

Table 4.3. Course Components Variable and Statement Statistics

Construct	Course Components Statements	Mean	S.D.	a, Alpha
Course Components		5.37	.94	0.72
	I routinely provide clear, obtainable lesson goals that are transparent and known to students.	5.90	1.42	
	The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications.	5.65	1.30	
	My developmental math courses utilize a math text book or workbook of some kind.	5.65	1.68	
	My developmental math courses provide students with a variety of life skills material and content.	5.31	1.45	
	My developmental math course provides multiple low stakes exams and quizzes for students to complete.	5.08	1.63	
	I provide detailed notes to every student for every lesson.	5.04	1.86	
	During each class, I present and link course content to college level requirements.	4.96	1.64	

Likert scale response of 5.94 and is at the top of the table (Table 4.4). Also, the statement "I ask questions to each student to check for their overall understanding of content." has a mean of 5.77, and is located at the top of the student instructor interactions' construct table. In contrast, the lowest mean of 2.60 for statement "I require students to communicate with me through math journaling or some type of record that records their thoughts" is located at the bottom of the student instructor interactions' construct table. The average Likert scale response for all course component statements is the construct value of 4.93 reported below. The Cronbach's Alpha test results produce a 0.79 for the student instructor interaction construct. This alpha test result falls in the acceptable range of 0.7 to 0.8 for construct internal reliability.

Table 4.4. Student Instructor Interactions Variable and Statement Statistics

Construct	Student Instructor Interactions Statements	Mean	S. D.	a, Alpha
Student Instructor Interactions		4.93	.90	0.79
	I create effective and meaningful communication with all of my students during the course.	5.94	1.18	
	I ask questions to each student to check for their overall understanding of content.	5.77	1.17	
	I work with students to discuss their past experiences and impressions of math.	5.54	1.38	
	I work with students to discuss their personal, educational, and life goals.	5.46	1.31	
	I provide every student with personal feedback in a one-on-one environment.	5.04	1.61	
	I interact with all my students outside of the classroom as much as professionally possible.	4.13	1.48	
	I require students to communicate with me through math journaling or some type of record that records their thoughts.	2.60	1.36	

In Table 4.5 I report the mean and standard deviation for the instructor personal actions variable construct and the construct's corresponding nine statements. Each of the instructor personal actions statements are provided (Table 4.5) along with the mean and standard deviation

Likert scale response. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement “I routinely monitor student progress and performance” has the highest mean Likert scale response of 6.37 and is at the top of the table (Table 4.5). Also, the statement “I provide a very high degree of structure with course layout, lesson content, and assignment expectations” has a mean of 6.10, and is located at the top of the instructors’ personal actions’ construct table. In contrast, the lowest mean of 3.67 for statement “I am aware of all my students’ academic status before each semester” is located at the bottom of the

Table 4.5. Instructors’ Personal Actions Variable and Statement Statistics

Construct	Instructors Personal Actions Statements	Mean	S. D.	a, Alpha
Instructors Personal Actions		5.29	.80	0.77
	I routinely monitor student progress and performance.	6.37	.94	
	I provide a very high degree of structure with course layout, lesson content, and assignment expectations.	6.10	.98	
	I highly value and prioritize each student’s cognitive growth.	5.92	1.06	
	I routinely share effective instructional strategies with other faculty members.	5.46	1.21	
	I routinely attempt to use graphical displays to depict lesson content to students.	5.31	1.57	
	I expect all my students to graduate.	5.17	1.57	
	I highly value and prioritize each student’s social and emotional development.	5.15	1.31	
	I am aware of all my students’ academic status during each semester.	4.31	1.65	
	I am aware of all my students’ academic status before each semester.	3.67	1.52	

instructors’ personal actions’ construct table. The average Likert scale response for all instructor personal actions statements is the construct value of 5.29 reported below. The Cronbach’s Alpha test results produce a 0.77 for the instructor personal actions construct. This alpha test result falls in the acceptable range of 0.7 to 0.8 for construct internal reliability.

In Table 4.6 I report the mean and standard deviation for the student participation variable construct and the construct's corresponding seven statements. Each of the student participation statements are provided (Table 4.6) along with the mean and standard deviation Likert scale response. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement "I highly motivate students to attend classes in person for multiple reasons" has the highest mean Likert scale response of 6.25 and is at the top of the table (Table 4.6). Also, the statement "I require students to dedicate large amounts of their time practicing course material" has a mean of

Table 4.6. Student Participation Variable and Statement Statistics

	Student Participation Statements	Mean	S. D.	a, Alpha
Student Participation		4.75	1.00	0.76
	I highly motivate students to attend classes in person for multiple reasons.	6.25	.93	
	I require students to dedicate large amounts of their time practicing course material.	5.29	1.58	
	I require students to take detailed notes during class.	4.75	1.52	
	I require students to work together on assignments, activities, and course work as much as possible.	4.60	1.76	
	I routinely require my students to help other students learn the course material.	4.35	1.60	
	I use whole class activities that require the participation of all students.	4.12	1.94	
	I routinely use physical manipulatives to represent course content.	3.90	1.45	

5.29, and is located at the top of the student participation's construct table. In contrast, the lowest mean of 3.90 for statement "I routinely use physical manipulatives to represent course content" is located at the bottom of the students' participation's construct table. The average Likert scale response for all student participation statements is the construct value of 4.75 reported below. The Cronbach's Alpha test results produce a 0.76 for the student participation construct. This alpha test result falls in the acceptable range of 0.7 to 0.8 for construct internal reliability.

In Table 4.7 I report the mean and standard deviation for the students' mental actions variable construct and the construct's corresponding seven statements. Each of the students' mental actions statements are provided (Table 4.7) along with the mean and standard deviation Likert scale response. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement "By the end of my developmental math course, my students learn that they can do college level math" has the highest mean Likert scale response of 5.60 and is at the top of the table (Table 4.7). Also, the statement "All of my students are routinely instructed to think about options, choices, and results

Table 4.7. Students' Mental Actions Variable and Statement Statistics

Construct	Students' Mental Actions Statements	Mean	S. D.	a, Alpha
Students' Mental Actions		5.04	.78	0.70
	By the end of my developmental math course, my students learn that they can do college level math.	5.60	1.07	
	All of my students are routinely instructed to think about options, choices, and results as they work with course content.	5.25	1.20	
	My students acknowledge their current position as a developmental math student.	5.23	1.28	
	My students describe and express their past experience with math.	5.13	1.21	
	My instructional practice facilitates students relating to one another.	5.00	1.20	
	I routinely require students to reflect on course content and their overall experience with math.	4.54	1.60	
	My practice involves students acknowledging multiple personal goals associated with the course.	4.54	1.47	

as they work with course content" has a mean of 5.25, and is located at the top of the students' mental actions' construct table. In contrast, the lowest mean of 4.54 occurs for two statements, "I routinely require students to reflect on course content and their overall experience with math" and "My practice involves students acknowledging multiple personal goals associated with the course". Both statements are located at the bottom of the students' mental actions construct table. The average Likert scale response for all students' mental actions statements is the construct value of 5.04 reported below. The Cronbach's Alpha test results produce a 0.70 for the students' mental actions construct. This alpha test result falls in the acceptable range of 0.7 to 0.8 for construct internal reliability.

Table 4.8 reports the mean, standard deviation, minimum, and maximum instructional practice variable construct values in no particular order. Note that all instructional practice variable values are the average of the Likert scale statement responses associated with that instructional practice category. Also, constructs are ordered with the highest mean value at the top and the lowest mean value at the bottom of the table (Table 4.8). Therefore, respondents agree with literature's statements of best practices in developmental math environments associated with course components the most, followed by instructor personal actions, students'

Table 4.8. Instructional Practice Variable Values Summary Statistics

Instructional Practice Variable Construct	Mean	S. D.	Min	Max
Course Components	5.37	.94	2.14	6.71
Instructor Personal Actions	5.29	.80	1.44	6.78
Students' Mental Actions	5.04	.78	3.29	7
Student Instructor Interactions	4.93	.90	1	6.86
Student Participation	4.75	1.00	2.71	6.71

mental actions, student instructor interactions, and agree with statements associated with student participation the least.

Factor Analysis Results

The following information provides results of a factor analysis. The factor analysis is particularly conducted on data from Likert scale responses to the 37 different instructional practice statements used within survey questions. The purpose of a factor analysis is to determine the fewest number of variables that can be used to represent a complex situation. In my case, I want the fewest number of variables that accurately represent developmental math instructors' personal instructional practice. The factor analysis demonstrates which of the 37 statements should be statistically clustered together, based on data gathered.

To determine the appropriate number of factors/constructs consider Table 4.9 where I report eigenvalues of the first 10 factors. Typically, any eigenvalue over 1 is acceptable, so I

Table 4.9. Eigenvalue Factor Analysis Results

Factor	Eigenvalue
Factor1	8.35019
Factor2	3.92198
Factor3	2.09753
Factor4	1.51130
Factor5	1.38862
Factor6	1.11757
Factor7	0.91712
Factor8	0.75080
Factor9	0.64647
Factor10	0.49898

would conclude that there are six factors or clusters in my data. Since I started out with five constructs, creating more, six, constructs from the factor analysis results is not fulfilling the motivation behind the analysis conducted. Therefore, when the eigenvalue greater than one method potentially produces too many factors, there is another option to determine the appropriate number of factors. To start, in Figure 4.1 on the next page I report factors 1-10's eigenvalues in a line chart. The other option for determining the appropriate number of factors is to determine the point where the line within figure 1 starts to level off. The point at which the line levels off is the last appropriate factor for the data set analyzed. In figure 1, the line starts to level off at the third point or at the third factor. Therefore, factor analysis results of data gathered conclude there are three factors or clusters that all 37 statement responses belong to, not four, five, or six.

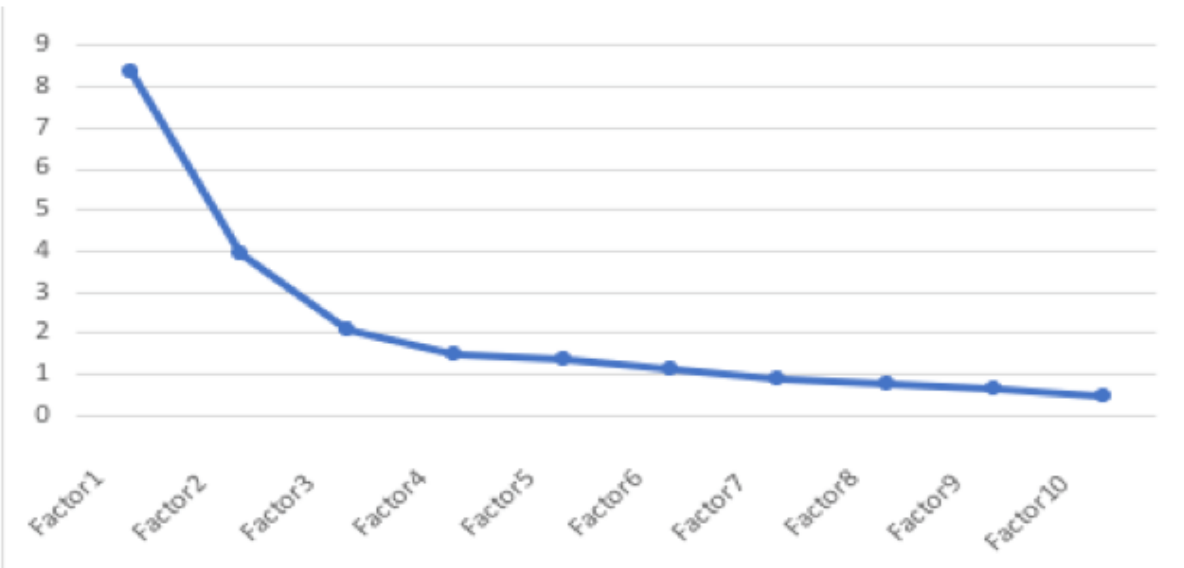

Figure 4.1. Eigenvalues of Factors 1-10

In table 4.10, I report additional results from the three factor, factor analysis. The table provides each of the 37 statements and their highest weight for either factor one, two, or three. The weight assigned to each statement represents how strongly it belongs to each factor/cluster of data. Only the highest weight for each statement is provided because the highest weight determines which factor/cluster the statement belongs to. For example, the second statement in Table 4.10 is "The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications".

Table 4.10. Factor Analysis Loading Results of Statements

Statement	Factor1	Factor2	Factor3
My developmental math courses provide students with a variety of life skills material and content.			0.52
The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications			0.47
My developmental math courses utilize a math text book or workbook of some kind			0.42
During each class, I present and link course content to college level requirements.			0.55
I routinely provide clear, obtainable lesson goals that are transparent and known to students.			0.69
I provide detailed notes to every student for every lesson.			0.47
My developmental math course provides multiple low stakes exams and quizzes for students to complete.	0.27		
I work with students to discuss their personal, educational, and life goals.	0.65		
I work with students to discuss their past experiences and impressions of math.	0.67		
I ask questions to each student to check for their overall understanding of content.	0.64		
I provide every student with personal feedback in a one-on-one environment.	0.61		
I create effective and meaningful communication with all of my students during the course.	0.78		
I require students to communicate with me through math journaling or some type of record that records their thoughts.			0.42
I interact with all my students outside of the classroom as much as professionally possible.	0.37		
I expect all my students to graduate.	0.54		
I provide a very high degree of structure with course layout, lesson content, and assignment expectations.	0.65		
I highly value and prioritize each student’s social and emotional development.	0.83		
I highly value and prioritize each student’s cognitive growth.	0.75		
I routinely share effective instructional strategies with other faculty members.			0.52

Table 4.10. Continued

Statement	Factor1	Factor2	Factor3
I routinely monitor student progress and performance.	0.77		
I routinely attempt to use graphical displays to depict lesson content to students.			0.51
I am aware of all my students' academic status before each semester.			0.37
I am aware of all my students' academic status during each semester.			0.33
I highly motivate students to attend classes in person for multiple reasons.		0.44	
I require students to work together on assignments, activities, and course work as much as possible.		0.57	
I require students to take detailed notes during class.		0.56	
I routinely use physical manipulatives to represent course content.		0.46	
I routinely require my students to help other students learn the course material.		0.60	
I use whole class activities that require the participation of all students.		0.63	
My practice involves students acknowledging multiple personal goals associated with the course.		0.67	
My students describe and express their past experience with math.		0.44	
All of my students are routinely instructed to think about options, choices, and results as they work with course content.		0.34	
I routinely require students to reflect on course content and their overall experience with math.			0.48
My students acknowledge their current position as a developmental math student.		0.27	
My instructional practice facilitates students relating to one another.		0.59	
By the end of my developmental math course, my students learn that they can do college level math.		0.58	

This statement loads the most on factor 3 with a weight of 0.47, and thus belongs to a factor temporarily titled construct 3. Also, consider the seventh statement of "My developmental math course provides multiple low stakes exams and quizzes for students to complete" that load on factor one with a weight of 0.27, and thus belong to construct one's cluster. New construct names of the resulting factor analysis clusters are provided in following paragraphs and Table 4.14.

Tables 4.11 through 4.13 provide the same information as tables 4.3 through 4.7, however using constructs produced from the factor analysis. Factor analysis results imply that new statement constructs/clusters are as follows (Tables 4.11-4.13). In Table 4.11, I report the mean and standard deviation for the factor analysis' first construct and the construct's corresponding instructional practice statements. Each of construct one's statements are provided (Table 4.11) along with the mean and standard deviation of all Likert scale responses. Statements are ordered with the highest mean response at the top and the lowest mean response at the

Table 4.11. Factor Analysis Construct 1 Statistics

New I.P. Variable	Statements that loaded on factor 1	Mean	S. D.	a, Alpha
Construct 1		5.47	0.88	0.88
	I routinely monitor student progress and performance.	6.37	.94	
	I provide a very high degree of structure with course layout, lesson content, and assignment expectations.	6.10	.98	
	I create effective and meaningful communication with all of my students during the course.	5.94	1.18	
	I highly value and prioritize each student's cognitive growth.	5.92	1.06	
	I ask questions to each student to check for their overall understanding of content.	5.77	1.17	
	I work with students to discuss their past experiences and impressions of math.	5.54	1.38	
	I work with students to discuss their personal, educational, and life goals.	5.46	1.31	
	I expect all my students to graduate.	5.17	1.57	
	I highly value and prioritize each student's social and emotional development.	5.15	1.31	
	My developmental math course provides multiple low stakes exams and quizzes for students to complete.	5.08	1.63	
	I provide every student with personal feedback in a one-on-one environment.	5.04	1.61	
	I interact with all my students outside of the classroom as much as professionally possible.	4.13	1.48	

bottom. For example, the statement “I routinely monitor student progress and performance” has the highest mean Likert scale response of 6.37 and is at the top of the table (Table 4.11). Also, the statement “I provide a very high degree of structure with course layout, lesson content, and assignment expectations” has a mean of 6.10, and is located at the top of construct one’s table. In contrast, the lowest mean of 4.13 for the statement “I interact with all my students outside of the classroom as much as professionally possible” is located at the bottom of construct one’s table. The average Likert scale response for all construct one statements is 5.47 reported below. The Cronbach’s Alpha test results produce a 0.88 for construct one. This alpha test result falls in the good range of 0.8 to 0.9 for construct internal reliability.

In Table 4.12 I report the mean and standard deviation for the factor analysis’ second construct and the construct’s corresponding instructional practice statements. Each of construct two’s statements are provided (Table 4.12) along with the mean and standard deviation of all Likert scale responses. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement “I highly motivate students to attend classes in person for multiple reasons” has the highest mean Likert scale response of 6.25 and is at the top of the table (Table 4.12). Also, the statement “By the end of my developmental math course, my students learn that they can do college level math” has a mean of 5.60, and is located at the top of construct two’s table. In contrast, the lowest means of 3.90 and 4.12 for the statements “I routinely use physical manipulatives to represent course content” and “I use whole class activities that require the participation of all students” are located at the bottom of construct two’s table. The average Likert scale response for all construct two statements is 4.92 reported below. The Cronbach’s Alpha test results produce a 0.81 for construct two. This alpha test result falls in the good range of 0.8 to 0.9 for construct internal reliability.

Table 4.12. Factor Analysis Construct 2 Statistics

New I.P. Variable	Statements that loaded on factor 2	Mean	S. D.	a, Alpha
Construct 2		4.92	0 .79	0.81
	I highly motivate students to attend classes in person for multiple reasons.	6.25	0.93	
	By the end of my developmental math course, my students learn that they can do college level math.	5.60	1.07	
	I require students to dedicate large amounts of their time practicing course material.	5.29	1.58	
	All of my students are routinely instructed to think about options, choices, and results as they work with course content.	5.25	1.20	
	My students acknowledge their current position as a developmental math student.	5.23	1.28	
	My students describe and express their past experience with math.	5.13	1.21	
	My instructional practice facilitates students relating to one another.	5.00	1.20	
	I require students to take detailed notes during class.	4.75	1.52	
	I require students to work together on assignments, activities, and course work as much as possible.	4.60	1.76	
	My practice involves students acknowledging multiple personal goals associated with the course.	4.54	1.47	
	I routinely require my students to help other students learn the course material.	4.35	1.60	
	I use whole class activities that require the participation of all students.	4.12	1.94	
	I routinely use physical manipulatives to represent course content.	3.90	1.45	

In Table 4.13 I report the mean and standard deviation for the factor analysis' third construct and the construct's corresponding instructional practice statements. Statements are ordered with the highest mean response at the top and the lowest mean response at the bottom. For example, the statement "I routinely provide clear, obtainable lesson goals that are transparent and known to students" has the highest mean Likert scale response of 5.90 and is at the top of the table (Table 4.13). Also, the statement "The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications" has a mean of 5.65, and is located at the top of construct three's table. In contrast, the lowest means of 2.60 and 3.67 for the statements "I require students to communicate with me through math journaling or some type of record that records their thoughts" and "I am aware of all my students' academic status before each semester" are located at the bottom of construct

Table 4.13. Factor Analysis Construct 3 Statistics

New I.P. Variable	Statements that loaded on factor 3	Mean	S.D.	a, Alpha
Construct 3		4.89	0.89	0.82
	I routinely provide clear, obtainable lesson goals that are transparent and known to students.	5.90	1.42	
	The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications.	5.65	1.30	
	My developmental math courses utilize a math text book or workbook of some kind.	5.65	1.68	
	I routinely share effective instructional strategies with other faculty members.	5.46	1.21	
	I routinely attempt to use graphical displays to depict lesson content to students.	5.31	1.57	
	My developmental math courses provide students with a variety of life skills material and content.	5.31	1.45	
	During each class, I present and link course content to college level requirements.	4.96	1.64	
	During each class, I present and link course content to college level requirements.	4.96	1.64	
	I routinely require students to reflect on course content and their overall experience with math.	4.54	1.60	
	I am aware of all my students' academic status during each semester.	4.31	1.65	
	I am aware of all my students' academic status before each semester.	3.67	1.52	
	I require students to communicate with me through math journaling or some type of record that records their thoughts.	2.60	1.36	

three's table. The average Likert scale response for all construct three statements is 4.89 reported below. Each of construct three's statements are provided (Table 4.13) along with the mean and standard deviation of all Likert scale responses. The Cronbach's Alpha test results produce a 0.82 for construct one. This alpha test result falls in the good range of 0.8 to 0.9 for construct internal reliability.

Table 4.14 provides names and statistics about the three new instructional practice variable constructs that are created with results from factor analysis. Note, this is the same information as table 9, however using the factor analysis constructs and not the literature based instructional practice constructs. After analyzing results from the factor analysis, names for each construct are determined. Construct one is named Instructor Actions, construct two is named Student Actions, and construct 3 is named Course Components. The new names are created to help understand why statements and data cluster the way they do according to factor analysis results.

Table 4.14. Summary Statistics of New Instructional Practice Constructs

New Instructional Practice Variable Constructs	Mean	Std. Dev.	Min	Max
Construct 1: Instructor Actions	5.47	.88	1.17	6.58
Construct 2: Student Actions	4.92	.79	3.15	6.70
Construct 3: Course Components	4.89	.89	2.25	6.92

Results for Research Questions 1c

The following information directly answers research question 1c. In research question 1c I ask, "What is the relationship between the measure of the instructors' perceptions of student success and instructors' personal instructional practice?". Results in this section of the research include multiple correlations of interest. Each correlation mentioned here either considers perception variable constructs, instructional practice constructs, or survey questions one and two responses. All correlations that are 90 percent statistically significant are stared and highlighted within tables presented for future discussion. The original instructional practice variables represent constructs of statements that current literature and I cluster together. The original five instructional practice constructs demonstrate acceptable alpha values for internal reliability. However, the factor analysis produces three constructs that are much more reliable according to the Cronbach's alpha test, producing good alpha test results. In addition, factor analysis results strictly use data gathered in my research to determine the appropriate clusters/constructs and the appropriate number of constructs. Therefore, the three instructional practice variable constructs from the factor analysis are used for correlation testing instead of the five original instructional practice variables I created using best practice statements from current literature because of the higher level of construct reliability.

Correlation of New Instructional Practice Constructs and Perception Variables

In table 4.15, I report correlation coefficients between each perception's rank (survey question 1) and the new instructional practice variable constructs. Most of the correlation coefficients demonstrate that there are weak relationships between the perceptions' ranks and the new instructional practice constructs. However, there are two correlation coefficients that demonstrate a moderate correlation. The first moderate correlation of -0.31 (Table 4.15) occurs between the perception that student goal completion is student success and instructional practices associated with student actions in the classroom. The correlation is negative and is statistically significant with the significance level $p < 0.10$. Therefore, the more instructors think of student success being when student complete a personal goal, the less instructors agree with their instructional practice aligning with literature's best practices about student actions. The second moderate correlation of 0.35 (see Table 4.15) occurs between the perception that student success is when students complete requisite college courses and instructional practices associated student actions in the classroom. The correlation is positive and is statistically significant with the significance level $p < 0.10$. Therefore, the more instructors perceive student success to be when students complete college requisite courses remediation is intended for, the more their instructional practice aligns with current literature about best practices associated with student behaviors in developmental math environments.

Table 4.15. Perception Rank and New I.P. Constructs' Correlation Matrix

	GC Rank	DC Rank	DCC Rank	RCCC Rank	SASK Rank	DSC Rank
Instructor Actions	0.02	-0.15	0.06	-0.16	0.11	0.09
Student Actions	-0.31*	-0.02	0.13	0.35*	0.00	-0.02
Course Components	0.01	-0.07	-0.02	0.12	-0.04	0.02

Table 4.16 is a correlation matrix that contains each perception's percentage of time spent (survey question 2) and the new instructional practice variable constructs. Most of the correlation coefficients demonstrate that there are weak relationships between time spent on each perception of student success and the new instructional practice constructs. However, there are two correlation coefficients that demonstrate greater than a 90 percent significance, $p < 0.10$. The first significant correlation of 0.25 (see Table 4.16) demonstrates a weak positive correlation between the amount of time spent on the perception that student success is when students complete the developmental sequence, and how much instructors' actions align with current literature about best practices. Therefore, the more time an instructor spends on student success being when students complete the developmental math course sequence, the more their personal instructional practice aligns with literature about best practices in college level developmental math environments. The second significant correlation of -0.38 (Table 4.16) demonstrates a moderate positive correlation between the amount of time spent on student success being when students complete the developmental course, and how much their practice demonstrates students actions that align with current literature about best practices. Therefore, the more an instructor

perceives student success to be when students complete a development course, the less their instructional practices associated with student actions align with current literature about best practices.

Table 4.16. Perception Percentage Time Spent and New I. P. Construct Correlations

	GC Percent	DC Percent	DCC Percent	RCCC Percent	SASK Percent	DSC Percent
Instructor Actions	0.10	0.21	-0.09	0.05	-0.18	0.25*
Student Actions	0.15	0.11	-0.38*	-0.06	0.11	-0.05
Course Components	0.08	0.00	-0.03	-0.01	-0.10	0.01

Table 4.17 is a correlation matrix of the new instructional practice constructs to themselves. Notice that of the three instructional practice categories, there is one relationship that is not statistically significantly correlated at the 90 percent significance level. The correlation coefficient of 0.17 (Table 4.17) demonstrates a weak not significant relationship between instructional practices associated instructors' actions and students' actions. Therefore, there is not a statistically significant relationship between what students and instructors do in the classroom. In contrast, the correlation coefficient of 0.51 (Table 4.17) demonstrates a strong statistically significant correlation between instructors' actions and the course components. Also, the correlation coefficient of 0.42 (Table 4.17) demonstrates a moderate statistically significant correlation between students' actions and the course components. Therefore, there are

Table 4.17. Correlation Matrix of New Instructional Practice Constructs to Themselves

	Instructor Actions	Student Actions	Course Components
Instructor Actions	1		
Student Actions	0.17	1	
Course Components	0.51*	0.42*	1

statistically significant correlations between instructors' actions and course components, as well as between students' actions and course components.

Overall Results

Results for my main research question primarily consist of a detailed quantitative instrument and two numerical constructs of instructors' perceptions of student success and instructors' instructional practice. The main research question I ask is, "What instrument can be created to measure the relationship between community college developmental math instructors' perceptions of student success and their instructional practice in classrooms?". The following information are results from my research.

Instrument constructs developed for this research include two types of variables. The variables are perceptions of student success and instructors' instructional practice. The six different perception variables include participants' rank of each perception and their percent of time spent on that particular perception. All perception variables provide a numerical representation of how much each perception align with that of the participant, and how much each perception influences what participants do in their classroom. The five initial instructional practice variables are the average Likert scale response for each instructional practice category of statements. Factor analysis on data gathered produces three new constructs that are deemed more reliable and useful than the original five constructs. All instructional practice variable constructs represent how much participants agree with statements about effective developmental math instruction derived from current literature. The original survey instrument that gathered all information provided here is found in Appendix II. Improvements and recommendations to the format and content of the survey instrument are provided in the following Chapter 5 along with a final version of the instrument to use in future research.

CHAPTER 5: INTERPRETATIONS, DISCUSSIONS, & IMPLICATIONS OF RESULTS

Introduction

The purpose of this dissertation is to develop and validate an instrument that quantitatively measures the relationship between North Carolina's community college instructors' perceptions of student success and their instructional practice. Results include a survey instrument, multiple variable constructs, a factor analysis on data gathered, and multiple correlation tests of potential relationships between constructs. Research questions consist of one main question and three sub-questions. Interpretations of each sub-questions are provided first. Next, the combination of interpretations and discussions from each sub-question accumulates to answer the main research question about survey instrument development. Taken together, the information provides interpretations of all results found, discussions linking results back to current literature, future implications, and survey instrument recommendations.

Question 1a Interpretations and Discussion

Research Question 1a asks, "What is the reliability and validity of the survey's measure for instructors' perceptions of community college developmental math student success?". Discussions and interpretations include how perception constructs rank compared to each other and how much time developmental math instructors spend on each construct in their classroom.

Interpret and Discuss Survey Question 1

According to results from survey question one, North Carolina community college developmental math instructors are most likely to perceive student success to occur when students graduate college or obtain a higher education certificate/credential. Therefore, the perception construct of students graduating college and obtaining some type of higher education credential aligns best with instructors' personal perception of student success. In addition, developmental course sequence completion, developmental course completion, and requisite college course completion are perceptions of student success that are likely to align with North Carolina's community college developmental math instructors' perceptions of student success. In contrast, instructors are less likely to view constructs of student personal goal completion and skill acquisition as student success when compared to other perception constructs. Key results produced by survey question one are that developmental math instructors' personal views of student success associates less with skill acquisition and more with college or course completion.

Existing current literature supports the interpretations of survey question one. There is a large amount of research and literature dedicated to studying student success with the view that students succeed when they graduate college. (Attewell, Lavin, Domina, & Levey 2006; Bailey, Jeong, & Cho, 2010; Chen, 2016; Juszkiewicz, 2015; NC Community College Creating Success, 2015; NC Community College Creating Success, 2017; NC Student Success Center, 2017). This large amount of research directly relates to the fact that a positive developmental math course outcome is to allow students that typically cannot enter college to enter and succeed in college. Developmental math instructors are aware that their course allows students that cannot enroll in college courses to attend college campuses in pursuit of college degrees. Therefore, developmental math instructors possess a more holistic view of student success instead of concentrating on immediate results of remediation. Current literature available as well as developmental math's role at community colleges contribute to instructors' perceptions of student success aligning best with when students graduate college.

In addition, current research discusses and demonstrates student goal completion and skill acquisition as important perceptions of student success. (Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Crews & Aragon, 2007; Kee, 2013; Kitchens, 2009). This is not the same conclusion as results from my survey question one. There is a substantial amount of literature about student skill acquisition and student goal completion. However, math skills and student goals found within developmental math environments are often assumed or neglected in these important discussions. This results in the relationship between students learning skills or completing goals to overall student success is omitted or highly neglected. Therefore, while there is a substantial amount of literature concerning skill acquisition and student goal completion, the current North Carolina developmental math environment down-plays the role of skill acquisition and student goal completion relationship with overall student success. The down-play appears to be due to how skill acquisition and goal completion are ingrained into college attendance and student experiences. The net results appear to be developmental math instructors not perceiving student success as defined by when students acquire skills or complete personal goals and instead focusing upon success defined as when their students obtain college credentials.

Interpret and Discuss Survey Question 2

Survey question 2 asks participants to weigh each perception of student success variable according to how much they think about each while performing their instructional practice. Instructors weigh each variable between 0 and 100 percent of their time in practice, and the cumulative total of responses to all six perception variables sum to 100 percent. How much instructors think about each particular perception of student success is considered to be the amount of time their practice is thinks about or caters to that particular type of student success. According to results from survey question two, North Carolina community college developmental math instructors spend most of their practice thinking about and catering to student success being when students acquire appropriate skills and knowledge. The second highest weighted perception of student success that receives substantial amounts of faculty time in practice is developmental course completion. Therefore, while instructors perform their personal instructional practice they are most likely thinking about and catering to the success of their students as being when appropriate skills or knowledge are obtained and when students complete the developmental course. In contrast, student success perception variables of requisite college course completion and college degree completion have the least amount of time spent on them within college level developmental math practice. Therefore, instructors spend a majority of time in their practice focused on and catering to student skill acquisition and students completing the developmental math course, and very little time is spent on ensuring student pass requisite college courses or complete college credentials.

Current literature supports the interpretations of survey question two. Substantial amounts of information originates from research on the perception that student success happens when students acquire appropriate skills and knowledge (Bahr, 2008; Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; NC Student Success Center, 2017). There is also a large amount of research on current policy and practices that highly rely on the perception that student success is when developmental math students complete developmental math courses (Aycaster, 2001; Bailey, Jeong, & Cho, 2010; Bettinger, Boatman, & Long 2013; Chen, 2016; NC Community Colleges Final Report, 2013; Boylan & Boone, 1995). This literature originates from researching effective developmental math instructional outcomes such as course completion and skill acquisition. Results from survey question two demonstrate that instructors spend their time in practice catering to these two particular positive outcomes of developmental instruction. Therefore, North Carolina developmental math instructors more likely spend their time in practice following literature’s suggestions about skill acquisition and course completion instead of literature's more holistic views of student success associated with developmental math students graduating college.

Compare and Contrast Survey Question 1 & 2

Survey questions one and two both ask questions about different perceptions of student success. However, the two questions capture completely different information. The first question gains information about instructors' personal perceptions of student success. The second question gains information about which perceptions of student success instructors think about and cater to in their developmental math practice. Since results from survey question one do not directly align with results from survey question two I compare and contrast these results here to further understand information gained.

North Carolina community college developmental math instructors are most likely to perceive student success as being when students graduate college, complete a sequence of developmental courses, and when students complete the developmental course they enroll in. However, these same instructors spend most of their time in practice focusing on skill acquisition, developmental course completion, and student personal goal completion. The only overlap between the two questions' top three perceptions includes the construct of developmental course completion being student success. Therefore, only one of the top three perception constructs that align with instructors' view of student success has substantial time spent on it in practice.

Results demonstrate that North Carolina community college instructors' personal perceptions of student success do not directly guide the instruction they provide. This is evident from the order of the six average perception variable construct values produced in tables 4.1 and 4.2. Results from these two tables imply that instructors primarily perceive student success as being college graduation and sequenced course completion. However, instructors focus on and spend time in practice helping students acquire appropriate skills and knowledge that allows them to pass the developmental course. The focus in practice on skill acquisition and developmental course completion are extremely important because both directly lead to student success in the form of college graduation and developmental sequence completion. The contrast between personal perceptions and instructional practice originates from the fact that student enrollment into developmental math courses is meant to help students attend and graduate from college. However, skill and knowledge obtainment are initial steps required to graduate college. Results show that instructors' overall perceptions of college student success is highly associated with developmental students completing all of their sequenced developmental courses and actually completing a college credential. Developmental math instructors' role and position impacts the perception of success that is most appropriate for them to spend time on in practice. In practice, developmental instructors know that skill acquisition and developmental course completion are what students need to accomplish in order to be successful, i.e. graduate college. In addition, student skill acquisition and developmental course completion are primarily what developmental math instructors have control over. Therefore, even though instructors agree the most with perceptions that student success is when student graduate college they know that their role and time is best spent focused on student skill acquisition and developmental course completion.

There are substantial amounts of information about student success being when students graduate college in current literature. However, information about how to facilitate this type of success (college completion) centers on college level developmental programs and particular college support services offered to students that promote overall college completion (Attewell, Lavin, Domina, & Levey 2006; Bailey, Jeong, & Cho, 2010; Chen, 2016; NC Student Success Center, 2017). This situation results in the responsibility to promote college completion and requisite college course completion being deferred to each college's developmental program of choice, and not necessarily placed on individual instructors. The situation provides potential justification for why instructors do not spend time in their practice thinking about or catering to college completion or requisite college course completion. College completion and requisite college course completion are positive outcomes of successful developmental math programs, and are associated less with outcomes of successful practice. In contrast, student skill acquisition and developmental course completion are positive outcomes to successful instructional practices. All representations of successful developmental math student outcomes in literature are viewed as important, however particular outcomes directly relate to program or college choice while other outcomes relate closer to specific instruction provided. Therefore, instructors spend time in their personal practice promoting perceptions of success associated with positive outcomes of effective instruction, and spend less time thinking about or catering to positive outcomes of effective developmental math program execution.

Question 1b Interpretations and Discussion

Research Question 1b asks: "What is the reliability and validity of the survey's measure for instructors' personal instructional practice in community college developmental math environments?". Discussions and interpretations includes an explanation of factor analysis results. In addition, all instructional practice constructs produced by the factor analysis are discussed in detail.

Interpret and Discuss Factor Analysis

Initially, my research presents five instructional practice variable constructs. The five constructs are course components, instructor personal actions, instructor student interactions, student physical actions, and student mental actions. These instructional practice constructs represents previous research and categorizes all best practices in college level developmental math environments. Participants answered questions about each construct within the survey instrument. Participants' Likert scale responses are used to calculate particular variable values for each construct. A factor analysis was performed to potentially increase the internal reliability of constructs created and used in my research. In addition, the factor analysis is used to potentially reduce the number of variables associated with the multifaceted act of instructing college developmental math. Results from the factor analysis concludes there are not five instructional practice constructs, but there are three instructional practice constructs. The factor analysis on data gathered concludes that three constructs accurately categorize community college level developmental math course instruction. After reviewing each construct, they were titled instructor actions, student actions, and course components. In addition, the three new constructs demonstrate more internal reliability according to Cronbach's Alpha tests than the previous five. Therefore, factor analysis results suggest that the three categories of instructor actions, student actions, and course components accurately represent all best practices performed by participants.

Literature about instructional practices in college level developmental math courses always includes information about instructors, students, or course components (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014; Killian, 2015). Many discussions about instructional practice in developmental math environments focus on what instructors are expected to do in their role. In addition, discussions of instructional practice also includes aspects and actions of students as well as course components. Therefore, results from my factor analysis on college level developmental math instructional practices of three categories/constructs being instructor actions, student actions, and course components are highly supported by current literature.

Interpret and Discuss Instructional Practice Constructs

My dissertation classifies literature's best practices associated with developmental math environments into three key constructs. The results strongly suggest that participants' personal instructional practice mostly resembles literature's best practices associated with instructor actions. In addition, participants instructional practice closely resembles literature associated with student actions, followed by literature's best practices associated with course components. Therefore, North Carolina community college developmental math instructors are more likely to agree with personal practices aligning with literature's best practices associated with instructor actions. Participants are less likely to agree with literature's best practices associated with student actions resembling their personal practice. Participants personal instructional practice resembles literature's best practices associated with course components the least. I interpret and discuss each of the three instructional practice constructs in the following paragraphs.

Instructor Actions

Instructor actions are any personal actions, preparatory actions, and instructor student interactions that takes place during the course of instructors carrying out their role. Naturally, a discussion on and research about instructors' instructional practice includes instructors' actions as a focal point. Therefore, the first and most promenade construct produced during factor analysis is instructor actions. Current literature strongly supports the fact that effective instructional practices rely on important instructor actions (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014; Killian, 2015). In addition, data analysis strongly supports this fact as well. The instructor actions cluster of data, the instructional practice statements, produced by the factor analysis was highly reviewed and analyzed. The cluster was named instructor actions only after all content was determined to represent instructors' personal actions, preparatory actions, and instructor student interactions related to their role as a developmental math instructor.

The instructor actions construct represents a particular cluster of literature related to effective college level developmental math practices. Interestingly, North Carolina community college developmental math instructors agree that their personal practice exhibits certain instructor action statements more than others. Therefore, participants agreed strongly with some statements, and closer to neutral for other statements. Notice that every instructional practice statement for instructor actions located in Table 4.11 receives a 7-point Likert scale response over 4.0. Therefore, instructors agree with all effective instructor action statements, however they agree with some more than others. Instructor action statements that instructors are most likely to agree with are "I routinely monitor student progress and performance", "I provide a very high degree of structure with course layout, lesson content, and assignment expectations.", "I create effective and meaningful communication with all my students during the course.", "I highly value and prioritize each student's cognitive growth.", and "I ask questions to each student to check for their overall understanding of content.". These statements are ordered with the highest average Likert response first. In contrast, instructors are less likely to agree with statements such as, "I interact with all my students outside of the classroom as much as professionally possible.", "I provide every student personal feedback in a one-on-one environment.", and "My developmental math course provided multiple low stakes exams and quizzes for students to complete.". These statements are ordered with the lowest average Likert scale response first.

The range of average Likert scale responses to literature's statements about effective instructional practice demonstrates that instructor prioritize what takes place in their personal practice. Instructors agree with all effective instructor action statements, however their role as an instructor impacts how much each statement appears in their personal practice. Certain statements about student expectations, student progress, and creating effective communication are important enough to ensure that they take place. These statements take place despite potential time or labor dedication due to their importance. On the other hand, certain statements may require more time, effort, and preparation than they are worth. Particularly, the statements at the bottom of table 4.11. These are the statements that participating instructors agree with least. Consider the statement, "I provide every student with personal feedback in one-on-one environments", located near the bottom of Table 4.11. This statement potentially requires a substantial amount of time dedication to fulfill. In addition, compared to the amount of time required for personal feedback with every student, there may be a minimal return in positive student outcomes. Therefore, participants prioritize literature's effective instructional practices within their personal roles' as developmental math instructors.

Student Actions

Student actions are any physical or mental action a student performs related to enrollment in a developmental math course. A large section of literature that researches instructional practices for college level developmental math environments relates to particular actions students perform and experience in order for instruction to be effective. Therefore, current literature supports the fact that there are important student actions that need to take place for effective developmental instruction to take place. In addition, my research's factor analysis results suggest that student actions are the second most promenade group of effective instructional practice statements. The student actions construct was named student actions only after the cluster of statements' content was determined to accurately represent physical and mental actions of students that enroll in developmental math courses. Therefore, important student actions represent a substantial portion of information about instruction practices within developmental math environments.

Current literature related to effective college level developmental math practices represents the student actions construct found during this dissertation's factor analysis. Similar to the instructor actions construct, North Carolina community college developmental math instructors' personal practice aligns with certain student action statements more than others. Student action statements that participants are most likely to agree with are "I highly motivate students to attend classes in person for multiple reasons.", "By the end of my developmental math course, my students learn that they can do college level math.", and "I require students to dedicate large amounts of their time practicing course material." These statements are ordered with highest average Likert response first in Table 4.12. In contrast, instructors are less likely to agree with student action statements such as "I routinely use physical manipulatives to represent course content.", "I use whole class activities that require the participation of all students.", and "I routinely require my students to help other students learn the course material." These statements are presented here with the lowest average Likert scale response first. Therefore, participants agree strongly with some student action statements, and disagree with others.

The range of average Likert scale responses to student action statements that represent literature's effective instructional practice demonstrates that instructors promote certain student actions taking place more often than others. North Carolina community college developmental math instructors promote actions such as student attendance, students dedicating time to material, and students that acknowledge they can do math. In contrast, instructors are less likely to facilitate student actions such as helping other students with material, whole class activities, and use of physical manipulatives. Choices of student actions that take place are not random and are done with intention. Table 4.12 provides the hierarchy of student actions that are preferred to take place by North Carolina's developmental math instructors. Instructor motivation behind their choice of instructional practice comes from many avenues. Developmental math instructors have limited time, a budget, and particular developmental students that are in need of excellent instruction. Therefore, developmental math instructors practice includes making personal choices of effective instruction that are based on what they expect developmental math students to do.

Course Components

The course components construct contains community college developmental math course attributes. Since this is the third and final construct created by my research's factor analysis, all statements that do not belong to the first and second construct belong to this one. Attributes of developmental math courses include physical texts, objectives, content, and college requirements. These attributes appear in instructors' personal practice and directly relate to particular components of community college developmental math courses. This information is included in researched here because instructors are in control of how these attributes are used in practice. Current literature also supports each course component statement as being effective for use in college level developmental math environments (Boroch, Fillpot, Hope, Johnstone, Mery, Serban, & Gabriner, 2007; Caffarella, 2014; Killian, 2015; Kitchens, 2009). In addition, data analysis strongly supports this fact for a majority of the course components statements researched. The third cluster of data produced by the factor analysis was highly reviewed and named course components after determining that particular developmental course components appear within all statements included. Therefore, the third and final instructional practice construct is titled course components.

The course components construct was produced by a unique cluster of literature that my dissertation's research grouped together. Instructors agree with certain statements about effective course components, and disagree with others. Course component statements that North Carolina community college developmental math instructors are most likely to agree with are "I routinely provide clear, obtainable lesson goals that are transparent and known to all students.", "The content of my developmental course provided students with transferable skills that they acknowledge as useful and can utilize in real-world applications.", and "My developmental math courses utilize a math text book or workbook of some kind.". These statements are ordered here with highest average Likert response first. In contrast, course component statements that participants are mostly likely to disagree with are "I require students to communicate with me through math journaling or some type of record that records their thoughts." and "I am aware of all my students' academic status before each semester." These two statements are ordered with the lowest average Likert scale response first. Therefore, similar to before, participating instructors' practice aligns with certain course components statements, more than with others.

The range of average Likert scale responses for course components statements about effective instructional practice demonstrates that instructors rely differently on different types of course components. Lesson goals, transferable content, and text books are highly utilized in practice. Student's previous experience, status, and thoughts are less likely used by instructors in practice. Developmental math instructors physically use clear lesson goals and transferable content, because these are course components that lead students to success. Current literature considers all course component statements used in my research as important for effective instruction. However, not all course components statements are used equally in practice. Developmental math instructors are less likely to use students' experience, status, or thoughts as important course components. This is because instructors prefer to use course components that are most appropriate. Over time developmental math instructors learn to focus on particular course components more than others. Course components such as students' previous experience with math and enrollment status are less likely focused on in developmental math environments. The list of average Likert scale responses for course components statements used in my research are provided in table 4.13. Table 4.13 demonstrates that instructors utilize course content, goals, and texts much more than student experiences, statuses, or thoughts. Therefore, instructor's personal experience in community college developmental math contexts allows them to effectively pick and use certain course components over others.

Question 1c Interpretations and Discussion

Research question 1c asks, "What is the relationship between the measure of the instructors' perceptions of student success and instructors' personal instructional practice?" Multiple correlation tests among all constructs created was conducted to answer this question. I interpret and discuss each of correlation test here. There were three correlation tests conducted. The first correlation test is between the six perception variables' ranks and the three instructional practice constructs. The second correlation test is between the amount of time spent on each six perception variable and the three instructional practice constructs. The third and final correlation test is between the three instructional practice variables to themselves. Information produced during the third correlation test provides a more complete understanding of results produced in the first two correlation tests.

Perception Variable's Rank and Instructional Practice Correlations

To start, there are very few correlation coefficients between the six perception variable's rank and the three instructional practice constructs that are moderate in strength or significant enough to discuss. Therefore, very few strong or significant correlation exist between this group of variable constructs. However, there are two correlations that are significant and warrant discussion. There is a moderate and significant negative correlation between how instructors rank the perception that student goal completion equates student success, and how instructors' practice aligns with effective best practices associated with student actions. This means that the more instructors agree with their practice resembling literature's best practices associated with student actions, the less likely instructors view student goal completion as student success. In the other direction, the more a developmental math instructor perceives student personal goal completion as student success, the less their practice resembles literature's effective practices associated with student actions. The significant correlation demonstrates there is a relationship between effective instructional practices focused on student actions and the perception that student success is obtained through student personal goal completion.

The second correlation is a moderate and significant positive correlation between how instructors rank the perception that requisite college course completion equates student success, and how instructors' practice aligns with literature's best practices associated with student actions. This means that instructors that follow current literature's best practices associated with student actions are more likely to view requisite college course completion as student success. In the other direction, instructors that perceive student success to be when students pass requisite college courses are more likely to have their instructional practice resemble literature's best practices associated with student actions. This significant correlation demonstrates there is a relationship between effective instructional practices that focus on student actions and the perception that student success takes place when student pass requisite college courses.

The first correlation demonstrates there is a disconnection or misalignment between effective student actions and student goal completion in practice. In developmental math courses student actions determined to be effective do not align with students completing personal goals. In contrast, implications of the second correlation demonstrate that student actions determined to be effective in practice align with students completing requisite college courses. Therefore, the relationships between developmental math instructors perceptions of student success and their personal instructional practice provide valuable new information. This valuable new information describes how perceptions of student success and effective instructional practice are being merged into an environment that many first-year college students experience.

Perception Variables' Time Spent and Instructional Practice Correlations

There are very few correlation coefficients between the amount of time spent on each perception of success and the three instructional practice constructs that are significant. Therefore, very few strong or significant correlations exist within this group of variable constructs. However, there are two significant correlations that warrant discussion. The first correlation is a weak positive correlation between the amount of time instructors spend getting students to complete developmental sequences of courses and how much their personal practice aligns with literature's best practices associated with instructors' actions. This means the more instructors agree with their practice aligning with literature associated with best practices for instructor actions the more time is focused on the perception that success happens when students complete all developmental sequenced courses. In the other direction, the more time instructors spend on the perception that student success is when students pass all sequenced developmental course the more their practice resembles literature's best practices in college level developmental environments associated with instructor actions. Therefore, this significant correlation demonstrates a relationship between how much time instructors spend on the perception that student success is when students pass all sequenced developmental courses and how much instructors' personal practice aligns with literature's best practices in developmental environments associated with instructor actions.

The second significant correlation is a moderate negative correlation between how much time instructors spend getting students to complete a developmental course and how much instructors' personal practice aligns with current literature's best practices associated with student actions. This means the more instructors agree with literature associated with best student action practices are less likely to spend time focused on student success happening when students complete a developmental course. In the other direction, the more time instructors focus on student success being when their students complete the developmental course the less instructors' practice aligns with literature's best practices in developmental math associated particularly with student actions. Therefore, this particular correlation demonstrates a relationship between the perception that student success is when students complete developmental math courses and how much instructors' practice aligns with literature's best practices associated with student actions.

The first correlation demonstrates a connection in practice between effective instructor actions within current literature and the amount of time spent to ensure students pass all sequenced developmental math courses. Best practices associated with instructors' actions currently available in literature align in practice with the amount of time spent helping students pass all sequenced developmental courses. In contrast, the second correlation discussed here demonstrates a poor connection between how much time is spent to help students pass a developmental course and the effective practices related to student actions that current literature provides. Therefore, these particular important relationships between variable constructs provide new information about how community college developmental math environments operate and what is focused on within them.

Instructional Practice Constructs Correlation to Self

The three instructional practice constructs' correlations to one another do not directly answer research question 1c. However, knowledge gained during review of this correlation test proves useful to further understand the previous two correlation tests. There are strong and moderate significant correlations between all three instructional practice constructs, with exception to one-pair. The instructional practice constructs measure how much instructors' agree with their practice resembling literature's best practices about either instructor actions, student actions, or course components. According to correlation table 4.17 if an instructor's practice resembles literature's best practices associated with instructor actions, then that instructor's practice resembles literature's best practices associated with course components. Similarly, if an instructor's practice resembles literature's best practices associated with student actions then that instructor's practice resembles literature's best practices associated with course components. However, if an instructor's practice resembles literature's best practices associated with instructor actions, according to results, that instructor's practice may or may not resemble literature's best practices associated with student actions. This is also true in the reverse direction with effective student actions and instructor actions. This means that the level at which instructors agree with literature about best practices associated with instructors actions is not correlated to the level at which instructors agree with literature's best practices associated with student actions. Therefore, a disconnect between what instructors are doing in their classrooms and practice related to instructor and student actions exist within current literature's suggestions for best practices. The disconnection between instructor and student actions within current literature provides a foundation for why different perceptions of student success influence instructor and student actions that take place in practice differently.

Main Research Question 1

The main research question asks, "What instrument can be created to measure the relationship between community college developmental math instructors' perceptions of student success and their instructional practice in classrooms?" A majority of discussion and interpretations for this research question includes information about the survey instrument itself and instrument implementation. After interpreting results for the main research question, obvious recommendations and improvements are made to improve overall instrument quality.

Interpretations of and Recommendations to Instrument Design

After a review of the results the initial survey instrument used to gather data analyzed for my research found in Appendix II has been highly improved. The initial survey instrument had substantial room for improvement that became evident after its implementation. In addition, the instructional practice variable constructs are refined based on factor analysis results. Based on these improvements a final survey instrument was created to more accurately and reliably measure instructors' perceptions of student success, instructors' instructional practice, as well as the relationship between the two. Therefore, the answer to the main research question is a final edited version of the survey instrument found in Appendix V, titled Final Survey. The following information provides an explanation of all edits and adjustments made to the initial instrument that produced the more accurate and reliable final instrument.

Initial recommendations relate to improving potential participants progress through the survey as seamlessly as possible. Current literature on appropriate survey design strongly embraces the act of supporting participants through completion of a survey instrument. These improvements intend to gain additional and more accurate information from each individual instructor that participates. For example, the statement “Please click on the green button to proceed through the survey.” has been placed at the end of each section within the survey. The additional statement allows participants to be aware of how to proceed to the next survey question and that there are additional questions following. Essentially, the additional statement in key locations helps guide participants through the online software and survey design as much as possible. Additional recommendations for improving participants progression through the instrument relates to the layout of the first two questions within the survey. The first two perception questions are now on pages by themselves to avoid participants responding to one, but not the other. This adjustment was made due to some participants thinking there was one large question instead of two separate questions. Therefore, potential participants are guided through the final survey instrument in Appendix V much better than in my initial version found in Appendix II.

Recommendations also include a new approach to survey question two when asking participants about the percentage of time they spend on each perception of student success in their personal practice. In the initial survey participants may or may not have interpreted this question the same. Different interpretations of the question by participants would produce inaccurate information. Table 5.1 is now used to link actions from instructors that are

Table 5.1. Activities and Examples of Each Perception

Perceptions of Student Success	Definitions	Activities/Examples
Developmental Course Completion	Perception that success happens when a student passes a single developmental course	1. Focus on course content only for developmental course assignments 2. Check student attendance 3. Work on grade improvement
Developmental Sequence Completion	Perception that success happens when a student passes all sequenced developmental courses	1. Focus on preparing for content in next developmental course 2. Set goals for when to complete sequenced courses
Requisite College Course Completion	Perception that success happens when a student passes the college level course remediation was intended for	1. Focus on preparation for content in next college level course 2. Talk about future college content 3. Talk about enrollment into college level course
Degree Completion	Perception that success happens when a student obtains a degree or certificate	1. Focus on good college student skills 2. Talk about resources available to students 3. Encourage students to graduate
Acquires Skills and Knowledge	Perception that success happens when a student acquires appropriate skills and knowledge	1. Teach content to students 2. Check for student understanding 3. Answer student questions
Goal Completion	Perception that success happens when a student completes a personal goal associated with their enrollment	1. Talk about why students enrolled 2. Ask students what they expect to accomplish in a developmental course

examples and activities related directly to each perception of student success. This table also helps interpret research question 1c's correlation tests' results by providing examples of activities that correlate to particular perceptions. Question two in the final survey now lists the activities and examples associated with each perception. Participants now weigh each activity or example according to their personal practice instead of each perception of student success. Therefore, participant and researcher interpretations of time spent on each perception of student success in practice can be clarified as much as possible with the use of information found in Table 5.1. The variable constructs remain the same, however there would be an additional step to combine weighted activities' percentages together into weights for each perception of student success.

Additional recommendations are aimed at improving the information produced from participants. The first recommendation relates to information obtained within the perception ranking question. The perception ranking question is the first question on the survey. In the initial survey, if participants partly answered question one, ranks for all six perceptions are were still produced. This fact was partly due to how I structured the perceptions' rank question, and was compounded by the online survey software design. In my final version of the survey instrument, question one is presented such that no initial rank or order exist, and any ranks placed on perceptions are strictly performed by participants. This adjustment is important and improves instrument reliability, because the order perceptions are presented to participants should not influence data gathered in any way.

The next recommendation relates to improving information gathered by participants to produce more information from participants that do not completely respond to all questions. There are large amounts of literature that discuss poor survey design and how to avoid survey non-response. To avoid potential loss of information due to non-response, the final survey instrument reorders survey sections to have participant demographics first. This change allows future users of the instrument to understand who non-response entries originate from. The initial survey instrument gathered participant demographic information last. Unfortunately, this results in not having the ability to understand who did/did not complete the instrument fully. Therefore, the final version of my survey instrument obtains more accurate and useable information than the initial instrument.

Factor analysis has become standard practice within recent quantitative research. The purpose of a factor analysis is to reduce the number of constructs/variables produced during research. A final and potentially most substantial recommendation to the initial survey instrument originates from the results of my research's factor analysis. Results from the factor analysis are used here to create more accurate and reliable instructional practice constructs within the instrument. There are now three instructional practice constructs, instead of the five originally used. These three instructional practice constructs generated by the factor analysis demonstrate higher levels of internal reliability when compared to the initial five used. The higher levels of internal reliability are results from data gathered. To accommodate results from the factor analysis, three sets of 12 or 13 statements that belong to the three new instructional practice constructs are put in place of the previous five sets of 7 or 9 statements. Therefore, the instructional practice section of the final survey is highly modified to accommodate factor analysis results from my research with the initial instrument.

Implications

Implications for research, theory, and practice related to college level developmental math environments are produced from my dissertation. Results imply important suggestions for future research and new research topics. The research design was not created with the intention of testing a theoretical framework, thus the findings/results are not heavily focused on theoretical implications. However, important implications that relate to the theory behind how developmental math environments operate are concluded. In addition, a new conceptual framework links the large amount of information about student success and instructional practices. Final implications relate directly to developmental math practice and improvements that substantially benefit students in developmental math environments.

Implications for Research

Thanks to this research's survey instrument, future research has a starting point to investigate perceptions of student success and instructional practices. The final survey provided in appendix V is not ready or intended to be picked up and used as is. Next steps for research that further develop this survey instrument include another pilot study with a larger number of participants, data analysis, and at least one more round of improvements to the instrument. Since the initial pilot study produced correlations between variable constructs, additional future research would be interesting and worth pursuing. The following implications relate to the use of this research on studies that are not necessarily related to survey development or developmental math environments.

Implications for research include the process taken to categorize the substantial amount of literature on this topic into important constructs of interest. The particular constructs created within this dissertation can be taken and used in additional future research. This research provides student success constructs of developmental course completion, sequenced courses completion, requisite college course completion, degree completion, skill and knowledge acquisition, and goal completion. In addition, this research provides instructional practice constructs of instructor actions, student actions, and course components. The perception constructs as well as the instructional practice constructs can be taken, used, and compared to other potential variables of interest. The final survey instrument provides a valuable means to gather the information required for these variable constructs. However, if these constructs are not of interest, then the construct development process can be mimicked for research of any topic. Therefore, future research now has constructs ready, developed, and available to depict perceptions of student success in developmental environments and effective developmental math instructional practices. Most importantly, not only are these constructs available for use, but this research provides an instrument that accurately and reliably gathers the information these constructs require.

Particular implications for research originate from results for research question 1c. Research question 1c asks about the relationship between perceptions of student success and practice. Results conclude that instructors level of agreement with current literature can be used to understand perceptions of student success and what takes place in developmental math environments. In the other direction, instructors' perception of student success can be used to understand how much instructors' practice aligns with current literature's best practices. This fact is important for research because the relationships revealed within this dissertation provide a new avenue for understanding instructor perceptions and practice that current research has not considered. We now know that developmental math instructors' practice is related in some capacity to their perception of student success. Similarly, we now know that instructors' perception of student success is related to their personal instructional practice. Therefore, new valuable approaches for understanding student success and instructional practices are provided through this dissertation's results.

Interpretations of results from research question 1c also conclude that instructors level of agreement with best practices associated with instructor actions is not related to instructors' agreement with best practices associated with student actions. That means that just because instructors agree with literature about appropriate personal actions in instruction, does not mean they agree with literature about appropriate student actions within instruction. Therefore, future research must be aware of this disconnection between instructor and student actions on practice. By being aware of this disconnection, future research avoids assumptions about how different aspects of instructors' practice connect or relate to best practices presented in current literature. If this disconnection of current literature within practice is further understood, improvements to current literature and research allow instructors to more consistently agree with the available information about effective practices for both instructor and student actions.

Further implications for research are directly related to the main research question about instrument development. These important implications originate from particular methodological choices. The methods this research follows to create and obtain data for analysis should be used, replicated, and mimicked in future research. Of particular interest is the process by which this research collects college directory emails and contacts a particular population of instructors. This process is a valuable asset for any future research. Therefore, even if the topic of this research is not of interest, the process by which data was obtained proves valuable to any educational researcher.

Implications for Theory

Developmental math classrooms are complex environments with different needs and wants expressed by a variety of students. This dissertation demonstrates that instructors' personal perceptions do not always align with their actions in practice. The combination of these two statements suggest that researchers and practitioners can apply these findings towards a more robust or well-rounded conceptualization of how students and faculty define success differently.

Both developmental math instructors and students have specific and unique goals in mind and future theories or research can take this into account. The result is that effective practice and student success initiatives are not perfectly aligned. Faculty and in particular developmental math students focus on skill obtainment and developmental course completion. This focus is on the micro-level contributions to graduating college. On the other hand, institutions such as community college have much larger goals for student success in the form of college requisite course completion and degree obtainment. This research found that developmental math instructors' strongest perception of student success does not guide a majority of their actions in practice. In order to align student success initiatives with current effective practices, future investigations of instructors' perceptions of student success need to consider a theoretical framework that contains variables for personal perceptions as well as those perceptions' appearance in practice. Therefore, results from this research demonstrate that a better alignment of current success initiatives to practice can be accomplished if student success in the form of college graduation and degree completion are not the primary focus of instruction in these environments.

Additional theoretical implications include six particular perceptions of student success that are now available to them. All six constructs for perceptions of student success classify a large portion of literature about developmental math environments. Not only do these constructs represent all different perceptions of student success, but they represent a way to classify the substantial amount of literature on this topic. The classification of these different perceptions of student success creates a concise all-inclusive summary of literature surrounding community college developmental math environments. With this concise summary, this research's conceptual framework can be utilized to target any instructor population's perceptions.

In addition, all available literature on college level developmental math instructional practices is expressed as belonging to one of three categories produced during factor analysis. All instructional practices associated with developmental math environments are now categorized according to three constructs of instructor actions, student actions, and course components to help understand this particular practice in its entirety. According to data gathered, there are not more than or less than three categories associated with instructional

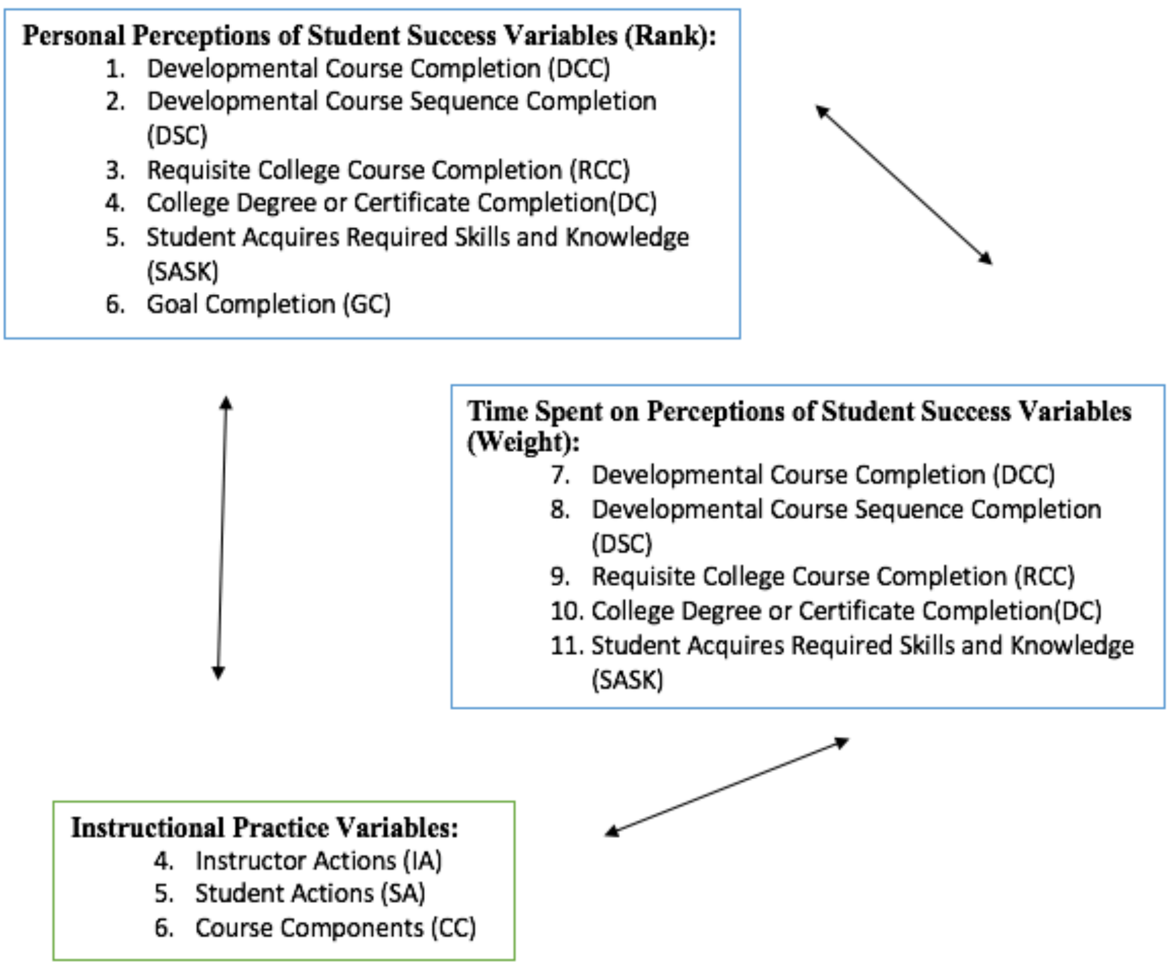

Figure 5.1. New Conceptual Framework

practice in developmental math courses. Future researchers may choose to rename construct titles, however this research demonstrates that theoretically there are three primary constructs for instructional practice in developmental environments. Therefore, this research provides a new conceptual framework that appropriately links large amounts of literature to particular instructor perceptions and attributes of their personal practice.

The combination of all theoretical implications creates a new more appropriate conceptual framework that serves as a beginning point for future research. The above conceptual framework in figure 5.1 represents a new theory for the exploration of relationships between personal perceptions of student success, those perceptions' influence on practice, and instructional practices that actually takes place.

Implications for Practice

A reliable and accurate survey instrument that answers my main research question is now created, and the final version is provided in Appendix V. The final survey can help instructors understand their practice and how views of student success relate to personal practice choices. Also, college administration can use implications of my research to understand how community college developmental math instructors view student success. College administration can use my instrument to understand how their developmental math faculty's practice aligns with current literature's effective best practices. By understanding how faculty's practice aligns with current literature, college administrations can be more informed of their faculty's perceptions of student success.

The interpretations and discussions of research question 1a provide a foundation for implications related to the different perceptions of student success. Together, community college environments and the particular role of developmental math instructors creates and highly influences instructors' personal perceptions of student success. This particular environment and role generates different perceptions of student success that are focal points in current research, literature, and practice. Important implications for practice include instructors understanding how each perception of student success influences different aspects of their profession. Particular aspects of instructors' profession that are influenced by perceptions of student success include expectations of self, expectations of students, views of role, and views of community colleges' purpose. Instructors who understand and embrace different perceptions of student success are more likely to reflect critically about expectations of self, students, instructors' role, and view of community colleges. Therefore, knowledge about how different perceptions of student success impact practice and college environments helps instructors as well as college administrations understand how views of success do impact many college students' experiences.

Particular implications from research question 1b relate to developmental math instructional practice. These implications for practice include a structure for instructors to acknowledge and embrace all aspects of their personal instructional practice. Instructors need to acknowledge that instructor actions, student actions, and course components are significant categories of interest for their profession. With this knowledge, instructors can better evaluate and understand their role as a developmental math instructor. The three instructional practice constructs allow instructors and college administration to analyze the multifaceted role of developmental math instruction one construct at a time. This break down provides a means to see where important practices are potentially neglected and not used as often as others. With the use of this dissertations survey instrument, colleges can see which of the three constructs are most prominent in their particular environment. With this information faculty can gain information behind why certain practices are utilized more than others. This research's results suggest that instructors' personal practice choices are correlated to certain perceptions of student success. If certain perceptions of student success are emphasized more, then certain instructional practices will be included or excluded more. This important information and the ability to persuade instructors' personal practice choices are gained due to this categorization of effective instructional practices. Therefore, implications for practice include the use of the three instructional practice constructs to critically analyze what takes place in college developmental math environments. Going further, instructors' choice of practices can be persuaded by emphasizing certain types of developmental math student success.

North Carolina community college developmental math instructors' views about current literature relate to what they spend their time on in the classroom. With the knowledge that time spent on certain perceptions of student success is related to instructors' personal actions, instructors and college administration have the ability to improve what takes place in their developmental math environments. Using this idea and the results from this dissertation the following examples can be concluded. For example, to increase the amount of time spent in practice helping students pass the sequence of developmental math courses, instructors or college administration should align their practice to literature's best practices associated with instructor actions. Similarly, to increase the amount of time spent helping students pass their developmental course, developmental math instruction should deviate from current literature's best practices associated with student actions. Important implications for practice are that college administration can stress certain literature's importance over other literature to influence the amount of time instructors spend on certain perceptions of student success. Therefore, instructors' views or agreement with current literature can potentially be persuaded in order to influence the amount of time spent on certain perceptions of student success.

An additional implication for practice is based on research question 1c and originates from the relationship between developmental math instructors' perceptions of student success and their personal instructional practice. Results suggest that the act of asking instructors questions about perceptions of student success correlates to asking questions about particular aspects of instructors' personal practice. Similarly, to ask instructors questions about their personal practice is to ask for information behind their perception of student success. This fact becomes very important when instructors critique their personal performance or instructional routines, or when administration is hiring new developmental instructors. If instructors understand that certain practices correlate to certain perceptions of student success and that certain practices do not correlate to certain perceptions of student success, then instructors have the ability to better influence the success of their students through their personal practice choices. Therefore, certain aspects of instructors' practice and information about their perceptions of student success can be better analyzed, understood, and utilized with the completion of the final survey instrument this dissertation produced.

Conclusion

In conclusion, interpretations of results for this dissertation's research questions produce a large amount of new and valuable information related to community college developmental math instruction. The overall product this research created is a final survey instrument that is provided in Appendix V. The final instrument provides new constructs of perceptions of student success and personal instructional practice for future research to consider. In addition, the final instrument provides a method to gather accurate information and reliably measure the relationship between perceptions of success and instructional practices in community college developmental math environments. Conclusions drawn from my research demonstrate the fact that there is a relationship between North Carolina community college developmental math instructors' perceptions of student success and their personal instructional practice. Implications of my research point to important improvements to current research, theory, and practice that directly relate to the improvement of college level developmental math environments.

REFERENCES

Achieving the Dream, (2017) Initiatives. Developmental Education Initiative. Accessed at: http://achievingthedream.org/resources/initiatives/developmental-education-initiative

American Association of Community Colleges. (2012). Reclaiming the American dream: Community colleges and the nation's future. A report from the 21st Century Commission on the Future of Community Colleges.

American Association of Community Colleges. (2017). Accessed at: https://www.aacc.nche.edu/

Aspen Institute. (2017). The Aspen Institute College Excellence Program. Accessed at: https://www.aspeninstitute.org/programs/college-excellence-program/

Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *The Journal of Higher Education*, *77*(5), 886-924.

Aycaster, P. W. (2001). Factors impacting success in community college developmental mathematics courses and subsequent courses. Community College Journal of Research & Practice, 25(5-6), 403-416.

Bahr, P. R. (2008). Does mathematics remediation work?: A comparative analysis of academic attainment among community college students. Research in Higher Education, 49(5), 420-450

Bailey, T. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community college. New Directions for Community Colleges, 2009(145), 11-30.

Bailey, T., Jeong, D. W., & Cho, S. W. (2010). Referral, enrollment, and completion in developmental education sequences in community colleges. Economics of Education Review, 29(2), 255-270.

Bailey, T., Jeong, D. W., & Cho, S. W. (2010). Student Progression through Developmental Sequences in Community Colleges. CCRC Brief. Number 45. Community College Research Center, Columbia University.

Belenky, M. F. (1986). Women's Ways Of Knowing: The Development Of Self, Voice. Basic books.

Bettinger, E. P., & Long, B. T. (2009). Addressing the needs of underprepared students in higher education does college remediation work?. *Journal of Human resources*, *44*(3), 736-771.

Boatman, A. (2012). *Evaluating Institutional Efforts to Streamline Postsecondary Remediation: The Causal Effects of the Tennessee Developmental-Course Redesign Initiative on Early Student Academic Success*. Harvard University.

Boatman, A., & Long, B. T. (2010). Does Remediation Work for All Students? How the Effects of Postsecondary Remedial and Developmental Courses Vary by Level of Academic Preparation. An NCPR Working Paper. National Center for Postsecondary Research.

Boggs, G. R. (2004). Community colleges in a perfect storm. Change: The Magazine of Higher Learning, 36(6), 6-11.

Boroch, D., Fillpot, J., Hope, L., Johnstone, R., Mery, P., Serban, A., ... & Gabriner, R. S. (2007). Basic Skills as a Foundation for Student Success in California Community Colleges. *Research and Planning Group for California Community Colleges (RP Group)*.

Boylan, H. R., & Boone, N. C. (1995). The scope of developmental education: Some basic information on the field. Research in Developmental Education, 12(4).

Brint, S., & Karabel, J. (1989). The diverted dream: Community colleges and the promise of educational opportunity in America, 1900-1985. Oxford University Press.

Brush, A. J., Bargeron, D., Grudin, J., Borning, A., & Gupta, A. (2002, January). Supporting interaction outside of class: anchored discussions vs. discussion boards. In Proceedings of the Conference on Computer Support for Collaborative Learning: Foundations for a CSCL Community (pp. 425-434). International Society of the Learning Sciences.

Bryant, A. N. (2001). ERIC review: Community college students recent findings and trends. Community College Review, 29(3), 77-93.

Caffarella, B. V. (2014). Exploring Best Practices in Developmental Math. Research & Teaching In Developmental Education, 30(2), 35-64.

Carnevale, A. P., Smith, N., Strohl, J. (2017) Recovery: Job Growth and Education Requirements Through 2020. George Town University

Chen, X. (2016). Remedial Coursetaking at US Public 2-and 4-Year Institutions: Scope, Experiences, and Outcomes. Statistical Analysis Report. NCES 2016-405. *National Center for Education Statistics*.

Choi, J. I., & Hannafin, M. (1995). Situated cognition and learning environments: Roles, structures, and implications for design. Educational Technology Research and Development, 43(2), 53-69.

Choy, S. P. (2002). Access & Persistence: Findings from 10 Years of Longitudinal Research on Students. ERIC Digest.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. Wittrock (Ed.), Handbook of research in teaching (3rd ed.) (pp. 255}296). New York: MacMillan.

Clayton, S. J., Crosta, P. M., & Belfield, C. R. (2014). Improving the targeting of treatment: Evidence from college remediation. *Educational Evaluation and Policy Analysis*, *36*(3), 371-393.

Clayton, S. J., & Rodriguez, O. (2012). *Development, discouragement, or diversion? New evidence on the effects of college remediation* (No. w18328). National Bureau of Economic Research.

COABE. (2017). Coalition on Adult Basic Education. Accessed at: https://www.coabe.org/

College Board. (2017). Accurate Placement. Accuplacer. Retrieved at: https://accuplacer.collegeboard.org/educator/accurate-placement

Completion by Design. (2017). Community College research Center. Accessed at: https://ccrc.tc.columbia.edu/research-project/completion-by-design.html

Crews, D. M., & Aragon, S. R. (2007). Developmental education writing: Persistence and goal attainment among community college students. *Community College Journal of Research and Practice*, *31*(8), 637-652.

Developmental Math Modular Curriculum. (2011). North Carolina Community College System. Retrieved At: https://www.google.com/#q=basics+of+nc+developmental+math+redesign

Dillman, D. A., Smyth, J. D., & Melani Christian, L. (2014). Internet, phone, mail, and mixed-mode surveys: The tailored design method. Hoboken, NJ: Wiley.

Dotzler Jr, J. J. (2003). A note on the nature and history of post-secondary developmental education in America. *Mathematics and Computer Education*, *37*(1), 121.

Edgecombe, N. D. (2011). Accelerating the academic achievement of students referred to developmental education.

Ender, S. C., & Newton, F. B. (2000). Students Helping Students: A Guide for Peer Educators on College Campuses. The Jossey-Bass Higher and Adult Education Series. Jossey Bass Publishers, 350 Sansome St., San Francisco, CA 94104.

Fang, Z. (1996). A review of research on teacher beliefs and practices. Educational Research, 38(l), 47}65.

Fields, R., & Parsad, B. (2012). Tests and Cut Scores Used for Student Placement in Postsecondary Education: Fall 2011. *National Assessment Governing Board*.

Fike, D. S., & Fike, R. (2008). Predictors of first-year student retention in the community college. Community College Review, 36(2), 68-88.

Fowler, P. R., & Boylan, H. R. (2010). Increasing student success and retention: A multidimensional approach. Journal of Developmental Education, 34(2), 2.

Getting the Facts. NC Community Colleges Creating Success. Retrieved from: http://www.nccommunitycolleges.edu/get-facts

Grubb, W. N., & Worthen, H. (1999). Honored but invisible: An inside look at teaching in community colleges. Psychology Press.

Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. Journal for research in Mathematics Education, 261-273.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. Journal for research in mathematics education, 33-46.

Herring, William D.(1992).What has happened to the golden door? Rose Hill, NC: Bedwyr Historical Press.

Hodara, M., Jaggars, S. S., & Karp, M. M. (2012). Improving Developmental Education Assessment and Placement: Lessons from Community Colleges across the Country.

CCRC Working Paper No. 51. Community College Research Center, Columbia University.

Horn, L., & Nuñez, A. M. (2000). Mapping the road to college first-generation students' math track, planning strategies, and context of support. DIANE Publishing

Horn, C. Ramos, M. Blumer, I. Madaus, G. (2000) Cut-Score: Results May Vary, Vol. 1.1, NBETPP, Boston College

Howard, L., & Whitaker, M. (2011). Unsuccessful and successful mathematics learning: Developmental students' perceptions. *Journal of Developmental Education, 35*(2), 2-4,6,8,10,12,14-16. Retrieved from http://search.proquest.com/docview/1023133496?accountid=12725

Jackson, K. L. T. (2014). *Connecting expectations and values: Students' perceptions of developmental mathematics in a computer-based learning environment* (Order No. 3584316). Available from Dissertations & Theses @ North Carolina State University @ Raleigh; ProQuest Dissertations & Theses Global. (1554324352). Retrieved from http://search.proquest.com/docview/1554324352?accountid=12725

Jenkins, D., Jaggars, S. S., & Roksa, J. (2009). Promoting Gatekeeper Course Success among Community College Students Needing Remediation: Findings and Recommendations from a Virginia Study (Summary Report). Community College Research Center, Columbia University.

Jenkins, P. D., & Cho, S. W. (2012). Get with the program: Accelerating community college students' entry into and completion of programs of study.

Juszkiewicz, J. (2015). Trends in Community College Enrollment and Completion Data, 2015. *American Association of Community Colleges*.

Kagan, D. M. (1992). Implications of research on teacher belief. Educational Psychologist, 27, 65}90.

Karp, M. M. (2011). Toward a New Understanding of Non-Academic Student Support: Four Mechanisms Encouraging Positive Student Outcomes in the Community College. CCRC Working Paper No. 28. Assessment of Evidence Series. *Community College Research Center, Columbia University*.

Kee, C. E. (2013). Faculty views of developmental math instruction at an urban community college: A critical pedagogy analysis.

Killian, S. (2015). Top 10 Evidence Based Teaching Strategies: for Those Who Care About Student Results. The Australian Society for Evidence Based Teaching. Accessed at: http://www.evidencebasedteaching.org.au/evidence-based-teaching-strategies/

Kitchens, A. (2009). Mathematics: Yes You Can!. Character Development Group. Boone, NC.

Kitchens, A. (2014). Instructing Developmental Math Students. San-Antonio, Texas.

Levinson, D. J. (1978). Chapter 2: Eras: The Anatomy of the Life Cycle & Chapter 3: Developmental Periods: The Evolution of the Individual Life Structure. In The Seasons of a Man's Life. (pp. 18-39 & pp. 40-63). New York: Knopf

Levinson, D. J. (2011). *The Seasons of a Woman's Life: A Fascinating Exploration of the Events, Thoughts, and Life Experiences That All Women Share*. Ballantine Books.

Matt Jans, Steven Heeringa, Anna-Sophie Charest. 2008. Imputation for Missing Physiological and Health Measurement Data: Tests and Applications. University of Michigan. JSM/SRMS

McCabe, R. H. (2000). No one to waste: A report to public decision-makers and community college leaders.

McKnight, P. E., McKnight, K. M., Sidani, S., & Figueredo, A. J. (2007). *Missing data: A gentle introduction*. Guilford Press.

Martorell, P., & McFarlin Jr, I. (2011). Help or hindrance? The effects of college remediation on academic and labor market outcomes. *The Review of Economics and Statistics*, *93*(2), 436-454Miller, N. C. (2000). Perceptions of Motivation in Developmental Mathematics Students: I Would Rather Drill My Own Teeth.

Mullin, C. M., & Phillippe, K. (2011). Fall 2011: Estimated Headcount Enrollment and Pell Grant Trends. American Association of Community Colleges (NJ1).

National Center for Education Statistics. (2016). Digest of Education Statistics. Washington, D.C.: United States Department of Education.

NC Community Colleges Creating Success, (2015). Performance Measures for Student Success

NC Community Colleges Creating Success, (2017). Performance Measures for Student Success

NC Community College Creating Success. (2016). State Aid Allocations and Budget Policies. State Board of Community Colleges.

NC Community College Creating Success. (2017). NC Diagnostic and Placement Test. Accessed at: http://www.nccommunitycolleges.edu/student-services/nc-diagnostic-and-placement-test

NC Community Colleges Final Report. (2013). SuccessNC. Raleigh, NC. Retrieved At: www.nccommunitycolleges.edu/.../successncfinalreportprintquality.pdf

NC Student Success Center, (2016). Important Definitions. Accessed at: http://www.nccommunitycolleges.edu/student-services/nc-student-success-center

Oxford, 2017, English Oxford Living Dictionaries, Accessed at: https://en.oxforddictionaries.com/definition/success

Perin, D. (2002). The location of developmental education in community colleges: A discussion of the merits of mainstreaming vs. centralization. Community College Review, 30(1), 27-44.

Puaa, E. A. (2011). A study of the strategies used by college faculty members of mathematics departments *and secondary teacher education programs for increasing enrollment in mathematics programs and secondary mathematics teacher certification programs* (Order No. 3487719)

Pretlow III, J., & Wathington, H. D. (2012). Cost of Developmental Education: An Update of Breneman and Haarlow. *Journal of Developmental Education*, *36*(2), 4.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning?. Educational researcher, 4-15.

Ralls, S., (2012). North Carolina Community College System Important Information. NCCCS

Santikian, H. (2015). Statewide Developmental Education Reform: Early Implementation in Virginia and North Carolina, , New York, New York: Community College Research Center: Teachers College, Columbia University

Schunk, D. H. (1991). Self-efficacy and academic motivation. Educational psychologist, 26(3-4), 207-231.

Sivley, S. M. (2013). Developmental Mathematics Education: A Study of Remedial Mathematics Programs in Alabama Community Colleges (Doctoral dissertation, The University of Alabama TUSCALOOSA).

Smith, A., A., (2017). Experiencing Developmental Education. Inside Higher Ed. Accessed: https://www.insidehighered.com/news/2016/02/23/broad-study-community-college-students-who-take-developmental-education-courses

Soltysik, R. C., & Yarnold, P. R. (2010). Automated CTA software: Fundamental concepts and control commands. Optimal Data Analysis, 1, 144-160.

Squires, J., Faulkner J., & Hite C., (2009) Course Redesign's impact on learning and Scheduling. Community College Journal of Research and Practice. 33(11)

Stipek, D. J., Givvin, K. B., Salmon, J. M., & MacGyvers, V. L. (2001). Teachers' beliefs and practices related to mathematics instruction. Teaching and teacher education, 17(2), 213-226.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), Handbook of research on mathematics teaching and learning (pp. 127}146). New York: Macmillan.

University of North Carolina: A System of Higher Learning. (2015). Statistical Abstract of Higher Education in North Carolina. Research Report. Retrieved at: http://www.northcarolina.edu/apps/stat_abstract/index.php?pg=vs&id=s17887

APPENDICES

APPENDIX I Basic Skills as a Foundation for Student Success in California Community Colleges

Organizational and Administrative Practices

1. Developmental education is clearly stated institutional priority.
2. A clearly articulate his mission based on a shared, overarching philosophy drives the developmental education program. Clearly stated goals and objectives are established for developmental courses and programs.
3. The developmental education program is centralized, or a highly coordinated.
4. Institutional policies facilitate student completion of necessary developmental course work as early as possible in the educational sequence.
5. A comprehensive system of support services exists, and is characterized by high degree of integration among academic and student support services.
6. Faculty who are both knowledgeable and enthusiastic about developmental education or recuperated and hired to teach in the program.
7. Institution manage faculty and student expectations regarding development of education.

Program Components

1. Orientation, assessment, and placement are mandatory for all new students.
2. Regular program evaluations are conducted, for adults are disseminated widely, and data are used to improve practice.
3. Counseling support provided is substantial, accessible, and integrated with academic courses/programs.
4. Financial aid is disseminated to support development of students. Making isn't exist to ensure that developmental students are aware of such opportunities and are provided with assistance to apply for and acquire financial aid.

Staff Development

1. Administrators support and encourage faculty development in basic skills, and the improvement of teaching and learning is connected to the institutional mission.
2. The faculty play primarily role in needs assessment, planning, and implementation of staff development programs and activities in support of basic skills programs.
3. Staff development minute programs are structured and appropriately supported to sustain them as ongoing efforts related to institutional goals for the improvement of teaching and learning.
4. Staff development opportunities are flexible, varied, and responsive to developmental needs of individual faculty, and diverse student populations, and coordinated program/services.
5. Faculty development is clearly connected to intrinsic an extra music faculty reward structures.

Instructional Practices

1. Sound principles of learning theory are applied in the design/delivery of courses in the developmental program.
2. Curricula and practices that have proven to be effective within specific disciplines are employed.
3. The developmental education program addresses holistic development of all aspects of the student. Attention is paid to the social and emotional development of the students as well as to their cognitive growth.

4. Culturally Responsive Teaching theory and practices are applied to all aspects of the developmental instructional programs and services.
5. A high degree of structure provided in developmental education courses.
6. Developmental education facilitate a variety of instructional methods to accommodate student diversity.
7. Programs align entry/exit skills among levels and link course content to college level performance requirements.
8. Developmental faculty routinely share instructional strategies.
9. Faculty and visors closely monitor student performance.
10. Programs for valid comprehensive academic support mechanisms, including the use of train tutors.

APPENDIX II Survey Instrument

Welcome to the North Carolina Developmental Math Instructors' Survey!

The purpose of this study is to learn about the relationship between North Carolina's developmental math instructors' perceptions of student success and their instructional practices. There are six identifiable perceptions of student success and 35 developmental instructional practices current literature associates with community college environments. This research will quantitatively relate a large amount of literature associated with developmental math community college environments.

Please answer the following screening question to see if this survey is for you.

1. Do you currently or have you previously instructed at least one developmental math course at a North Carolina community college?
    a. Yes
    b. No

Great! Thank you for your interest and participation. To continue, please read the following information and click “consent” to participate in the survey, or “exit” if you do not consent to participating.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to complete multiple-choice, ranking, and Likert scale questions related to perceptions of developmental math student success and your instructional practices.

Risks
There are minimal risks to participants of this research study.

Benefits Academically, the study provides new information on the relationship between perceptions of student success and instructional practices.

Confidentiality The information in the study records will be kept confidential to the full extent allowed by law. Data will be stored securely in by a sole researcher and the researcher does not have your name or identity. No reference will be made in oral or written reports which could link you to the study. You will NOT be asked to write your name on any study materials so that no one can match your identity to the answers that you provide.

Compensation You will not receive anything for participating.

What if you have questions about this study? If you have questions at any time about the study or the procedures, you may contact the researcher, Jonah Winkler, at jwinkle@ncsu.edu, or [828-750-3285].

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions on this page, or your rights as a participant in research have been violated during the course of this project, you may contact the IRB office at irb-director@ncsu.edu or by phone at 1-919-515-4514.

Consent To Participate

“I have read and understand the above information. I agree to participate in this study with the understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits.”

a. Consent
b. Exit

Section 1 of Survey

1. Previous research indicates that developmental math instructors have different perceptions of student success. Please rank the following statements from 1 to 6 according to your definition of student success, with 1 being the most aligned to your definition and 6 being the least.

- ___Student success is when students accomplish their goals as they define them
- ___Student success is when students complete an educational credential
- ___Student success is when students pass your developmental math course
- ___Student success is when students pass their requisite college math courses
- ___Student success is when students acquire math skills and knowledge
- ___Student success is when students complete the developmental math course sequence

2. Please provide your best estimate of the percentage of time you spend on each definition of student success while you teach your developmental math courses. (Note: All percentages indicated should sum to 100. Blank responses will automatically receive a 0 percent.)

- ___Student success is when students accomplish their goals as they define them
- ___Student success is when students complete an educational credential
- ___Student success is when students pass your developmental math course
- ___Student success is when students pass their requisite college math courses
- ___Student success is when students acquire math skills and knowledge
- ___Student success is when students complete the developmental math course sequence

Section 2 of Survey

Please respond to the following statements about *your personal instructional practices*.

Course Components

1. My developmental math courses provide students with a variety of life skills material and content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
2. The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. My developmental math courses utilize a math text book or workbook of some kind.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
4. During each class, I present and link course content to college level requirements.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. I routinely provide clear, obtainable lesson goals that are transparent and known to students.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral

   e. somewhat agree
   f. agree
   g. strongly agree
6. I provide detailed notes to every student for every lesson.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
7. My developmental math course provides multiple low stakes exams and quizzes for students to complete.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree

Instructor Student Interactions

1. I work with students to discuss their personal, educational, and life goals.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
2. I work with students to discuss their past experiences and impressions of math.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
3. I ask questions to each student to check for their overall understanding of content.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree

    g. strongly agree
4. I provide every student with personal feedback in a one-on-one environment.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. I create effective and meaningful communication with all of my students during the course.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
6. I require students to communicate with me through math journaling or some type of record that records their thoughts.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
7. I interact with all my students outside of the classroom as much as professionally possible.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree

Instructor Personal Actions

1. I expect all my students to graduate.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree

g. strongly agree

2. I provide a very high degree of structure with course layout, lesson content, and assignment expectations.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
3. I highly value and prioritize each student's social and emotional development.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
4. I highly value and prioritize each student's cognitive growth.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
5. I routinely share effective instructional strategies with other faculty members.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
6. I routinely monitor student progress and performance.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
7. I routinely attempt to use graphical displays to depict lesson content to students.
   a. strongly disagree
   b. disagree
   c. somewhat disagree

    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
8. I am aware of all my students' academic status before each semester.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
9. I am aware of all my students' academic status during each semester.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    a. agree
    b. strongly agree

Student Participation

1. I highly motivate students to attend classes in person for multiple reasons.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
2. I require students to work together on assignments, activities, and course work as much as possible.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. I require students to dedicate large amounts of their time practicing course material.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree

f. agree
g. strongly agree

4. I require students to take detailed notes during class.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. I routinely use physical manipulatives to represent course content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
6. I routinely require my students to help other students learn the course material.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
7. I use whole class activities that require the participation of all students.
    a. strongly disagree
    a. disagree
    b. somewhat disagree
    c. neutral
    d. somewhat agree
    e. agree
    f. strongly agree

Student Mental Actions

1. My practice involves students acknowledging multiple personal goals associated with the course.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree

2. My students describe and express their past experience with math.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. All of my students are routinely instructed to think about options, choices, and results as they work with course content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
4. I routinely require students to reflect on course content and their overall experience with math.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. My students acknowledge their current position as a developmental math student.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
6. My instructional practice facilitates students relating to one another.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
7. By the end of my developmental math course, my students learn that they can do college level math.
    a. strongly disagree
    a. disagree

b. somewhat disagree
c. neutral
d. somewhat agree
e. agree
f. strongly agree

Note: After the above question, you cannot return to any previous questions.

1. Course Components Statements (Please rank 1 through 7 with 1 being the one you most strongly agree to and 7 the one you least strongly agree to)

- __My developmental math courses provide students with a variety of life skills material and content.
- __The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications.
- __My developmental math courses utilize a math text book or workbook of some kind.
- __During each class, I present and link course content to college level requirements.
- __I routinely provide clear, obtainable lesson goals that are transparent and known to students.
- __I provide detailed notes to every student for every lesson.
- __My developmental math course provides multiple low stakes exams and quizzes for students to complete.

2. Instructor Student Interactions Statements (Please rank 1 through 7 with 1 being the one you most strongly agree to and 7 the one you least strongly agree to)

- __I work with students to discuss their personal, educational, and life goals.
- __I work with students to discuss their past experiences and impressions of math.
- __I ask questions to each student to check for their overall understand of content.

- __I provide every student with personal feedback in a one-on-one environment.
- __I create effective and meaningful communication with all of my students during the course.
- __I require students to communicate with me through math journaling or some type of record that records their thoughts.
- __I interact with all my students outside of the classroom as much as professionally possible.

3. Instructor Personal Actions Statements (Please rank 1 through 9 with 1 being the one you most strongly agree to and 9 the one you least strongly agree to)

- __I expect all my students to graduate.
- __I provide a very high degree of structure with course layout, lesson content, and assignment expectations.
- __I highly value and prioritize each student's social and emotional development.
- __I highly value and prioritize each student's cognitive growth.
- __I routinely share effective instructional strategies with other faculty members.
- __I routinely monitor student progress and performance.
- __I routinely attempt to use graphical displays to depict lesson content to students.
- __I am aware of all my students' academic status before each semester.
- __I am aware of all my students' academic status during each semester.

4. Student Participation Statements (Please rank 1 through 7 with 1 being the one you most strongly agree to and 7 the one you least strongly agree to)

- __I highly motivate students to attend classes in person for multiple reasons.

- __I require students to work together on assignments, activities, and course work as much as possible.
- __I require students to dedicate large amounts of their time practicing course material.
- __I require students to take detailed notes during class.
- __I routinely use physical manipulatives to represent course content.
- __I routinely require my students to help other students learn the course material.
- __I use whole class activities that require the participation of all students.

5. Student Mental Actions Statements (Please rank 1 through 7 with 1 being the one you most strongly agree to and 7 the one you least strongly agree to)

- __My practice involves students acknowledging multiple personal goals associated with the course.
- __My students describe and express their past experience with math.
- __All of my students are routinely instructed to think about options, choices, and results as they work with course content.
- __I routinely require students to reflect on course content and their overall experience with math.
- __My students acknowledge their current position as a developmental math student.
- __My instructional practice facilitates students relating to one another.
- __By the end of my developmental math course, my students learn that they can do college level math.

Section 3 of Survey

Please respond to all 10 of the following demographic questions. All questions' content and answers cannot be traced back to participants of this research in any way. In addition, strict data storage methods will take place with all information gathered through this survey. Thank you.

1. What is Your Gender?
    a. Female
    b. Male
    c. No Response
2. What is Your Age?
    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54
    e. 55-64
    f. Over 64
3. How many years of experience instructing developmental math at community colleges do you have?
    a. 0-2
    b. 3-5
    c. 6-10
    d. 11-20
    e. 21-30
    f. Over 30
4. What is your current employment status as a developmental math instructor?
    a. Part-time
    b. Full-time
5. About how many students are typically in your classrooms?
    a. 0-10
    b. 11-15
    c. 16-20
    d. 21-25
    e. 26-35
    f. More than 36
6. On average, about how many developmental math courses do you teach each semester?
    a. 1-2
    b. 2-4
    c. 4-6
    d. over 6
7. About how many students attend your community college?
    a. 0-5,000
    b. 5,000-10,000
    c. 10,001-25,000

   d. 25,001-50,000
   e. 50,001-75,000
   f. More than 75,000
8. How many instructors are there per class?
   a. 1
   b. 2
   c. 3
   d. 4
   e. More than 4
9. What type of location is your community college in?
   a. Rural
   b. Urban
   c. City
   d. Industrial
10. Do you also instruct college level math courses?
   a. Yes
   b. No

APPENDIX III Approved IRB Form

Project Title

NORTH CAROLINA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD FOR THE USE OF HUMAN SUBJECTS IN RESEARCH SUBMISSION FOR NEW STUDIES

Protocol Number 12451

Development of an Instrument to Measure the Relationship Between Community College Developmental Math Instructors' Perceptions of Student Success and Instructional Practice

IRB File Number:

Original Approval Date:

03/08/2018

Approval Period

03/08/2018 -

Source of funding (if externally funded, enter PINS or RADAR number of funding proposal via 'Add New Sponsored Project Record' button below):

Personal

NCSU Faculty point of contact for this protocol: NB: only this person has authority to submit the protocol

Barcinas, Susan J: Educational Leadership, Policy, and Human Development (ELPHD)

Does any investigator associated with this project have a significant financial interest in, or other conflict of interest involving, the sponsor of this project? (Answer No if this project is not sponsored) No *Is this conflict managed with a written management plan, and is the management plan being properly followed?*

No

Preliminary Review Determination

Category:

Exempt b.2

In lay language, provide a brief synopsis of the study (limit text to 1500 characters)

This study is focused on North Carolina community college developmental math instructors. In particular, it investigates how instructors' perceptions of student success are related to their instructional practice. Participating instructors will take a quantitative survey. Survey variables represent instructors' perceptions of success and instructional practice. The survey has 54 questions that are divided in three sections. The three sections are perceptions of student success, instructional practice, and demographics each with 2, 42, and 10 questions. All content in the survey was developed by the researcher by a review of current literature and research about student success in developmental courses at community colleges.

Briefly describe in lay language the purpose of the proposed research and why it is important.

This study is important for learning about the relationship between North Carolina's developmental math instructors' perceptions of student success and their instructional practices. This survey is the first step toward developing and validating an instrument that quantitatively measures perceptions of student success and instructional practice. The creation of this measurement instrument includes multiple recognized survey development and validation techniques. There are six identifiable perceptions of student success in literature about college level developmental students. In addition, there are 35 developmental instructional practices literature associates with community college environments. This research will quantitatively relate a large amount of literature associated with developmental math community college environments.

My research qualifies for Exemption. Exempt research is minimal risk and must fit into the categories b.1 - b.6 found here: http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html
1 *Is this research being conducted by a student?*

Yes

Is this research for a thesis?

No

Is this research for a dissertation?

Yes

Is this independent research?

No

Is this research for a course?

No

Do you currently intend to use the data for any purpose beyond the fulfillment of the class assignment?

No

Please explain

If so, please explain

If you anticipate additional NCSU-affiliated investigators (other than those listed on the Title tab) may be involved in this research, list them here indicating their name and department.

Will the investigators be collaborating with researchers at any institutions or organizations outside of NC State?

No

List collaborating institutions and describe the nature of the collaboration

What is NCSU's role in this research?

Describe funding flow, if any (e.g. subcontractors)

Is this international research?

No

Identify the countries involved in this research

An IRB equivalent review for local and cultural context may be necessary for this study. Can you recommend consultants with cultural expertise who may be willing to provide this review?

Adults 18 - 64 in the general population?

Yes

NCSU students, faculty or staff?

No

Adults age 65 and older?

No

Minors (under age 18--be sure to include provision for parental consent and/or child assent)?

No

List ages or age range:

Could any of the children be "Wards of the State" (a child whose welfare is the responsibility of the state or other agency, institution, or entity)?

No

Please explain:

Prisoners (any individual involuntarily confined or detained in a penal institution -- can be detained pending arraignment, trial or sentencing)?

No

Pregnant women?

No

Are pregnant women the primary population or focus for this research?

No

Provide rationale for why they are the focus population and describe the risks associated with their involvement as participants

Fetuses?

No

Students?

No

Does the research involve normal educational practices?

No

Is the research being conducted in an accepted educational setting?

No

Are participants in a class taught by the principal investigator?

No

Are the research activities part of the required course requirements?

No

Will course credit be offered to participants?

No

Amount of credit?

No

If class credit will be given, list the amount and alternative ways to earn the same amount of credit. Note: the time it takes to gain the same amount of credit by the alternate means should be commensurate with the study task(s)

How will permission to conduct research be obtained from the school or district?

Will you utilize private academic records?

No

Explain the procedures and document permission for accessing these records.

Employees?

Yes

Describe where (in the workplace, out of the workplace) activities will be conducted.

The survey completion is at the voluntary and anonymous discretion of participants who work with the NC community college system, which has 58 locations. They will need a computer with internet access to navigate to the NC State Qualtrics site to participate. *From whom and how will permission to conduct research on the employees be obtained?*

Participants will be screened through NC State Qualtrics asking if they are a current or former developmental math instructor in North Carolina. If yes, they will view an informed consent explanation and form which must be acknowledged in order to proceed to the online survey. The wording of the informed consent is embedded in the front matter of the survey.

How will potential participants be approached and informed about the research so as to reduce any perceived coercion to participate?

Participants will be notified through a general community college announcement listserv. The invitation will be a narrative description of the survey with a web-link available for those who are interested to voluntarily respond via NC State Qualtrics. Word file of the announcement is attached. *Is the employer involved in the research activities in any way?*

No

Please explain:

All NC developmental math community college faculty including department heads, deans, chairs, and coordinators are contacted as potential participants. *Will the employer receive any results from the research activities (i.e. reports, recommendations, etc.)?* No

Please explain. How will employee identities be protected in reports provided to employers?

Impaired decision making capacity/Legally incompetent?

No

How will competency be assessed and from whom will you obtain consent?

Mental/emotional/developmental/psychiatric challenges?

No

Identify the challenge and explain the unique risks for this population.

Describe any special provisions necessary for consent and other study activities (e.g., legal guardian for those unable to consent).

People with physical challenges?

No

Identify the challenge and explain the unique risks for this population.

Describe any special provisions necessary for working with this population (e.g., witnesses for the visually impaired).

Economically or educationally disadvantaged?

No

Racial, ethnic, religious and/or other minorities?

No

Non-English speakers?

No

Describe the procedures used to overcome any language barrier.

Will a translator be used?

No

Provide information about the translator (who they are, relation to the community, why you have selected them for use, confidentiality measures being utilized).

Explain the necessity for the use of the vulnerable populations listed.

The survey is intended to gather perceptions of community college math instructors and information about instructional practices that currently take place. Employees of community colleges are the only population that currently instructs developmental math courses in NC. *State how, where, when, and by whom consent will be obtained from each participant group. Identify the type of consent (e.g., written, verbal, electronic, etc.). Label and submit all consent forms.*

Consent from participants will be gather electronically as part of participants' access to the online survey. Once participants have answered screening questions in NC State Qualtrics and have met the inclusion criteria, they will be directed to the consent page. The consent describes the target audience of the survey and the purpose. If they answer yes to consent to the survey, they are taken to the initial question. If they answer no, they are exited from the survey.

If any participants are minors, describe the process for obtaining parental consent and minor's assent (minor's agreement to participate).

No minors

Are you applying for a waiver of the requirement for consent (no consent information of any kind provided to participants) for any participant group(s) in your study? No *Describe the procedures and/or participant group for which you are applying for a waiver, and justify why this waiver is needed and consent is not feasible.*

Are you applying for an alteration (exclusion of one or more of the specific required elements) of consent for any participant group(s) in your study?

No

Identify which required elements of consent you are altering, describe the participant group(s) for which this waiver will apply, and justify why this waiver is needed.

Are you applying for a waiver of signed consent (consent information is provided, but participant signatures are not collected)? A waiver of signed consent may be granted only if: The research involves no more than minimal risk. The research involves no procedures for which consent is normally required outside of the research context. Yes

Would a signed consent document be the only document or record linking the participant to the research?

Yes

Is there any deception of the human subjects involved in this study?

No

Describe why deception is necessary and describe the debriefing procedures. Does the deception require a waiver or alteration of informed consent information? Describe debriefing and/or disclosure procedures and submit materials for review. Are participants given the option to destroy their data if they do not want to be a part the study after disclosure?

For each participant group please indicate how many individuals from that group will be involved in the research. Estimates or ranges of the numbers of participants are acceptable. Please be aware that participant numbers may affect study risk. If your participation totals differ by 10% from what was originally approved, notify the IRB. Participants are recruited through a general community college announcement listserv oriented toward developmental or basic skills faculty. The listserv has several hundred recipients. With an average of 4 to 5 developmental math instructors per community college in North Carolina and with there being 58 community colleges in North Carolina, the listserv will hopefully contact between 200-300 members of the target audience. I hope to achieve 30 complete survey responses. Therefore, I need between 10 and 15 percent participation.

How will potential participants be found and selected for inclusion in the study?

All participants self-screen for inclusion by voluntarily going to the advertised NC State Qualtrics web-link.

For each participant group, how will potential participants be approached about the research and invited to participate? Please upload necessary scripts, templates, talking points, flyers, blurbs, and announcements. All participants will be approached through an invitation on a general community college listserv announcement. Word file with the invitation wording is attached.

Describe any inclusion and exclusion criteria for your participants and describe why those criteria are necessary (If your study concentrates on a particular population, you do not need to repeat your description of that population here.) The study focuses on developmental math course instructors. Both former and current developmental math instructors are eligible to take the survey. Participants may have any level of experience instructing developmental math courses in NC community colleges.

Is there any relationship between researcher and participants - such as teacher/student; employer/employee?

No

What is the justification for using this participant group instead of an unrelated participant group? Please outline the steps taken to mitigate this relationship.

Describe any risks associated with conducting your research with a related participant group.

Describe how this relationship will be managed to reduce risk during the research.

How will risks to confidentiality be managed?

Address any concerns regarding data quality (e.g. non-candid responses) that could result from this relationship.

In the following questions describe in lay terms all study procedures that will be experienced by each group of participants in this study. For each group of participants in your study, provide a *step-by-step description of what they will experience from beginning to end of the study activities.* 1. Contacted by listserv announcement 2. Access the NC State Qualtrics survey link

3. Complete screening questions - If eligible to continue and, if not, participation ends 4. Answer yes or no to consent - If yes, they continue and, if no, participation ends 3. Participants complete a 54 question survey about their perceptions of student success and instructional practice. The survey takes approximately 5 to 10 minutes to complete and ask for multiple choice, ranking, and Likert scales responses. *Describe how, where, when, and by whom data will be collected.* Data are collected with the use of the NC State Qualtrics server. The time and location of participation is the choice of the individual. *Social?* No *Psychological?* No

Financial/Employability?

No

Legal?

No

Physical?

No

Academic?

No

Employment?

No

Financial?

No

Medical?

No

Private Behavior?

No

Economic Status?

No

Sexual Issues?

No

Religious Issues/Beliefs?

No

Describe the nature and degree of risk that this study poses. Describe the steps taken to minimize these risks. You CANNOT leave this blank, say 'N/A', none' or 'no risks'. You can say "There is minimal risk associated with this research." There is minimal risk associated with this research.

If you are accessing private records, describe how you are gaining access to these records, what information you need from the records, and how you will receive/record data.

Are you asking participants to disclose information about other individuals (e.g., friends, family, co-workers, etc.)?

No

You have indicated that you will ask participants to disclose information about other individuals (see Populations tab). Describe the data you will collect and discuss how you will protect confidentiality and the privacy of these third-party individuals.

If you are collecting information that participants might consider personal or sensitive or that if revealed might cause embarrassment, harm to reputation or could reasonably place the subjects at risk of criminal or civil liability, what measures will you take to protect participants from those risks?

If any of the study procedures could be considered risky in and of themselves (e.g. study procedures involving upsetting questions, stressful situations, physical risks, etc.) what measures will you take to protect participants from those risks?

Describe the anticipated direct benefits to be gained by each group of participants in this study (compensation is not a direct benefit).

No direct benefits. Published study data may be utilized to improve developmental math instruction at the community college level. *If no direct benefit is expected for participants describe any indirect benefits that may be expected, such as to the scientific community or to society.* Academically, the study provides new information on the relationship between perceptions of student success and instructional practices.

Will you be receiving already existing data without identifiers for this study?

No

Will you be receiving already existing data which includes identifiers for this study?

No

Describe how the benefits balance out the risks of this study.

Will data be collected anonymously (meaning that you do not ever collect data in a way that would allow you to link any identifying information to a

participant)?

Yes

Will any identifying information be recorded with the data (ex: name, phone number, IDs, e-mails, etc.)?

No

Will you use a master list, crosswalk, or other means of linking a participant's identity to the data?

No

Will it be possible to identify a participant indirectly from the data collected (i.e. indirect identification from demographic information)?

No

Audio recordings?

No

Video recordings?

No

Images?

No

Digital/electronic files?

No

Paper documents (including notes and journals)?

No

Physiological Responses?

No

Online survey?

Yes

Restricted Computer?

Yes

Password Protected files?

No

Firewall System?

Yes

Locked Private Office?

Yes

Locked Filing Cabinets?

Yes

Encrypted Files?

No

Describe all participant identifiers that will be collected (whether they will be retained or not) and explain why they are necessary.

None.

If any links between data and participants are to be retained, how will you protect the confidentiality of the data?

Not applicable.

If you are collecting data electronically, what (if any) identifiable information will be collected by the host site (such as email and/or IP address) and will this information be reported to you?
None. *Describe any ways that participants themselves or third parties discussed by participants could be identified indirectly from the data collected, and describe measures taken to protect identities.*

None.

For all recordings of any type: Describe the type of recording(s) to be made Describe the safe storage of recordings Who will have access to the recordings? Will recordings be used in publications or data reporting? Will images be altered to de-identify? Will recordings be transcribed and by whom?

Describe how data will be reported (aggregate, individual responses, use of direct quotes) and describe how identities will be protected in study reports. Aggregate *Will anyone besides the PI or the research team have access to the data (including completed surveys) from the moment they are collected until they are destroyed?*

No.

Describe any compensation that participants will be eligible to receive, including what the compensation is, any eligibility requirements, and how it will be delivered. None. *Explain compensation provisions if the participant withdraws prior to completion of the study.*

N/A

APPENDIX IV Email to Community College Developmental Math Professionals

Are you a part time or full time developmental math instructor? Are you interested in seeing your students do well in their studies? We need your help.

I am an NC State graduate student conducting research on basic skills math at community colleges. My dissertation is designed to learn more about how community college developmental math instructors define student success, and how ideas about student success influence how you actually teach and interact with students.

It will only take a few minutes of your time, and all survey responses are 100% voluntary and anonymous. Please take a few minutes and click on the survey link below. Also, please feel free to forward or disperse this announcement to any basic skills departments or areas at your college.

Thank you very much!

If you have any questions, please contact: Jonah Winkler at jwinkle@ncsu.edu

The survey link is: https://ncsu.qualtrics.com/jfe/form/SV_9EmS51nTVbXiP5z

APPENDIX V Final Survey Instrument

Welcome to the North Carolina Developmental Math Instructors' Survey!

The purpose of this study is to learn about the relationship between North Carolina's developmental math instructors' perceptions of student success and their instructional practices. There are six identifiable perceptions of student success and 35 developmental instructional practices current literature associates with community college environments. This research will quantitatively relate a large amount of literature associated with developmental math community college environments.

Please answer the following screening question to see if this survey is for you.

1. Do you currently or have you previously instructed at least one developmental math course at a North Carolina community college?
   a. Yes
   b. No

Please click on the green arrow in the bottom corner of your screen after you have selected your answer. Thank you.

Great! Thank you for your interest and participation. To continue, please read the following information and click “consent” to participate in the survey, or “exit” if you do not consent to participating.

What will happen if you take part in the study? If you agree to participate in this study, you will be asked to complete multiple-choice, ranking, and Likert scale questions related to perceptions of developmental math student success and your instructional practices.

Risks There are minimal risks to participants of this research study.

Benefits Academically, the study provides new information on the relationship between perceptions of student success and instructional practices.

Confidentiality The information in the study records will be kept confidential to the full extent allowed by law. Data will be stored securely in by a sole researcher and the researcher does not have your name or identity. No reference will be made in oral or written reports which could link you to the study. You will NOT be asked to write your name on any study materials so that no one can match your identity to the answers that you provide.

Compensation You will not receive anything for participating.

What if you have questions about this study? If you have questions at any time about the study or the procedures, you may contact the researcher, Jonah Winkler, at jwinkle@ncsu.edu, or [828-750-3285].

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions on this page, or your rights as a participant in research have been violated during the course of this project, you may contact the IRB office at irb-director@ncsu.edu or by phone at 1-919-515-4514.

Consent To Participate “I have read and understand the above information. I agree to participate in this study with the understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits.”

c. Consent
d. Exit

Please click on the green arrow in the bottom corner of your screen after you have selected your answer. Thank you.

Section 1 of Survey

Please respond to all 10 of the following demographic questions. All questions' content and answers cannot be traced back to participants of this research in any way. In addition, strict data storage methods will take place with all information gathered through this survey. Thank you.

1. What is Your Gender?
    a. Female
    b. Male
    c. No Response
2. What is Your Age?
    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54
    e. 55-64
    f. Over 64
3. How many years of experience instructing developmental math at community colleges do you have?
    a. 0-2
    b. 3-5
    c. 6-10
    d. 11-20
    e. 21-30
    f. Over 30
4. What is your current employment status as a developmental math instructor?
    a. Part-time
    b. Full-time
5. About how many students are typically in your classrooms?
    a. 0-10
    b. 11-15
    c. 16-20
    d. 21-25
    e. 26-35
    f. More than 36
6. On average, about how many developmental math courses do you teach each semester?
    a. 1-2
    b. 2-4
    c. 4-6
    d. over 6
7. About how many students attend your community college?
    a. 0-5,000
    b. 5,000-10,000
    c. 10,001-25,000

   d. 25,001-50,000
   e. 50,001-75,000
   f. More than 75,000
8. How many instructors are there per class?
   a. 1
   b. 2
   c. 3
   d. 4
   e. More than 4
9. What type of location is your community college in?
   a. Rural
   b. Urban
   c. City
   d. Industrial
10. Do you also instruct college level math courses?
    a. Yes
    b. No

Please click on the green arrow in the bottom corner of your screen after you have selected your answers. Thank you.

Section 2 of Survey

1. Previous research indicates that developmental math instructors have different perceptions of student success. Please rank the following statements from 1 to 6 according to your definition of student success, with 1 being the most aligned to your definition and 6 being the least.

- ___Student success is when students accomplish their goals as they define them
- ___Student success is when students complete an educational credential
- ___Student success is when students pass your developmental math course
- ___Student success is when students pass their requisite college math courses
- ___Student success is when students acquire math skills and knowledge
- ___Student success is when students complete the developmental math course sequence

Please click on the green arrow in the bottom corner of your screen after you have selected your answers. Thank you.

2. Please provide your best estimate of the percentage of time you spend on each definition of student success while you teach your developmental math courses. (Note: All percentages indicated should sum to 100. Blank responses will automatically receive a 0 percent.)

- ___ Focus on course content only for developmental course assignments
- ___ Check student attendance
- ___ Work on grade improvement
- ___ Focus on preparing for content in next developmental course
- ___ Set goals for when to complete sequenced courses
- ___ Focus on preparation for content in next college level course
- ___ Talk about future college content
- ___ Talk about enrollment into college level course
- ___ Focus on good college student skills
- ___ Talk about resources available to students
- ___Encourage students to graduate
- ___ Teach content to students
- ___ Check for student understanding
- ___ Answer student questions
- ___ Talk about why students enrolled
- ___ Ask students what they expect to accomplish in a developmental course
- ___ Fill in Blank:____

Please click on the green arrow in the bottom corner of your screen after you have selected your answers. Thank you.

Section 3 of Survey

Please respond to the following statements about *your personal instructional practices*.

Instructor Actions

1. I work with students to discuss their personal, educational, and life goals.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
2. I work with students to discuss their past experiences and impressions of math.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. I ask questions to each student to check for their overall understanding of content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
4. I provide every student with personal feedback in a one-on-one environment.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. I create effective and meaningful communication with all of my students during the course.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree

    g. strongly agree

6. I interact with all my students outside of the classroom as much as professionally possible.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
7. I expect all my students to graduate.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
8. I provide a very high degree of structure with course layout, lesson content, and assignment expectations.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
9. I highly value and prioritize each student's social and emotional development.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
10. I highly value and prioritize each student's cognitive growth.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
11. I routinely monitor student progress and performance.
    a. strongly disagree
    b. disagree

c. n somewhat disagree
d. neutral
e. somewhat agree
f. agree
g. strongly agree

12. My developmental math course provides multiple low stakes exams and quizzes for students to complete.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree

Student Actions

1. I highly motivate students to attend classes in person for multiple reasons.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
2. I require students to work together on assignments, activities, and course work as much as possible.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. I require students to dedicate large amounts of their time practicing course material.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
4. I require students to take detailed notes during class.
    a. strongly disagree
    b. disagree
    c. somewhat disagree

   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
5. I routinely use physical manipulatives to represent course content.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
6. I routinely require my students to help other students learn the course material.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
7. I use whole class activities that require the participation of all students.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
8. My practice involves students acknowledging multiple personal goals associated with the course.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree
9. My students describe and express their past experience with math.
   a. strongly disagree
   b. disagree
   c. somewhat disagree
   d. neutral
   e. somewhat agree
   f. agree
   g. strongly agree

10. All of my students are routinely instructed to think about options, choices, and results as they work with course content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
11. My students acknowledge their current position as a developmental math student.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
12. My instructional practice facilitates students relating to one another.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
13. By the end of my developmental math course, my students learn that they can do college level math.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree

Course Components

1. My developmental math courses provide students with a variety of life skills material and content.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree

2. The content of my developmental math courses provides students with transferable skills that they acknowledge as useful and can utilize in real-world applications.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
3. My developmental math courses utilize a math text book or workbook of some kind.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
4. During each class, I present and link course content to college level requirements.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
5. I routinely provide clear, obtainable lesson goals that are transparent and known to students.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
6. I provide detailed notes to every student for every lesson.
    a. strongly disagree
    b. disagree
    c. somewhat disagree
    d. neutral
    e. somewhat agree
    f. agree
    g. strongly agree
7. I require students to communicate with me through math journaling or some type of record that records their thoughts.
    a. strongly disagree
    b. disagree

- c. somewhat disagree
- d. neutral
- e. somewhat agree
- f. agree
- g. strongly agree

8. I routinely share effective instructional strategies with other faculty members.
   - a. strongly disagree
   - b. disagree
   - c. somewhat disagree
   - d. neutral
   - e. somewhat agree
   - f. agree
   - g. strongly agree
9. I routinely attempt to use graphical displays to depict lesson content to students.
   - a. strongly disagree
   - b. disagree
   - c. somewhat disagree
   - d. neutral
   - e. somewhat agree
   - f. agree
   - g. strongly agree
10. I am aware of all my students' academic status before each semester.
   - a. strongly disagree
   - b. disagree
   - c. somewhat disagree
   - d. neutral
   - e. somewhat agree
   - f. agree
   - g. strongly agree
11. I am aware of all my students' academic status during each semester.
   - a. strongly disagree
   - b. disagree
   - c. somewhat disagree
   - d. neutral
   - e. somewhat agree
   - f. agree
   - g. strongly agree
12. I routinely require students to reflect on course content and their overall experience with math.
   - a. strongly disagree
   - b. disagree
   - c. somewhat disagree
   - d. neutral
   - e. somewhat agree
   - f. agree
   - g. strongly agree

Please click on the green arrow in the bottom corner of your screen after you have selected your answers. Thank you very much for your participation.