An Evaluation of the Vccs Developmental Math Redesign from A Faculty Perspective

Michael Frank Adkins
College of William and Mary - School of Education, mfadkins@email.wm.edu

Follow this and additional works at: https://scholarworks.wm.edu/etd

Recommended Citation
http://doi.org/10.21220/W4ZT09

This Dissertation is brought to you for free and open access by the Theses, Dissertations, & Master Projects at W&M ScholarWorks. It has been accepted for inclusion in Dissertations, Theses, and Masters Projects by an authorized administrator of W&M ScholarWorks. For more information, please contact scholarworks@wm.edu.
AN EVALUATION OF THE VCCS DEVELOPMENTAL MATH REDESIGN
FROM A FACULTY PERSPECTIVE

A Dissertation
Presented to
The Faculty of the School of Education
The College of William and Mary in Virginia

In Partial Fulfillment
Of the Requirements for the Degree
Doctorate of Education

By
Michael F. Adkins II
May 2017
AN EVALUATION OF THE VCCS DEVELOPMENTAL MATH REDESIGN
FROM A FACULTY PERSPECTIVE

by

Michael F. Adkins II

Approved May 2017 by

Pamela L. Eddy, Ph.D.
Committee Chair

Thomas J. Ward, Ph.D.

Heather D. Wathington, Ph.D.
TABLE OF CONTENTS

Acknowledgements ....................................................................................... vii
List of Tables .................................................................................................. viii
List of Figures .................................................................................................. x
Abstract .......................................................................................................... xi
Half Title Page ................................................................................................. xiii

CHAPTER I: INTRODUCTION .............................................................................. 1
   The Problem Statement..................................................................................... 2
      Completion agenda ........................................................................................ 3
      Developmental math crisis ........................................................................... 4
         Developmental math as a barrier to completion ....................................... 4
         Focus on programs and interventions, not change ................................... 5
      Change ......................................................................................................... 5
      VCCS Developmental Math Redesign .......................................................... 8
   Evaluation Questions ....................................................................................... 9
   Evaluation Framework .................................................................................... 10
      Step one .................................................................................................... 12
      Step four .................................................................................................. 12
      Step five .................................................................................................. 13
   Purpose of the Study ..................................................................................... 13
   Significance ................................................................................................... 14
   Overview of the Methodology ....................................................................... 15
   Definition of Terms ....................................................................................... 15
   Assumptions .................................................................................................. 17
   Delimitations ................................................................................................. 18
   Limitations .................................................................................................... 19
   Summary ....................................................................................................... 19
   Overview of the Dissertation ....................................................................... 20

CHAPTER II: LITERATURE REVIEW ................................................................. 21
   Community Colleges ..................................................................................... 22
      Functionalist perspective ......................................................................... 23
      Class-reproduction perspective ................................................................. 24
      Relative autonomy perspective ................................................................. 25
      Synthesis of perspectives ........................................................................... 26
   Developmental Education ............................................................................ 29
      Debate over developmental math .............................................................. 30
      Developmental math courses are ineffective ............................................. 31
         Critique ................................................................................................... 32
            Claim a ............................................................................................... 33
            Claim b ............................................................................................... 34
            Claim c ............................................................................................... 34
         Summary ................................................................................................. 35
   Developmental math research .................................................................... 35

iii
Feasibility ................................................................. 87
Accuracy ............................................................... 87
Protection of human subjects ........................................ 87
The role of the researcher ............................................. 88
Design Issues ........................................................ 88
Summary ............................................................... 88

CHAPTER IV: RESULTS .................................................. 90
Sample ......................................................................... 90
Survey Item’s Relationship to Kotter’s Model ...................... 94
Evaluation Question One .............................................. 98
  Model fit ............................................................... 102
  Model reliability ..................................................... 103
Evaluation Question Two ............................................. 104
  Factor structure ..................................................... 111
  Hybrid factors ....................................................... 112
Urgency/Empowerment ................................................. 113
Evaluation Question Three .......................................... 114
Evaluation Question Four ........................................... 115
Summary ............................................................... 119

CHAPTER V: EXECUTIVE SUMMARY .............................. 122
Evaluation Question One .............................................. 123
  Discussion of the results ......................................... 124
  Implications for practice ........................................ 127
  Future research ..................................................... 129
Evaluation Question Two ............................................. 130
  Discussion of the results ......................................... 130
  Implications for practice ........................................ 133
  Future Research ..................................................... 135
Evaluation Question Three .......................................... 136
  Discussion of the results ......................................... 136
  Implications for practice ........................................ 140
  Future Research ..................................................... 140
Evaluation Question Four ........................................... 141
  Discussion of the Results ....................................... 141
  Implications for practice ........................................ 143
  Future research ..................................................... 144
Critique of the Research Study ....................................... 144
  Sample ............................................................... 144
  Methods ............................................................. 145
  Execution ........................................................... 145
  Conclusion .......................................................... 146

Appendix A: First Survey .............................................. 151
Appendix B: Second Survey .......................................... 155
<table>
<thead>
<tr>
<th>Appendix C: Final Survey</th>
<th>158</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix D: Email Sent to Faculty During Data Collection</td>
<td>165</td>
</tr>
<tr>
<td>Appendix E: VCCS College Abbreviations and Full Names</td>
<td>168</td>
</tr>
<tr>
<td>Appendix F: Permission to Use Copyrighted Material for Table 5</td>
<td>169</td>
</tr>
<tr>
<td>References</td>
<td>172</td>
</tr>
<tr>
<td>Vita</td>
<td>184</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

I would like to thank the following people for their help and support while working on this dissertation.

Ruth Adkins – for your never ending love, encouragement, and support in completing my doctoral work even though it took longer than I thought.

Frankie and Cariann Adkins – for being my motivation to keep working even when I didn’t want to.

Dr. Betsy Harrison – for our talks about your doctoral experience, and your professional mentorship, insight, and friendship.

Dr. Pam Eddy – for the come to Jesus talks, your brilliance, invaluable feedback, consistent support, and expertise.

Dr. Tom Ward – for loving statistics and taking the time to talk with me about the fundamentals of the analysis.

Dr. Heather Wathington – for being a great teacher, and inspiring me to continue my education to the doctoral level.

Thank you all so much!

Mike
LIST OF TABLES

Table 1: Pre-2010 Developmental Math Redesign Literature ........................................36
Table 2: Post-Developmental Math Redesign Literature (2010-Present) .........................37
Table 3: Timeline for the VCCS Developmental Math Redesign ..................................44
Table 4: Pre and Post-redesign Developmental Math Student Outcomes .......................52
Table 5: Characteristics of the Six Schools of Thought related to Change .......................57
Table 6: Alignment Between Kezar’s (2014) Schools of Thought and Kotter’s (2012) Model ..................................................................................................................65
Table 7: Demographic Characteristics of the VCCS in 2009 and 2015 ............................74
Table 8: Crosswalk Table: Alignment of Survey Statements and Questions with the Study’s Evaluation Questions ..............................................................................82
Table 9: Overview of Data Analysis ..................................................................................86
Table 10: Comparison of the Institutional Makeup of the Population Sample and Respondents.............................................................................................................92
Table 11: Demographic Breakdown by Gender, Employment Status, and Years of Teaching ..............................................................................................................93
Table 12: Breakdown of Survey Questions and their Relationship to the Factors of Urgency, Communication, and Empowerment ........................................96
Table 13: CFA Model Fit Summary ..................................................................................102
Table 14: CFA Model Fit Comparison ..............................................................................102
Table 15: Reliability of Total Scale and Proposed Factors ..............................................103
Table 16: Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables ................................106

Table 17: Summary of Findings from EFA Analysis .................................................................111

Table 18: Comparison of Factor Means ......................................................................................115

Table 19: Results of Independent Samples T-test for Gender, Taught a Developmental Math Course, and Taught a College Math Course .........................................................117

Table 20: ANOVA Results for Employment Category and Years Taught by Faculty ........................118

Table 21: Post Hoc Analysis for Significant Between-Groups Results for Employment Category ANOVA ..............................................................................................................118

Table 22: Summary of Results in Chapter Four ........................................................................121
LIST OF FIGURES

Figure 1: Student Progression Through the Developmental Math Sequence ..................38
Figure 2: Examples of MTT Shell Courses ......................................................................51
Figure 3: Logic Model of the Developmental Math Redesign ............................................70
Figure 4: Map of the Virginia Community College System ..............................................76
Figure 5: Confirmatory Factor Analysis of Structure and Factor Loadings Using All
Survey Items for Urgency, Communication, and Empowerment ..................100
Figure 6: Confirmatory Factor Analysis of Structure and Factor Loadings after Urgency 5
and Empowerment 6 were removed ....................................................................101
ABSTRACT

Community colleges face an environment that requires them to increasingly focus on completion while simultaneously maintaining open admissions (Sydow & Alfred, 2013). Developmental math courses are a linchpin in improving college completion because approximately 60% of community college students are placed into developmental math courses, yet very few of those students make it through developmental courses and on toward degree completion (Bailey, 2009; Developmental Math Redesign Team, 2010).

In 2009, the Virginia Community College System (VCCS) embarked on a system-wide redesign of developmental math courses (Developmental Education Task Force, 2009). However, such large-scale system change means challenges and previous experience highlights that approximately 50% – 80% of change initiatives fail to meet their goals (Black, 2013).

This study evaluated the change process used to implement the VCCS developmental math redesign. A uniquely created survey based on Kotter’s (2012) change model was used to determine if faculty observed sound change practices at their institutions during the redesign. Using confirmatory factor analysis, the findings suggest that faculty saw evidence of Kotter’s (2012) change model in the implementation of the redesign. There were differences in how faculty perceived the change processes based on different demographic characteristics.
There was evidence that Kotter’s (2012) model was fully implemented in the redesign, and there were some significant differences in faculty perceptions of Empowerment. This study concluded that positively framing the results of the redesign at the system level could have improved student outcomes and that it would be wise for colleges to assess the change processes they use.
AN EVALUATION OF THE VCCS DEVELOPMENTAL MATH REDESIGN
FROM A FACULTY PERSPECTIVE
CHAPTER 1: INTRODUCTION

Modern community colleges are forced to navigate multiple contradictory conditions. For example, accomplishing the goals of both access and completion create what Sydow and Alfred (2013) label the ultimate expression of paradox for community colleges. “In the short span of a decade, the interests of federal and state governments and foundations have coalesced to encourage a paradigm shift for community colleges from one emphasizing access to one emphasizing completion” (Sydow & Alfred, 2013, p. 52). This paradigm shift is significant because it is requiring community colleges to think about their mission differently and to change the way that they have historically operated. Instead of merely thinking of how to get students into college, institutions must now focus more on how to get students out of college. The goal of completion requires a different set of actions as a result.

The paradox of balancing access and completion is paralleled by the recent focus on developmental math. Almost two out of three community college students are unprepared for college-level math courses (Bailey, 2009; Jaggars, Hodara, Cho, & Xu, 2015). Underprepared students are routinely placed into developmental courses designed to help ready them for college-level math courses; yet, only a small number of those students make it through their required developmental sequences and into a college-level math course (Bailey, 2009; Jaggars & Stacey, 2014). An even smaller number of developmental math students actually pass a college math course (Bailey, 2009; CCRC, 2014). According to Merseth (2011), “nowhere in the community college curriculum is
the failure rate of graver concern that the developmental mathematics courses” (p. 32). Community college leaders are increasingly pressured to grapple with the developmental math problem by external stakeholders such as state and federal governments and foundations focused on improving student outcomes, particularly completion (Sydow & Alfred, 2013). Even though this paradigm shift should not be surprising because completion rates in community colleges are historically low, it does pose new problems for institutions that traditionally focused on being accessible to students with low academic preparation (Bragg & Durham, 2012).

**The Problem Statement**

Historically, the community college’s open door mission targeted increased access to higher education for those with limited postsecondary options. Cohen and Brawer (2008) suggested U.S. community colleges’ focused on access because “the United States has been more dedicated to the belief that all individuals should have the opportunity to rise to their greatest potential. Accordingly, all barriers to individual development should be broken down” (p. 11). An emphasis on providing access to higher education has historical roots in the report of the Truman Commission, which in 1947 recommended that higher education should be more accessible and equitable (Gilbert & Heller, 2013).

Given the community colleges’ emphasis on open admissions policies, many students start their college career underprepared for college work. Developmental education programs have historically been used to ramp up underprepared students’ preparation for college coursework since colonial times (Attewell, Lavin, Domina, & Levey, 2006). Developmental education is critical for making community colleges
accessible to students who have historically been excluded from higher education (Cohen & Brawer, 2008). Indeed, community colleges enroll the greatest percentage of minority students, low-income students, and returning adult students of all the types of institutions of higher education (Mullin, 2012; NCES, 2015a). Developmental education has been at the center of a national debate concerning community colleges’ need to change. However, there is little empirical evidence to guide leaders in choosing interventions that work best to help achieve student success, particularly in improving completion and a college degree attainment (Bailey, 2009; Rutschow & Schneider, 2011).

**Completion agenda.** Stakeholder perceptions about the importance of access to higher education are changing as state funding for education is becoming scarce (F. C. Fowler, 2013). Stakeholders are now more concerned about holding colleges more accountable in how their use of public funds translates to student outcomes (Cohen & Brawer, 2008; F. C. Fowler, 2013). Specifically, many programs and associations, including Achieving the Dream (2016), American Association of Community Colleges (AACC) (McPhail & AACC, 2011), Bill and Melinda Gates Foundation (2010), Complete College America (2014), and the Lumina Foundation (Matthews, 2015), are encouraging community colleges to focus on improving degree completion while simultaneously providing access to all.

State and federal governments have also focused on completion because of the tangible benefits associated with degree attainment; projections of future workforce needs; and the desire to improve international competitiveness (Baum, Ma, & Payea, 2013; Matthews, 2015; Sydow & Alfred, 2013; U.S. Department of Education [USDoE], 2006; White House, 2010). College completion affects our national prosperity and
should be an important area of focus for community colleges because they serve students who have traditionally been excluded from reaping the economic and personal benefits associated with completion (Mullin, 2012; USDoE, 2006). Indeed, many states are creating Performance Based Funding mechanism that ties institutional funding to completion targets (Freidel, Thornton, D’Amico, & Katsinas, 2013).

**Developmental math crisis.** The focus on completion from stakeholders and pundits has drawn attention to the deeper issues inherent in developmental education programs. Community college students are typically less academically prepared, which results in the need for developmental coursework. However, many researchers contend that enrollment in developmental math courses negatively impacts students’ completion (Bailey, 2009; Martorell & McFarlin, 2010). Almost 60% of community college students are referred to developmental math courses (Bailey, 2009; Bailey, Jeong, & Cho; 2010). Yet, only 27% of students who took developmental courses passed a college math course, while 72% of the students who chose to skip the developmental courses passed a gatekeeper college math course (Bailey et al., 2010). The data suggest that current developmental math courses are not helping students succeed in making progress towards completion as intended (Bailey, 2009; Jaggers & Stacey, 2014). What remains unknown is if different approaches to developmental math result in significantly different success rates (Rutschow & Schneider, 2011).

**Developmental math as a barrier to completion.** Because so many students are placed into developmental math and fail to make it through the developmental sequence, researchers have suggested that the traditional developmental math sequence is a significant barrier to college completion (Bailey et al., 2010; Hern, 2012).
Developmental coursework consumes students’ time and financial aid while providing few, if any, benefits. Failing to complete developmental coursework can jeopardize a student’s financial aid eligibility, and taking the courses wastes finite Pell Grant money.

For community colleges to maintain their open access mission and simultaneously improve completion, they will have to make significant changes in the way that they place and move students through the developmental math sequence to ensure that students gain an understanding of the math content they need and maintain their financial aid.

**Focus on programs and interventions, not change.** Even though researchers have focused their attention on deficiencies plaguing developmental math sequences (Bailey, 2009; Bailey et al., 2010; Hern, 2012), little, if any, of the discussion in the literature addresses how college and system leaders should go about implementing programmatic change concerning developmental math. Kezar (2014) observed that leaders, and in this case researchers as well, focus on interventions while ignoring the change process. This singular focus on interventions is problematic because most change initiatives fail (Black, 2013). If community colleges are going to make changes in developmental math that will positively impact student outcomes, stakeholders within the organizations will need to be cognizant of the change process, and intentionally manage it to bring about expected outcomes (Kezar, 2014; Kotter, 2012).

**Change.** The need for organizational change to improve institutional effectiveness and the difficulties associated with it are not specific to community colleges. All organizations have to adapt and change to survive and succeed in fulfilling their missions (Drucker, 1994; Kotter, 2012). The need to change can often be attributed
to a shift in an organization’s relationship to its external or internal environment (Drucker, 1994; Kezar, 2014; Kotter, 2012), which changes the organization’s context for operation. Often these changes are necessary because of organizational crisis. As Drucker (1994) argued,

> The assumptions on which the organization has been built and is being run no longer fit reality…These are the assumptions that shape any organization’s behavior, dictate its decisions about what to do and what not to do, and define what the organization considers meaningful results. (pp. 95 – 96)

Drucker (1994) labeled these assumptions an organization’s *theory of the business* (p. 96, emphasis in the original text). When the organization’s theory of the business no longer fits reality, it compromises the organization’s ability to fulfill its mission.

Kotter (2012) predicted that more organizations will be forced to revise their theory of the business and change as they are “pushed to reduce costs, improve the quality of [their] products and services, locate new opportunities for growth, and increase [their] productivity” (p. 3). The need for organizations to change in response to macroeconomic forces will only intensify over the next few decades. Thus, given the prospects of continuous organizational change (Black, 2013; Eckel, Hill, & Green, 1998; Kezar 2014; Kotter, 2012), the ability to change will become increasingly important to organizations’ abilities to fulfill their missions and meet their stakeholders’ needs. This is the exact situation in which community colleges find themselves. Changes in stakeholder expectations emphasizing completion—while still expecting access—force community college leaders to rethink their theory of the business. Reforming developmental math is at the center of rethinking the theory of the business.
The problem to date is that the research focused on change clearly shows that organizations are notoriously bad at making intentional changes (Black, 2013; Kotter, 2012). Currently, between 50% and 80% of change efforts fail (Black, 2013; Kotter, 2012). According to Black (2013), the fact that so many change initiatives fail is important to note because:

If the failure rate were 30 percent, we might attribute it to the failings of less motivated and skilled managers. But at 50 – 80 percent, this means that there are many motivated, skilled and otherwise successful leaders who are nonetheless falling short of their organizational change objectives. (“Failure Rate,” para. 1)

Thus, even effective leaders fail to successfully institute change the majority of the time even when there is a compelling need. What we do know is that successful change initiatives “tend to be associated with a multistep process that creates power and motivation sufficient to overwhelm all sources of [organizational] inertia…[and] this process is never employed effectively unless it is driven by high quality leadership” (Kotter, 2012, p. 21).

So why do so many change initiatives fail? Change efforts fail to create enough power and motivation to overcome organizational inertia. Eckel, Green, Hill, and Mallon (1999b) suggested that this is because the change process is hard to comprehend and manage. Kezar (2014) further suggested that leaders fail to make significant changes because they focus their attention on interventions and programs; they emphasize what needs to be changed. However, these same leaders often ignore the change process; they ignore how they are going to make the needed change happen, or they use oversimplified and ineffective models of change, which are unable to overcome inertia. One example
Kezar (2014) offered is that leaders often assume that people will change simply because they are told, or because they are provided with evidence that change is necessary. In reality, people rarely change as a result of a rational argument (Kezar, 2014; Kotter, 2012). Thus, for community colleges to implement successful change, leaders will need to focus on the change process, use effective theories based on research, and find innovative ways to gather feedback to tweak their change processes when necessary, because organizational change is complex and never straight forward (Black, 2013; Eckel, Hill, & Green, 1998; Fullan, 2001; Kezar, 2014; Kotter, 2012).

Critical to the change process is the concept of double-loop learning; here, leaders put processes in place to take a second look at how an organization is operating and question underlying assumptions (Morgan, 2006). Evaluating the change process gives leaders and change agents a second look to better understand if the change process is unfolding how they intended.

As organizations, community colleges are no strangers to change. Throughout their history, they have continuously added to their mission as they strive to meet the needs of their communities and increasingly provide more educational opportunities for their students. However, these changes have often been incremental and focused more on providing access to educational opportunities. Now, community colleges are currently facing a changing environment in which shifting stakeholder expectations demand exponential change (F. C. Fowler, 2013; Sydow & Alfred, 2013).

**VCCS developmental math redesign.** Starting in 2009, the Virginia Community College System (VCCS) initiated a developmental math redesign as part of its strategic planning process to develop the system’s strategic plan, Achieve 2015. The
redesign was initiated with the formation of The Developmental Education Task Force (DETF), which looked at data concerning developmental mathematics across the VCCS. The DETF found that approximately 52% of the new program placed students were placed in developmental math courses and that approximately 36% of the students in transfer curriculums passed a gatekeeper math course. The DETF determined there was a need to redesign developmental mathematics, which resulted in the creation of the Developmental Mathematics Redesign Team (DMRT). The DMRT was formed to handle the specifics of redesigning developmental mathematics. Recommendations from the DMRT resulted in the system-wide implementation of redesigned developmental math courses in spring 2012.

**Evaluation Questions**

The evaluation questions guiding this study include:

Evaluation question 1: What factors do development math faculty perceive as critical in the redesign of the math curriculum?

Evaluation question 2: How do these factors differ by demographic characteristics such as:

- gender;
- employment category;
- years of teaching experience; and,
- if the faculty member has taught a college-level math course?

Evaluation question 3: What are developmental math faculty perceptions of the change process during the redesign regarding the role of Urgency, Communication, and Empowerment?
Evaluation question 4: How do developmental math faculty perceptions of the role of Urgency, Communication, and Empowerment differ by demographic characteristics such as:

- gender;
- employment category;
- institution;
- years of teaching experience;
- if the faculty member had taught a developmental math course before the redesign;
- and if the faculty member has taught a college-level math course?

It is important to note that this study does not question whether change has occurred during the VCCS developmental math redesign. There have been significant changes in the way that students are placed due to the creation of the Virginia Placement Test (VPT), and the structure and content of developmental math courses. Instead, this study seeks to understand math faculty perceptions of the change process, as they are responsible for implementing the changes created at a system level. Specifically, the survey addresses math faculty opinions regarding the need to change, opinions of the Communication used during the implementation of the developmental math redesign, and opinions concerning whether faculty felt empowered to implement redesigned developmental math courses.

**Evaluation Framework**

This study uses a sub-set of Kotter’s (2012) eight-step change framework to understand faculty opinions of the change process used in the developmental math
redesign. Kotter developed his framework using data collected in studying hundreds of organizations, the majority of these in the business sector, involved in intentional change efforts. Like Black (2013), Kotter (2012) determined that within his sample of organizations, the majority of change efforts fail. The eight steps of Kotter’s (2012) framework represent what he determined to be the steps that successful organizations engaged in to make organizational changes successful. Kotter’s steps include:

1. Establishing a sense of Urgency;
2. Creating a guiding coalition;
3. Developing a vision and strategy;
4. Communicating the change vision;
5. Empowering employees for broad-based action;
6. Generating short-term wins;
7. Consolidating gains and producing more change;
8. Anchoring new approaches in the culture.

Kotter argues that all steps are important for successful change to occur.

Kotter’s (2012) change framework was chosen as this study’s evaluation framework because its linear step approach best aligned with the overall process used by the VCCS during the redesign. However, this study is focused on only part of that overall change process, specifically the perceptions of math faculty during a specific time period. The survey instrument used in this study focused only on steps one (Urgency), four (Communication), and five (Empowerment) because, while the overall change process looks most like Kotter’s (2012) model, faculty would have only participated in steps one, four, and five.
Step one. The intention of the first step in the model is to make sure that Urgency is high amongst a large enough group of people (Kotter suggested 75% or higher) and that complacency is low. Urgency is important because when change agents do not feel there is a sense of Urgency they “will find a thousand ingenious ways to withhold cooperation from a process that they sincerely think is unnecessary or wrongheaded” (Kotter, 2012, p. 38). Understanding more about the level of Urgency felt by math faculty regarding the redesign provides important information about the potential success of the change. For example, if only a small portion of the math faculty felt a sense of Urgency, Kotter (2012) would argue that the change process rested on a weak foundation. Kotter (2012) believes that the majority of change efforts fail before they even get started because there is not a great enough sense of Urgency. Kotter’s (2012) step one—establishing a sense of Urgency—was used to better understand faculty perception concerning the need to redesign developmental math.

Step four. Kotter’s (2012) step four – communicating the change vision – focuses on how Communication can impact organizational members’ actions because the power of a change vision is unleashed when the majority of participants have a common knowledge of the goals and direction of the change initiative. In Kotter’s (2012) model, Communication is multifaceted and often overlooked in the change process. Good Communication is simple, repeated using multiple media, modeled by leader’s actions, and two-way within the organization (Kotter, 2012). For the current study, this step will be used to better understand faculty opinions of the Communication they received during the redesign. Communication is key to the success of any change initiative, and if good practices concerning Communication are not used, the success of the change initiative
can be negatively impacted. It is important for change leaders at the VCCS to understand how faculty perceived the Communication they received regarding the developmental math redesign and to determine if the Communication strategies are sufficient to enact change in student outcomes.

**Step five.** According to Kotter (2012), “the purpose of step five is to empower a broad base of people to take action by removing as many barriers to the change vision as possible...Four [obstacles] can be particularly important: structures, skills, systems, and supervisors” (p. 106). So, empowering employees for broad-based action is really focused on how change agents share power with others in the organization and how faculty are supported in ways that allow them to actually change operations and practices. For this research, knowing how faculty perceives the level of power they have to make change can highlight ways to leverage change and can identify things that faculty perceive as barriers in their ability to make needed changes to improve courses for students. Step five is intended to indicate whether faculty feel they have the skills to implement redesigned developmental math courses and whether faculty think that leaders and supervisors within the organization support the change initiative.

**Purpose of the Study**

The purpose of this study is to conduct an evaluation of faculty perceptions of the change process used for the VCCS developmental math redesign. Evaluating faculty perspectives of the change process is vital because faculty makes up the operating core (Mintzberg, 1980) of the developmental math enterprise in the sense that they physically implemented the developmental math redesign and are responsible for the majority of the work associated with developmental education. The evaluation was conducted by using a
survey instrument based on Kotter’s (2012) change framework, which will be administered to Virginia community college math faculty in order to better understand their opinions on the change process. This research study also tested the reliability and validity of the survey instrument.

**Significance**

This study has the potential to help community colleges and community college systems focus on the change process they use to rethink and redesign their developmental math offerings. Mechanisms such as the survey instrument in this study allow organizations to participate in double loop learning by providing data for implementers to have and reflect on. Reflecting on the data provides implementers the chance to change incorrect assumptions about the change process and improve it (Morgan, 2006). Leaders and stakeholders involved in the change effort need to understand how the change process is working in order to make adjustments to improve the implementation of developmental math reforms.

Goudas and Boylan (2012) argued that developmental interventions work differently at different institutions based on the way that they are implemented. Because implementation impacts developmental math student outcomes, all stakeholders who are committed to improving community college student completion in developmental math courses, college math courses, and degrees and certificates have a vested interest in understanding, assessing, and improving the college’s change process. When considering that lasting change may take as long as 10 years, as Kotter (2012) suggests, focusing on planning, evaluating, and improving the change process is important for both those
currently redesigning and preparing to redesign their developmental offerings. The instrument developed during this study will help leaders accomplish those tasks.

**Overview of Methodology**

This study utilized a self-created survey instrument based on Kotter’s (2012) change steps one (Urgency), four (Communication), and five (Empowerment). The unit of analysis was individual VCCS math faculty. I used quantitative methods to evaluate the results. Descriptive mean Likert scores were used to determine average faculty responses to individual survey statements. Exploratory factor analysis was used to make sure that the questions used in the survey cluster together and represent each of Kotter’s (2012) steps which they were intended to represent. ANOVAs were completed to determine if there are differences between respondents based on demographic characteristics. The survey went through two rounds of feedback from expert panels to improve the wording and face validity of the instrument.

**Definition of Terms**

*Change:* includes two different levels. First-order change “involves minor improvements” (Kezar, 2014, p. 49). First-order change is also referred to as incremental change, whereas second-order change includes when “underlying values, assumptions, structures, processes, and culture need to be addressed for change to happen” (Kezar, 2014, p. 49). Second-order change is also referred to as transformational change.

*Change Agent:* the primary implementer of the change initiative. Change agent and faculty is used interchangeably within this study.

*College Credential(s):* any college degree or certificate.
A college-level math course(work): math course(work) intended to transfer to a four-year institution and meet the math requirements for a Bachelor of Arts or Science degree.

Community College: “any institutions regionally accredited to award the associate in arts or the associate in science as its highest degree” (Cohen & Brawer, 2008, p. 5).

Completion: when a student finishes a college degree or certificate.

Developmental math course(work): course(work) designed to prepare a developmental math student for college-level math coursework.

Developmental math student: a student who is placed into a developmental math course based on initial placement test scores.

Exit Points: any point at which a student can exit the developmental math sequence. For example, students starting two levels below college math or English face five exit points before completing the college-level course. They must 1) pass the first course, 2) choose to enroll in the next course, 3) pass the second course, 4) choose to enroll in the college-level course, and 5) pass that course (Hern, 2012, p. 61).

Frame: “is a mental model [or map] – a set of ideas and assumptions – that you carry in your head to help you understand and negotiate a particular territory” (Bolman & Deal, 2008, p. 11).

Operating Core: “includes all those employees who themselves produce the basic products and services of the organization, or directly support their production” (Mintzberg, 1980, p. 323).

Sequence: “a process that begins with initial assessment and referral to remediation and ends with the completion of the highest level developmental course—the
course that in principle completes the student’s preparation for college-level studies” (Bailey et al., 2010, p. 1).

Stakeholder(s): “any person, group, or organization that can place a claim on…[a community college’s] attention, resources, or output, or is affected by that output” (Bryson, 2011, p. 48).

System: also referred to as community college system or state-wide system describes the organization and governance structure of community colleges. All 23 colleges in the VCCS are part of the same system led by a chancellor. Even though the system office allows colleges within the VCCS to generally operate autonomously, the system office does mandate certain activities and set certain policies for all colleges in the system. All colleges in the VCCS were mandated to implement the redesigned developmental math courses.

Theory of the business: “Assumptions that shape any organization's behavior, dictate its decisions about what to do and what not to do, and define what the organization considers meaningful results” (Drucker, 1994, pp. 95 – 96).

Assumptions

There are a number of assumptions inherent in this study. The main assumption is that the three steps (Urgency, Communication, and Empowerment) from Kotter’s (2012) model can best help to understand faculty perspectives of the change process and evaluate it. One can change structures, programs, curriculum, and reporting lines, but for change agents to effectively implement a change initiative they need to believe that there is a compelling need to make the change, receive constant effective Communication regarding the direction and purpose of the change, and be empowered to do what is
required of them to implement the changes. In essence, changing an organization is tied directly to changing individuals’ mental maps and the way that they make sense of the problem being addressed and the proposed solution (Senge, 1990). Since the VCCS used a change process that closely lined up with Kotter’s (2012) model, this study also assumes that the VCCS’s planned change process was sound. Linked with the idea that changing individuals is necessary for organizations to create second-order change (Kezar, 2014) is the assumption that change agents’ opinions of the change process are important indicators for determining whether a change process is effective. So while in practice it appears that the VCCS used a sound change process, the real question is if faculty perceived it that way.

**Delimitations**

This study is specifically delimited to focusing on understanding the perspectives of full and part-time developmental math faculty members currently employed by the VCCS who taught anytime from Fall 2011 to the Fall 2013 semesters. There are two main reasons for focusing on developmental math. First, more students test into developmental math and fewer make it through the developmental math sequence compared to developmental English (Bailey et al., 2010). Second, developmental math courses were the first to be redesigned in Virginia’s developmental education redesign.

The reason for exclusively surveying math faculty is that they are the primary implementers of redesigned developmental math courses. They are the operating core of developmental math education, which means they are the primary doers of the work and in this case the primary change agents (Mintzberg, 1980). Focusing specifically on the
faculty in Virginia provides some continuity in the study because states use different change processes to undergo their developmental math redesigns.

**Limitations**

One limitation of focusing on including only math faculty is that it eliminates many different stakeholders who have a vested interest in and perspectives about the developmental math redesign. Virginia community colleges are part of a fairly tightly coupled system (Weick, 1976), so observations of the change process within Virginia will not necessarily translate to states without community college systems or with loosely coupled systems.

Another limitation is the historical nature of this study, the primary activity involving the implementation of the developmental math redesign happened between the start of the Fall 2011 Semester and the end of the Fall 2013 Semesters. Because time has elapsed since the beginning of the redesign efforts, faculty observations and sensemaking may be different now that faculty have had time to reflect on the process (Weick, 1995). Retroactive sensemaking is a natural part of processes in which individuals make sense of new changes.

**Summary**

Change is difficult, and in many instances organizations fail to make the changes that they need (Kezar, 2014; Kotter, 2012). Community colleges are currently being called on by a multitude of stakeholders to change their theory of the business by improving college completion (Sydow & Alfred, 2014). Community colleges’ success in meeting this challenge is directly related to their ability to move more students through the developmental sequence and college-level math.
Too many students are excluded from earning college credentials because developmental math courses are failing to meet their needs. A number of community colleges and community college systems have decided to try and redesign their developmental math programs, however, those organizations are more focused on implementing specific interventions and programs rather examining the change process they use to implement their developmental math redesigns. This study used a survey specifically developed for this study, based on particular steps of Kotter’s (2012) change process, which was used to evaluate the change processes used during developmental math redesigns. The results of this evaluation will allow system leaders to understand how the change process was interpreted and implemented by those directly charged with making changes to developmental math programs.

**Overview of the Dissertation**

Chapter II includes a detailed review of the literature concerning developmental mathematics redesign initiatives, the process and curriculum used by the VCCS, and an overview of the literature on change. Chapter III covers the study’s methods in a more comprehensive manner. Chapter IV reviews the findings, and finally, chapter V includes the discussion and conclusion of the study.
CHAPTER II: LITERATURE REVIEW

Studying change within the Virginia Community College System’s (VCCS) Developmental Math Redesign requires an understanding of the community college context. Specifically, it is important to review the various theoretical lenses that researchers have used to understand how these institutions operate, and the multiple often contradictory roles community colleges have played in the history and structure of U.S. higher education. The role that community colleges play in the structure of higher education provides context for understanding how developmental math courses provide access to higher education.

The review of the developmental education literature focuses on developmental education in general, and math in particular. The history, rationale, current research, and divergent opinions concerning developmental math provide evidence that there is a gap in the literature regarding the role of the change process in developmental math reform. Researchers have focused on looking at what needs to change in developmental math, but not how colleges need to implement change. A historical account of the process used during the VCCS Developmental Math Redesign is provided to add context for understanding change at the system level, the goals of the redesign, and what individual colleges were expected to do in implementing redesigned developmental math courses. Reviewing the change literature presents an overview of change theories and introduces Kotter’s (2012) change model in more detail. I argue that the steps in Kotter’s (2012) model appropriately represent the logic used to guide the activities of the redesign.
Community Colleges

Community colleges are a vital part of the U.S. system of higher education. During the 2012-2013 academic year, public 2-year institutions enrolled 10,128,642 students compared to public 4-year institutions, which enrolled 9,677,077 undergraduate students that equate to 51% of the students enrolled in public higher education (NCES, 2015b). Community colleges are the primary access point to public higher education for students in the United States due to their low cost and location in communities throughout the nation that provides ease of attending college. This trend of access persists in Virginia as well with 281,976 students attending one of the 23 public two-year colleges in the VCCS, compared to the 253,359 students attending the state’s public four-year institutions. Virginia community colleges serve more students across the commonwealth than any other type of post-secondary institution (NCES, 2015b). In general, community colleges serve a greater portion of students with risk factors such as minority status, low-income, and first-generation students (Mullin, 2012; NCES, 2015a).

The creation and expansion of the American community college movement is a phenomenon that has had a lasting impact on the structure and ethos of the American higher education system (Witt, Wattenbarger, Gollattscheck, & Suppiger, 1994). On one hand, community colleges have made more room in higher education for students that have traditionally been excluded (Dougherty, 1988; Witt et al., 1994). Without community colleges more that 10 million students might not have access to a college education. Community colleges and their proponents have championed educational equality and the importance of providing all a chance at social and economic mobility through college access, as the Truman Commission recommended (Cohen & Brawer,
Key stakeholders such as community members, state government officials, and business leaders were so convinced that community colleges would add value to local communities that at the peak of their expansion in the 1960s approximately one new community college was founded each week (Witt et al., 1994).

On the other hand, though community colleges have provided greater access to higher education, there are researchers who argue they do not provide economic and social mobility. In the community college literature, there are three distinct schools of thought concerning community colleges. These different schools of thought or perspectives include differing interpretations of the history and motivation behind the community college movement and make different claims about the outcomes and social implications of community colleges. These perspectives include functionalism, class-reproduction, and relative autonomy (Dougherty, 1988).

**Functionalist perspective.** The functionalist perspective regarding the role of community colleges focuses on the way these institutions operate within the context of higher education. In the functionalist view, community colleges provide the economy with skilled labor and individuals with social mobility (Dougherty, 1988). According to Dougherty (1988):

Most commentators have taken a functionalist view of the community college, applauding it as the product of a broad social movement to meet the fundamental need of society for expanded higher education opportunity and labor training for the economy. They have noted approvingly the finding that community colleges have become a crucial port of entry into higher education for working-class and nonwhite students. (pp. 351-352)
According to the current enrollment data, this assessment of the role of community colleges is true; more students enter college through public two-year colleges than any other type of post-secondary institution. There is historical evidence that the community college expansion was part of a broad social movement (Witt et al., 1994). Not only have more students accessed higher education through community colleges than any other type of institution (NCES, 2015b), the colleges have also provided educational opportunities for students that were traditionally excluded from higher education (Brint, 2003; Dougherty, 1988; Mullin, 2012). According to the functionalist analysis, as long as community colleges provide access as a means to achieving positive student outcomes, such as social and economic mobility, they are working as intended and making a positive contribution to society. Others offer a different perspective.

**Class-reproduction perspective.** Over the last three decades, the positive view of community colleges has been questioned by a small number of researchers (Dougherty, 1988). These researchers argue that community college expansion has been encouraged by elites that wish to reproduce existing class relations (Beach, 2009; Brint, 2003; Brint & Karabel, 1989; Dougherty, 1988). These researchers argue that community colleges’ success in providing broad access to higher education and attracting low-income and minority students ultimately has a negative impact on society (Dougherty, 1988). The negative impact is that community colleges divert these students away from earning 4-year degrees, which would provide greater economic benefits. Community colleges divert students by first attracting students away from 4-year institutions and then tracking them into educational pathways that do not lead to a bachelor’s degree. Clark (1960) labeled this process “cooling out” because students’
educational expectations and goals are “cooled” as they are tracked into vocational programs by counselors and advisors (p. 569).

Brint and Karabel (1989) draw many of their conclusions from data that suggests 70% of community college entrants have a goal of earning a 4-year credential, but only about 15% actually accomplish it (Brint, 2003). They infer and provide evidence that community colleges keep students from reaching their educational goals by diverting them into educational pathways, such as vocational programs, that do not lead toward a 4-year degree. According to Brint and Karabel (1989), community colleges hinder social and economic mobility in support of the current social structure by taking those on the lowest rungs of the social ladder and keeping them there (Brint, 2003; Dougherty, 1988). This perspective argues that community colleges are not living up to their espoused missions because they are not helping students achieve the desired outcome of earning a college degree, but rather keeping them from it.

**Relative autonomy perspective.** Dougherty (1988) suggested that both the functionalism and class reproduction arguments are flawed. Neither a broad social movement, as functionalism argues, nor elites’ interest in class reproduction, as class reproduction argues, can completely explain the rapid and widespread expansion of the community colleges throughout the United States. Dougherty (1988) argued instead that community colleges spread because government officials have relative autonomy over many of the solutions they choose to provide to meet stakeholder needs. Dougherty (1988) suggested that the structure of community colleges aligned with education administrators’, politicians’, and key stakeholders’ interests. This perspective takes a less dualistic view of community colleges’ as either good or bad. According to Dougherty
(1988), the origins of the community college and its expansion should be seen as value neutral. The community college was simply an organizational solution that aligned with individuals’ interests.

**Synthesis of perspectives.** One plausible explanation for the co-existence of the three perspectives is that they emphasize different institutional realities occurring in practice simultaneously. Witt and colleagues (1994) suggested that the broad social movement which functionalists attribute to community college expansion was actually the synthesis of two different movements. One was the populist movement that emphasized the need for broad access to higher education to provide citizens opportunities for economic and social mobility; the other was an elitist movement, which wished to keep unprepared students from entering universities (Witt et al., 1994).

Populists saw community colleges as a means to meeting their political agenda by providing access, and elites saw community colleges as a means to reach their goals by providing a buffer to weed out students who were unprepared for university studies (Witt et al., 1994). In their inception, community colleges were intended to meet the needs of these seemingly contradictory movements by simultaneously extending and limiting access to higher education. This confirms the narrative of both functionalism and class reproduction. Sydow and Alfred (2014) explained that there are numerous paradoxes, or incongruous states, that exist within community colleges. The functionalist and class-reproduction schools of thought highlight one of those paradoxes.

Dougherty’s (1988) account of relative autonomy of community colleges adds richness to our understanding of these institutions by identifying key stakeholders in the creation and expansion of community colleges, while at the same time highlighting
another paradox that Sydow and Alfred (2014) identified. Namely, community colleges often try to be everything for everyone (Cohen & Brawer, 2008; Dougherty & Townsend, 2006). This broad view of the mission was desirable for state government officials that saw community colleges as an institution that aligned with many stakeholders needs and their own policy goals (Dougherty, 1988; F. C. Fowler, 2013). However, community colleges are rarely provided the funding necessary to fulfill their multiple functional missions well (Sydow & Alfred, 2014).

All three perspectives highlight the differing views on community colleges and the many voices that also appear in the recent discussion of development math. If community colleges are going to continue to provide access to all, as proponents of functionalism suggest, community colleges are going to needed to provide developmental math instruction to provide access for students who are academically underprepared in math (Goudas & Boylan, 2012). Yet, if community colleges are going to improve outcomes for students rather than diverting them away from four-year institutions, they are going to have to improve the outcomes of students in developmental math courses, as class-reproduction scholars suggest (Bailey, 2009). Lastly, community colleges need to focus on stakeholders’ wants and needs if they are going to stay relevant, as Dougherty’s (1988) relative autonomy emphasizes. All of the stakeholders identified by each school of thought have a relevant interest in the issues facing community colleges today (Sydow & Alfred, 2014), but according to Dougherty and Townsend (2006) community colleges are:

Rooted in the essential contradictions of U.S. society. This is a society deeply divided by class, race, gender, and other factors. These divisions show up in the
community college in debates about preserving open access while maintaining academic excellence and in conversations about meeting students’ needs for broad-based occupational skills and employers’ desires for skills more narrowly tailored to their particular interests. These contradictions have divided the community college almost from its inception, and will likely continue to do so.

(p. 10)

These deep divides and contradictions also rear their head in the developmental mathematics literature (Bailey, Jaggers, & Scott-Clayton, 2013; Goudas & Boylan, 2012, 2013). For the purposes of this study, I am inclined to agree with scholars who argue that there is a crisis because developmental math courses are not producing the desired outcomes; this line of reasoning necessitates a drastic change in developmental math offerings. I agree with this perspective because the research supports it; the data discussed later in this literature review shows how the majority of outcomes for developmental math are either negative or null effects.

Researchers argue that we are in the midst of a developmental math crisis (Levin & Calcagno, 2007). Boatman (2010) suggested improving math literacy is the most important factor in improving the nation’s global competitiveness. Those noting the crisis in developmental math are aligned with the class reproduction school of thought; the argument here is that by focusing on outcomes in conjunction with attention to access requires drastic changes in the way that developmental math courses are designed and taught. Others argue that evidence of developmental math crisis is tentative at best and that empirical data shows mixed rather than definitive results (Goudas & Boylan, 2012). These researchers are aligned with the functionalist school of thought and argue that
developmental education is working as intended by providing access to college math and enabling developmental math students to fair as well in college math courses as students that did not take college math (Goudas & Boylan, 2012). The following section reviews in more detail literature related to community college developmental education.

**Developmental Education**

Historically, developmental coursework was used as an intervention for students with weak academic skills, in fact, “remedial courses have been a regular part of the curriculum at Ivy League universities and other colleges from the Colonial period to the present” (Attewell et al., 2006, p. 888). Researchers have even written articles about colleges’ attempts to rectify students’ academic weaknesses since the mid-nineteenth century (Rutschow & Schneider, 2011). The important point is developmental education is not a new practice or a new topic of discussion. However, the number of students entering community colleges underprepared for college coursework is rising, and this trend is likely to hold in the future because of changing student demographics (Sydow & Alfred, 2014)

The history of developmental education shows that remedial support was created as a common sense solution to help academically underprepared students by providing them with the fundamental English and math skills they would need to be successful in college-level work (Attewell et al., 2006; Martorell & McFarlin, 2010). Martorell and McFarlin (2010) suggested that the debate over developmental education is very similar to the debate in labor economics over policies to improve the human capital of low-skilled workers. One side of the debate argues that little can be done to improve human capital after an individual reaches a certain age because skills build on skills and effective
interventions have to be implemented early in life. The other side argues that some second chance programs have contributed to positive outcomes for low skill workers even though the interventions did not happen at an early age.

Developmental education can certainly be labeled a second chance intervention designed to help underprepared students succeed in college; because of this, some stakeholders question whether developmental courses should even be offered at all (Calcagno & Long, 2008). Some argue that developmental courses should not be offered or subsidized by the state because these courses cover skills that students should have already learned during their k-12 education (Calcagno & Long, 2008). The argument given is that by providing developmental courses the state and by extension taxpayers are required to pay for students to learn basic skills twice. This argument seems particularly salient since there are serious question about whether or not developmental coursework actually helps students in college math (Martorell & McFarlin, 2010)

**Debate over developmental math.** Focused attention on developmental education has sparked considerable debate in the developmental math literature (Calcagno & Long, 2008). The debate has been contentious and politically charged (Attewell et al., 2006). The argument revolves around the paradox of access and completion and is further complicated by community colleges’ scarce funding (Sydow & Alfred, 2014). Traditionally, community colleges have focused on access to higher education through open-admissions policies as functionalists suggest they should. Class-reproduction scholars focused national attention on the importance of outcomes such as degree attainment and transfer while arguing that community colleges were failing students in those areas (Brint, 2003; Brint & Karabel, 1989). Stakeholders’ emphasis on
accountability for community colleges and higher education has only increased as time has passed (Sydow & Alfred, 2014).

At the same time, there has been a dramatic divestiture in higher education by state governments (Delaney & Doyle, 2007; F. C. Fowler, 2013; SCHEV, 2009). Community colleges have been particularly hard hit by funding cuts because, in general, their funding model depends more on state funding than four-year institutions (Mullin, 2014; Palmer, 2008; Sydow & Alfred, 2014). Funding scarcity has made developmental education a target for scrutiny and researchers have focused on trying to figure out if developmental math is a good investment for community colleges, states, and ultimately taxpayers.

For comprehensive community colleges, developmental education can be considered a part of the functional mission of the institution (Dougherty & Townsend, 2006). In fact, some researchers, such as Goudas and Boylan (2012), contend that the debate over the effectiveness of developmental education is an attack on community colleges themselves. Goudas and Boylan (2012) argued that the literature, which characterizes developmental education as ineffective, is leading some policy makers to take action that represents “a radical shift in the history of developmental education…[which] all educators should be extremely concerned about” (p. 11). This view of developmental math reform as radical is strikingly different from the assessment of many researchers looking specifically at the outcomes associated with developmental math.

**Developmental math courses are ineffective.** Multiple researchers maintain that until recently many of the studies concerning developmental education were either
methodologically weak or suffered from severe methodological flaws, which limited the researchers’ ability to draw causal inferences about the effectiveness of developmental education courses (Bailey et al., 2013; Calcagno & Long, 2008; Martorell & McFarlin, 2007; Martorell & McFarlin, 2010). To address this research shortcoming, a group of scholars focused on conducting a number of different studies utilizing experimental and quasi-experimental methods to try and draw causal relationships between participation in developmental math courses and desired outcomes (Bailey et al., 2013).

The most common assessment provided by these researchers is that developmental math courses are ineffective in helping students (Bailey et al., 2013; Calcagno & Long, 2008; Martorell & McFarlin, 2007; Martorell & McFarlin, 2010). One of the more popular methodologies employed in researching the influence or causal relationship for developmental math and student outcomes is the regression discontinuity (RD) design, which compares students just above and just below the cutoff line for developmental courses (Bailey et al., 2013). The intention of the RD design is to examine the outcomes of statistically similar students to see if there is an added benefit to taking developmental math courses while maintaining a robust sample. Bailey and colleagues (2013) maintain that RD studies are superior to other methodologically sound studies using propensity score matching because RD studies do not require perfect matches for comparison and therefore do not discard a large portion of the sample as studies using propensity score matching tend to do.

**Critique.** However, these more rigorous methodologies have been criticized by some researchers. The most direct critique of this body of research was published by Goudas and Boylan (2012) in an article titled “Addressing Flawed Research in
Developmental Education.” In their article, Goudas and Boylan (2012) called into question many of the assumptions, conclusions, and even intentions of researchers utilizing the regression discontinuity methodology. This critique highlights how contentious and politically charged the debate is. In their response to this article Bailey et al. (2013) fairly and accurately sum up Goudas and Boylan’s (2012) critique by stating:

Alexandros Goudas and Hunter Boylan (2012) aimed several criticisms at this body of work, with the key claims being that: (a) we unfairly portray developmental education as ineffective because it does not lead to outcomes better than those of college-ready students; (b) we ignore several studies showing positive results; and (c) we overgeneralize from results that are only valid for students near the developmental cutoff scores. These three claims are woven into a broader critique that we have ”cherry picked” negative results, neglected methodological problems with the studies yielding such results, and ignored positive results in order to advance our own reform agenda. (p. 18)

Goudas and Boylan’s (2012) account implies that the researchers who claim that developmental math courses are ineffective are confused, intentionally misleading, or misinterpreted. Bailey et al. (2013) addressed the three main criticisms made by Goudas and Boylan (2012) and provided a strong argument for accepting the literature base that has shown developmental education needs to be redesigned and that current outcomes for students in developmental math classes have been and are destined to be poor.

Claim a. Goudas and Boylan (2012) introduce their first claim by arguing the purpose of developmental education is to help students with deficient academic skills prepare to be successful in college. So, researchers should not be looking for positive
outcomes, but rather similar outcomes to those who did not take developmental math courses (Goudas & Boylan, 2012). Goudas and Boylan (2012) insisted that if students who complete developmental math courses have similar outcomes to those that were not required to take them, then developmental math courses are working as intended.

Bailey et al. (2013) maintained, however, that Goudas and Boylan (2012) would be correct only if the researchers were comparing dissimilar students. The regression discontinuity studies in particular and other recent research on developmental education, in general, have focused on comparing statistically similar students. Thus, if developmental math courses are effective they should show evidence of producing some positive outcomes for the student participating in these courses. If there are no positive outcomes, then the students would have fared the same whether or not they took the developmental course. If students would have the same outcomes whether or not they took developmental coursework, there is no need for community colleges to invest in developmental education or for students to waste their time and financial aid participating in them (Bailey et al., 2013).

Claim b. In their second claim, Goudas and Boylan (2012) listed several articles that were left out of the discussion by RD researchers. Bailey et al. (2013) explained that some were not included because they focused on students at 4-year colleges rather than community college students, had methodological problems because they compared students who are not equivalent, or did not fundamentally change the overall assessment of developmental math courses.

Claim c. Goudas and Boylan’s (2012) last claim is that RD research is more reliable for students near the cutoff for developmental math courses. Bailey et al. (2013)
concede that Goudas and Boylan’s third claim is correct when looking at individual studies, but that their criticism loses potency when one looks at RD studies as a body of research because different researchers looked at developmental math students at different cutoff points. By utilizing different cutoff points, RD research provides data about outcomes for students at all different academic levels.

**Summary.** This debate in the developmental literature is important because the body of RD research that Bailey et al. (2013) advocate for has major implications for community colleges and their need to change developmental math offerings. Therefore, Goudas and Boylan (2012) are right when they state that the research is profoundly influencing community college policy and programming nationally. Yet, Bailey et al.’s (2013) responses to Goudas and Boylan (2012) is equally important because it clarifies and strengthens the argument for using this body of research which community colleges and systems, such as the VCCS, used as their rationale for making policy and programming decisions to redesign developmental math courses. Based on this debate, I agree with the arguments of Baily and colleagues (2013) and their assessment that developmental education needs to be redesigned.

**Developmental math research.** When looking at the developmental math literature with respect to the VCCS developmental math redesign, I think that it is important to examine the literature in two different timeframes. The first set of research reviewed includes studies that were available before the redesign was started, whereas the second batch of research reviewed is comprised of the studies that emerged as the redesign was underway. Recall, the VCCS developmental math redesign began in 2009. An overview of effects of developmental math on student outcomes in general highlights
the need to redesign developmental math courses. Because of the debate between Goudas and Boylan (2012) and Bailey et al. (2013), I have chosen to include studies that they both cite as being important. I agree with Bailey et al.’s (2013) assertion that the added pre-redesign studies which Goudas and Boylan (2012) suggested Bailey et al. (2013) ignored do not change the overall picture of developmental education’s effectiveness.

Table 2.1 summarizes the findings of national studies completed prior to the redesign that measured the impact of developmental education on student outcomes. In aggregate, these researchers found four instances of developmental education having positive effects on student outcomes, 10 negative effects on outcomes, and eight null or non-effects on student outcomes. These findings align with the assertions of Bailey and colleagues (2013) about developmental courses being ineffective, as the research reported in Table 1 only 18% of researched developmental math programs provide evidence of creating positive outcomes for students.

Table 1

<table>
<thead>
<tr>
<th>Authors</th>
<th>Positive</th>
<th>Negative</th>
<th>Null</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attewell et al. (2006)</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Bettinger &amp; Long (2005)</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Calcagno &amp; Long (2008)*</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Martorell &amp; McFarlin (2007)*</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

*Regression Discontinuity Studies

The second group of studies summarized in Table 2 includes those that were conducted after the start of the redesign in 2009. This group of studies essentially
reinforces what the previous studies showed; that there is little evidence that traditional developmental math courses positively affect student outcomes.

Table 2

<table>
<thead>
<tr>
<th>Authors</th>
<th>Positive</th>
<th>Negative</th>
<th>Null</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boatman &amp; Long (2010)*</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Dadgar (2012)*</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Crisp &amp; Delgado (2014)</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Martorell &amp; McFarlin (2010)*</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

*Regression Discontinuity Studies

In the post-developmental math redesign body of literature, there are no positive effects, only eight negative effects, and seven null effects. These studies as a whole effectively show that to date, developmental math courses do not produce many positive effects in comparison to the number of negative and null effects. Only four of the total reported effects were positive compared to the 18 negative and 15 nulls. In aggregate, developmental math courses had a positive effect on only 11% of the outcomes measured by researchers.

The results highlighted in Tables 1 and 2 represent studies that focused exclusively on community college students (Bettinger & Long, 2005; Calcagno & Long, 2008; Crisp & Delgado, 2014; Dadgar, 2012) and studies directly related to community college students including 2-year and 4-year students (Attewell et al., 2006; Boatman & Long, 2010; Martorell & McFarland, 2007, 2010). These research studies draw from national data sets (Attewell et al., 2006; Crisp & Delgado, 2014) and statewide data sets from Florida (Calcagno & Long, 2008), Ohio (Bettinger & Long, 2005), Tennessee
(Boatman & Long, 2008), Texas (Martorell & McFarlin, 2007, 2010), and Virginia (Dadgar, 2012) giving this body of literature a very diverse sample. Thus, the results should be highly generalizable due to the relative similarity in findings.

**Developmental math pipeline.** Some researchers have chosen to focus on the developmental math sequence and how many students are unable to finish a college-level math course. The Community College Research Center (Jaggers & Stacey, 2014) tracked students who tested into three developmental math courses below college-level. They found that many students did not enter into or complete the developmental sequence. The conclusions of the CCRC are illustrated in Figure 1 (Jaggers & Stacey, 2014).

---

**Figure 1.** Student Progression Through the Developmental Math Sequence. Adapted from “What We Know About Developmental Education Outcomes,” by S. S. Jaggers and G. W. Stacey, 2014, Community College Research Center, p. 5.
In Figure 1, it is clear to see that attrition happens at each level of the developmental math sequence so that in the end only 11% of students who started out in the lowest level of developmental math actually pass a college-level math course. It is important to note that even though students leave the developmental pipeline at each level, it does not mean that these students necessarily left the college. Rather, these students were unable or unwilling to continue working through the developmental math pipeline. They may work on other coursework that does not have math as a prerequisite or they may choose to leave the college. However, if they stay, the longer students avoid developmental math the longer it will take to graduate in programs with math requirements, which can have a negative effect on completion (Bailey, 2009). Hern (2012) labeled these transitions between developmental math courses where students have an option to leave the developmental pipeline exit points. Researchers have demonstrated that when there are more exit points, or courses, along the developmental math pipeline, more students leave (Bailey et al., 2010; CCA, 2012; Hern, 2012). Many of the proposed developmental math reforms, including those adopted by the VCCS, are intended to eliminate the leaky pipeline problem by eliminating exit points in the developmental math sequence.

Developmental math interventions. One practical problem in conducting a system-wide developmental math redesign is that even though there is a great deal of consensus concerning the need to improve current developmental math offerings, there is little consensus on how this should be done (Bailey, 2009). Part of the issue in building consensus around specific developmental math interventions is that there is a lack of rigorous research confirming causal connections between specific interventions and their
proposed outcomes (Bailey, 2009; Rutschow & Schneider, 2011). Rutschow and Schneider (2011) completed a literature review of developmental interventions and determined that there were four different categories of promising interventions.

Categories of promising interventions. Rutschow and Schneider’s (2011) first category involved interventions aimed at helping students avoid developmental education. Interventions which avoid developmental education in this category included dual enrollment, early assessment programs, and summer bridge programs. Their second category consisted of interventions intended to accelerate students’ progress through the developmental sequence (Rutschow & Schneider, 2011). Interventions that accelerate students’ progression included: fast-track courses, modularized courses, and mainstreaming. Their third category involved interventions focused on contextualized instruction (Rutschow & Schneider, 2011). Interventions which contextualized instruction included: contextualized learning, vocational programs, and learning communities. Rutschow and Schneider’s (2011) fourth category was comprised of interventions that used supplemental supports to advance students’ academic achievement. The interventions that provided supplemental supports included: tutoring and supplemental instruction, advising, and student success courses.

Rutschow and Schneider (2011) concluded that more research needs to be conducted concerning the effectiveness of individual interventions, but the current research highlighted that:

a) there was little evidence to suggest that interventions intended to help students avoid developmental education were successful regardless of intervention type;
b) acceleration strategies still require more evaluation, but there has been some rigorous research supporting mainstreaming and all acceleration strategies show promising trends in student achievement;

c) interventions focused on contextualizing course content show mixed results because learning communities are not very effective, and even though there is evidence that many vocational contextualized learning programs work well, Rutschow and Schneider (2011) question whether these strategies will translate well into programs that focus on preparing students for college-level math; and,

d) while there have been studies supporting positive benefits associated with student support services, these interventions’ effects are limited and are unlikely to bring about a dramatic shift in student outcomes.

Drawing from their reviewed literature, Rutschow and Schneider (2011) concluded that:

Research to date clearly demonstrates that minor modifications in developmental education programs are insufficient for producing dramatic improvements in student achievement. Given this, educators, policymakers, and researchers should continue to question the traditional developmental course sequence and should turn to more innovative efforts aimed at transforming the educational experience of academically underprepared students. (p. 67)

Rutschow and Schneider’s (2011) literature review provides evidence that there is broad consensus among a number of researchers concerning the ineffectiveness of the traditional developmental math sequence.
**Redesigned developmental math courses.** Currently, there are more than 34 states involved in critically rethinking and restructuring their developmental math offerings (Achieving the Dream, 2014; CCA, 2012). Redesigning developmental math courses is one way that community colleges and community college systems have engaged in changing their theory of the business by trying to improve student outcomes in developmental math courses (Developmental Mathematics Redesign Team [DMRT], 2010; Hern, 2012).

This type of intervention assumes, as researchers have suggested, that developmental math courses are currently not producing the positive outcomes we should expect (Jaggers & Stacey, 2014; Martorell & McFarlin, 2007; Martorell & McFarlin, 2010). An important objective of most developmental math redesign initiatives is to accelerate students through the developmental math sequence, which Rutschow and Schneider (2011) found to show positive trends in students outcomes. To accelerate students through the developmental math sequence the curriculum needs to be aligning with students’ math needs, and the developmental math sequence needs to be restructured. Colleges who are redesigning their developmental math courses usually take one of two different approaches to restructuring the developmental math sequence by either compressing it or modularizing it.

**Summary.** Developmental education has been a part of higher education for a long time (Attewell et. al., 2006). Though developmental education debate has been heated, there is a compelling body of research that developmental math courses, in particular, need to be redesigned if the 60% of students who enter community colleges needing math remediation are going to have a chance at completing their degrees (Bailey
et al., 2013). After reviewing the research on the many promising interventions colleges are using to improve developmental math outcomes, Rutschow and Schneider (2011) determined that acceleration strategies show the most promise in improving student outcomes. However, this body of literature concerning developmental math does little to help change agents in community colleges implement change. As Goudas and Boylan (2012) suggested, interventions work differently at colleges based on how they are implemented. This study sought to address this gap in the literature by focusing on the change process during implementation. By studying the change process leaders can collect empirical evidence concerning how their implementation is proceeding and make adjustments if necessary.

**VCCS Developmental Math Redesign**

The Redesign was a part of the VCCS Chancellor’s intentional push to improve student success. When Glenn Dubois became chancellor of the VCCS 2001, he asked all 23 college presidents in the system to outline their strategic plans: he got 23 different answers and none focused on student success (Asera, 2011). Dubois shared: “The fact that only one in six students was graduating within three years seemed not to be cause for alarm” (Asera, 2011, p. 1). The lack of focus on student success was obviously a problem in an educational climate that is increasingly emphasizing the importance of improving student outcomes such as graduation. With the development of Achieve 2015, the system’s strategic plan, student success was placed at the forefront by setting ambitious goals for improving college completion state-wide (Asera, 2011).

To enact a system-wide cultural change, the chancellor, and his staff intentionally focused on publishing data that clearly identified problems before any committees were
formed to work on solutions (Asera, 2011). The redesign process was participatory and started with a series of town hall meetings held across the VCCS (Asera, 2011; Kalamkarian, Raufman & Edgecombe, 2016). Table 3 provides a timeline of the major events of the Redesign.

As shown in Table 3, the first major step toward redesigning developmental math was the creation of the Developmental Education Task Force (DETF) to research and assess the state of developmental education within the system (DETF, 2009; Kalamkarian et al., 2015).

Table 3

Timeline for the VCCS Developmental Math Redesign

- **September 2008**: Developmental Education Taskforce convened
- **September 2009**: Developmental Education Task Force report *The Turning Point* calls for system-wide redesign of developmental education
- **August 2010**: Developmental Math Redesign Team report, *The Critical Point*, recommends modularization of all developmental math courses
- **Spring 2011**: VCCS pilot tested new math placement test questions with 5,000 students
- **February 2011**: Developmental Math Curriculum team publishes *Curriculum Guide for Developmental Mathematics*
- **Fall 2011**: Pilot of new developmental math curricula and programs at two colleges
- **November 2011**: Virginia Placement Test- Math implemented
- **Spring 2012**: Colleges implement developmental math redesign

*Note.* Adapted from “Innovation at Scale: How Virginia Community Colleges are Collaborating to Improve Developmental Education and Increase Student Success” by R. Asera, 2011; Jobs For the Future, p. 4 and “Statewide Developmental Education Reform: Early Implementation in Virginia and North Carolina” by Kalamkarian Raufman, & Edgecombe, 2015, Community College Research Center, p. 5.
The Developmental Education Task Force. The DETF provided the rationale for change and consisted of 10 college administrators, three faculty, one K-12 administrator, one classified staff, and four system office members: they concluded that developmental math courses needed to be redesigned. This group made a number of recommendations that centered around three umbrella goals which included: (a) reducing the need for developmental education, (b) decreasing the time required to complete developmental coursework, and (c) improving the number of developmental students that graduated or transferred in four years from one in four (25%) to one in three (33%) (DETF, 2009). The research that the DETF based their recommendations on painted a vivid picture: the majority of students needed developmental education. Particularly concerning was the large percentage of students in need of developmental math courses and the low percentage that completed their developmental math sequence.

According to the data used by the DETF (2009), nationally more than 60% of new community college students are required to take developmental math courses based on their placement test scores. Of those, only 18% complete their required developmental math sequence and moved on to take a college math course. Developmental math students make up the majority of students entering community colleges across the nation and in Virginia. In Virginia during the fall 2004 semester, 52% of new students were required to take a developmental math course and 36% completed their developmental math sequence and enrolled in a college math course (DETF, 2009). Even though the data for VCCS students was better than the national averages, the DETF determined that there was still considerable room for improvement. Based on the DETF’s suggestions, the VCCS decided to move ahead with redesigning developmental education across the
system and the Developmental Math Redesign Team (DMRT) was formed to make recommendations for redesigning developmental mathematics.

**The Developmental Math Redesign Team.** The DMRT operated as the guiding coalition (step two in Kotter’s 2012 model) in the developmental math redesign and consisted of eight teaching faculty, seven administrators, and four executive leaders, and six system Office staff. The four system office staff members from the DETF and one math faculty member were also involved in the DMRT. They determined that the curriculum needed to be changed to match the content that students needed to be successful in college math. Previous developmental math courses were designed to mirror high school curriculum, which the DMRT considered to be inappropriate. Rather, they decided to define what is required for students to be successful in college math and build the curriculum around those necessary skills (DMRT, 2010). The observation that impacted their recommendations most was that the traditional three-course sequence of developmental math was broken. The following list summarizes the major recommendations of the DMRT:

- that the developmental math curriculum should be modularized and divided into units so that students only received instruction on the math content that they needed;
- a new web-based adaptive placement test should be developed to better assess what content developmental math students will need; and,
- each college would choose the delivery mode they feel best supports the developmental math program while incorporating mathematics software to enhance student learning. (types of proposed developmental math delivery
methods included classroom, hybrid, and online options). (DMRT, 2010, p. 3)

All three recommendations were adopted. A Developmental Math Curriculum Team (DMCT) was created to develop the outcomes, map the content of the redesigned developmental math curriculum, develop curricular materials; and address issues associated with implementing the redesigned curriculum.

The Developmental Math Curriculum Team. The DMCT consisted of 21 math faculty, three developmental math faculty, and one administrator. Three of the faculty members from the DMRT were included in the DMCT. The new developmental math curriculum developed by the DMCT divided all of the developmental mathematics content into nine different Math Essentials (MTE) units or modules. The units include:

1. MTE 1: operations with positive fractions;
2. MTE 2: operations with positive decimals and percents;
3. MTE 3: algebra basics;
4. MTE 4: first degree equations and inequalities in one variable;
5. MTE 5: linear equations, inequalities, and systems of linear equations in two variables;
6. MTE 6: exponents, factoring, and polynomial equations;
7. MTE 7: rational expressions and equations;
8. MTE 8: rational exponents and radicals;

(DMCT, 2011, p. 2)
The DMCT determined that the math skills in the MTE units would provide underprepared students with the foundation necessary to be successful in any VCCS program of study.

**Placement in MTE units.** Two factors determine how many and which MTE units a student will have to complete; the student’s test results on the Virginia Placement Test (VPT) and their chosen program of study. All students are required to take the math VPT (unless they completed a college-level math course at any time or received SAT or ACT scores within the last two years which exempt them from testing). Testing usually happens after applying to the respective VCCS College, but before registering for classes.

The VPT progresses a student through different tests that cover all nine units of developmental math and can continue through calculus. The VPT ends when the student is unable to answer a satisfactory percentage of questions right on a given test. After completing the math VPT, students meet with an advisor who explains their scores. The advisor discusses options for selecting a program of study. Advisement in VCCS colleges differs by campus, and the advising formats range from centralized advising models in one-stop-shops to decentralized models housed in disciplinary divisions. Advisors can be professional advising staff or faculty members depending on the college.

Students are not required to complete coursework for the units they pass on the VPT. However, different programs of study require different numbers of MTE units. For example, some programs of study require MTE units one – three (usually non-STEM AAS programs), whereas others require MTE units one – five (AA and some AAS programs), or all nine MTE units (AS programs, and STEM AAS programs). Each MTE unit was designed to be completed in four weeks.
Developmental math courses. VCCS colleges have two different registration and delivery options for developmental math courses. The MTE option allows students to register for a specific unit in a four-week format with traditional instruction lead by a developmental math faculty member. Students can register for up to four of the MTE courses in a semester. The MTE courses are homogenous. For example, if a student registered for MTE 1, all of the students in that course would be working on the same course content (operations with positive fractions). With the MTE courses, a student can potentially complete four units of developmental math in a semester as long as they pass each of the MTE courses.

The second option is the Math Technology-based (MTT) shell course. MTT courses are offered in an MTT 1, MTT 2, MTT 3, MTT 4 option. The number after the MTT prefix denotes the number of units the student has registered for. MTT courses are heterogeneous because not all students are working on the same MTE course content at the same time. For example, one student may be working on unit one, two, four, and six based on their VPT math placement and another may be working on units three, four, five, and six. In this format, students receive technology-based instruction. Students attend class and work on homework, quizzes, and tests on computer software instead of receiving traditional instruction like in the MTE courses. MTT instructors are present to help answer students’ questions and provide individualized attention to students who need help with coursework.

The benefit of the MTT format is that it provides the student flexibility with the pace of their learning. For example, in an MTE 1 course, students are all working on the same course content and need to pass the course in four weeks to move onto the next
MTE course they need. If a student does not pass the course in the four weeks they will be required to retake it to move on to the next unit. However, the MTT course allows the student to spend more or less time on a specific MTE unit, the only constraint is the length of the shell course. The length of an MTT course is determined by the number of units the student has registered for. Like the MTE courses, students are given four weeks per unit they register for. So, if a student registers for and MTT 1 course it is four weeks, an MTT 2 course is eight weeks, an MTT 3 course is 12 weeks, and an MTT 4 course is 16 weeks. However, within the total length of the MTT course, there is more flexibility than in the MTE course.

In an MTT course, students only get credit for the units they complete by the end of the course. The courses are pass-fail and to get a passing grade, students need to pass the post-tests for the number of units they registered for in the MTT course. However, even if a student does not pass the number of units for which they registered they still get credit for the units within the course they pass. For example, if a student was registered for an MTT 3 class and needed to complete MTE units seven, eight, and nine they would need to complete all three units to get a passing grade for the MTT 3 course. If the student was able to complete units seven and eight, but not unit nine, they would technically fail the course. However, rather than having to retake the same course with some of the content that the student was able to master, the student would still get credit for passing units seven and eight and would only need to retake unit nine.

Students are also able to complete more than four MTE units in a given semester if they are able. For example, if a student registers for MTT 4, they have 16 weeks to complete as much coursework as they are able. Even though they are only registering for
four MTE units and only paying for four MTE units, if they are able to complete their
four units before the end of the 16 weeks, the student is can move on and complete extra
units at no charge. Figure 2 provides a visual of how the shell courses work.

---

*Figure 2.* Examples of MTT Shell Courses. Adapted from “Statewide Developmental
Education Reform: Early Implementation in Virginia and North Carolina” by
Kalamkarian Raufman, & Edgecombe, 2015, Community College Research Center, p. 10.

---

**Developmental math outcomes.** Since completing the redesign, the VCCS
published a report on the outcomes (Office of Institutional Research & Effectiveness,
2014) and another more recent article has been published that shows evidence of positive
outcomes associated with the redesign (Edgecombe, 2016). Edgecombe (2016) summed up the state of outcomes assessment regarding the redesign by stating:

Although rigorous evidence on whether the developmental education redesign
improved student outcomes is not yet available, descriptive analyses of early
outcomes conducted by the Community College Research Center, in partnership
with the VCCS, suggest that fewer students placed into developmental education
and more students enrolled in and successfully completed college math and English courses after the redesign. (p. 40)

The results of both studies are included in Table 4.

Table 4

<table>
<thead>
<tr>
<th>Source</th>
<th>Activity</th>
<th>Student Population</th>
<th>Pre-redesign</th>
<th>Post-redesign</th>
<th>+ Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edgecombe (2016)</td>
<td>Placement in developmental math</td>
<td>First-time-in-college-students</td>
<td>87%</td>
<td>57%</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Enrolled in college math within one year</td>
<td>College-math-placed-students</td>
<td>11%</td>
<td>29%</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Completed a college math course with a C or higher</td>
<td>College-math-placed-students</td>
<td>8%</td>
<td>18%</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Developmental math enrollment</td>
<td></td>
<td>36.8%</td>
<td>30.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Office of Institutional Research &amp; Effectiveness (2014)</td>
<td>Attempted college math</td>
<td></td>
<td>36%</td>
<td>40%</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>58,078</td>
<td>68,854</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Completed gatekeeper math course</td>
<td>First-time-in-college-students (program placed)</td>
<td>38,667</td>
<td>45,330</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Passed college math on 1st attempt</td>
<td></td>
<td>61%</td>
<td>59%</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Passed college math eventually</td>
<td></td>
<td>71%</td>
<td>70%</td>
<td>No</td>
</tr>
</tbody>
</table>

As the table indicates, Edgecombe (2016) showed that after the redesign fewer first-time-in-college-students placed into developmental math, and that students who
placed into college math were more likely to enroll in college math and pass it. The VCCS IR Office report from 2014 also showed a decrease in developmental math enrollment, an increase in the number and percentage of students attempting gatekeeper math courses, and an increase in the number of students passing gatekeeper courses. However, the Office of Institutional Research & Effectiveness (2014) also showed that even though the number of students who passed a gatekeeper course improved, the percentage of students passing gatekeeper courses decreased slightly. Edgecombe (2016) provided data on completion of gatekeeper courses for students that tested out of developmental math, but not those who completed developmental math. Thus, there is no way to know from Edgecombe’s (2016) analysis whether or not the trends published by the VCCS regarding students who completed redesigned developmental math courses have improved in the last few years.

**HB 1184.** In the 2012 legislative session, HB 1184 was passed which requires local school boards and community colleges to work together to ensure that dual enrollment students have a pathway to complete an associate’s degree or certificate while in high school (Virginia, 2012). Even though this was not part of the developmental math redesign, it is important to note because its implementation was impacted by the developmental math redesign.

For students to participate in dual enrollment they have to be college ready. This requires them to place into college level English on the English VPT (unless exempted based on PSAT, SAT, or ACT scores). Students are also required to take the Math VPT (unless exempted by the Algebra SOL, PSAT, SAT, or ACT) to participate in dual enrollment, but are only required to place into developmental math. However, this can be
problematic because students need to complete at least one college-level math course to complete an associate’s degree or certificate, but they are not allowed to complete developmental coursework while in high school.

The rationale for excluding high school students from taking developmental coursework is that it is high school level material and that if students need instruction in high school content they should be getting in their high school. This rationale makes sense since the state supplements community college tuition. Taxpayers should not have to subsidize students’ high school level education at both the high school and the community college. Therefore, you potentially have students that can participate in dual enrollment but not be able to complete a degree or certificate and these students are directly impacted by the developmental math redesign because they may be required to take the VPT.

**Summary.** Over a few years, the VCCS was able to develop the Virginia Placement Test to better place students in the developmental math content they need and redesign the curriculum, content, and delivery method of developmental courses to ensure that students were not required to take extra developmental math. The intention of this redesign was to speed up students’ movement through the developmental pipeline and improve graduation rates and transfer rates (DETF, 2009). The VPT and redesigned developmental math courses were then implemented at all 23 colleges across the state. This process was a large undertaking; unprecedented in its size and scope (Asera, 2011). The purpose was to improve graduation and transfer rates (DETF, 2009). The changes made in the redesign, particularly the creation of the VPT, also impact dual enrollment
students and potentially their ability to complete degrees and certificates while in high school.

What the process does not tell us is how those responsible for implementing the redesigned developmental math courses, math faculty on the all 23 campuses, perceived the process. The fact that the Redesign was so large in size and scope make it excellent for studying how faculty perceived the process and should provide valuable data to leaders within the VCCS about how the Redesign implementation was perceived by faculty throughout the system and at individual colleges. Because Virginia was a pioneer in redesigning developmental math system-wide at the 23 VCCS colleges, other community colleges and systems can learn from the VCCS’s experience.

**Change Theory**

Undertaking a large scale change initiative such as redesigning developmental mathematics is audacious and risky. The change process requires a large investment of time and money, and it is often difficult to achieve desired results. As noted above, researchers suggest that between 50% and 80% of change initiatives fail to meet expectations (Black, 2013; Kotter, 2012). There are many reasons that change initiates fail to accomplish their goals; in summary, failure is usually linked to change initiates being poorly conceived, poorly implemented, or both (Kezar, 2014; Kotter, 2012). For change to be meaningful, it needs to be second-order change. The Redesign certainly represents changes that are both cultural and structural, which align with second-order change.

**Kezar’s change theory summary.** Many researchers have looked at how organizations change and developed their own analysis of what a successful change
process looks like. Kezar’s (2014) research has focused on the magnitude of change and the different theories that have been proposed to explain change over time. She suggests that there are two magnitudes of change first-order and second-order change. First-order change is incremental and happens slowly over time. Second-order change involves changing the “values, assumptions, structures, processes, and culture” (Kezar, 2014, p. 49) of an organization. Kezar (2014) synthesized over 30 years of change literature and determined that there are six different categories of change theories or schools of thought which include scientific management theories, evolutionary theories, social cognition theories, cultural theories, political theories, and institutional/neo-institutional theories (Kezar, 2014). Table 5 provides a detailed overview of the six schools of thought.
### Table 5

**Characteristics of the Six Schools of Thought related to Change**

<table>
<thead>
<tr>
<th></th>
<th>Scientific Management</th>
<th>Evolutionary</th>
<th>Political</th>
<th>Social Cognition</th>
<th>Cultural</th>
<th>Institutional and Neo-Institutional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why Change Occurs</strong></td>
<td>Leaders; internal environment</td>
<td>External environment</td>
<td>Dialectal tension of values, norms, or patterns</td>
<td>Cognitive dissonance; appropriateness</td>
<td>Response to alterations in human environment</td>
<td>External pressure combined with internal norms</td>
</tr>
<tr>
<td><strong>Process of change</strong></td>
<td>Rational; linear; purposeful</td>
<td>Adaptation; slow; gradual; non-intentional</td>
<td>First-order, then occasional Second-order; negation and power</td>
<td>Learning; altering paradigms or lenses; interconnected and complex</td>
<td>Long-term; slow; symbolic process; non-linear; unpredictable</td>
<td>Exchange of adaptation and schemas, norms</td>
</tr>
<tr>
<td><strong>Outcomes of change</strong></td>
<td>New structures and organizing principles</td>
<td>New structure and processes; first-order</td>
<td>New organizational ideology</td>
<td>New frame of mind</td>
<td>New culture</td>
<td>New schema and norms</td>
</tr>
<tr>
<td><strong>Type of change</strong></td>
<td>Planned; organizational; first-order</td>
<td>Unplanned, external</td>
<td>First- and second-order; organizational and enterprise</td>
<td>Second-order and more individual in focus</td>
<td>Second-order; organizational; planned and unplanned</td>
<td>Unplanned; organizational changes tied to external environment</td>
</tr>
<tr>
<td><strong>Criticisms</strong></td>
<td>Lack of human emphasis; deterministic quality</td>
<td>Lack of human emphasis; deterministic</td>
<td>Deterministic; lack of environmental concerns; little guidance for leaders</td>
<td>Deemphasizes environment; overemphasizes ease of change; ignores values and emotions</td>
<td>Impractical to guide leaders; focus on universalistic culture; mostly untested</td>
<td>Hard to document external forces; does not account for agency; often overemphasizes lack of change or static nature</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>Environmental emphasis; systems approach</td>
<td>Environmental emphasis; systems approach</td>
<td>Change not always progressive; irrationality; role of power</td>
<td>Emphasizes socially constructed nature; emphasis on individuals; habits and attitudes as barriers</td>
<td>Context; irrationality; values and beliefs; complexity; multiple levels of change</td>
<td>Attention to macro context; norms and their power; irrationality; fields and complexity of forces</td>
</tr>
</tbody>
</table>

**Scientific management.** Scientific management theories are drawn mainly from business literature’s models of change. Some of the assumptions of scientific management theories Kezar (2014) identified include:

- organizations have a purpose and adapt to fulfill that purpose;
- change is driven by leaders and stakeholders that identify a need to change;
- the need for change is internal;
- change is productive and goal oriented; and,
- change agents have agency.

In general, the change process is seen as linear, rational, and highly dependent on organizational leaders. Some of the limitations of scientific management theories that Kezar (2014) identified include:

- organizational context is ignored because change strategies are not thought of as being context specific;
- leaders’ positional power and authority are over exaggerated;
- organizational politics and change agents’ irrational behavior are ignored; and,
- barriers to change are deemphasized.

Though there are some significant limitations to scientific management theories of change, Kezar (2014) suggested that those theories offer many different strategies for leaders and change agents to employ in organizational change efforts. “The tactics offered range from strategic planning, providing incentives and rewards, restructuring [or redesign] efforts, implementing professional development and support, creating a collective vision, preparing ongoing Communication and influence vehicles, and engaging in feedback and evaluation” (Kezar, 2014, p. 27).
Scientific management is set apart from other schools of thought because of its assumptions about change being possible and constructive – based on individual actors choosing to engage in the change process – and the number of different strategies it provides for leaders and change agents to use.

**Evolutionary.** Evolutionary theories are drawn from biological concepts and natural systems. Kezar (2014) identified many of the assumptions of this school of thought which include:

- change is caused by organizational circumstances, situational variables, and the environment;
- social systems are varied, dependent on each other, and intricate;
- organizations are often unable to anticipate and manage change; and,
- change is a result of external factors that influence organizations to change to survive.

Evolutionary theories are not process oriented because change is largely seen as unplanned, and unmanageable.

Kezar (2014) also identified limitations of evolutionary theory, which include:

- economic forces are emphasized more than other external forces;
- leadership’s role in change initiatives is deemphasized;
- individuals’ agency are ignored; and,
- it provides no practical strategies for change agents to employ.

What sets evolutionary theory apart from other schools of thought is the focus on organizations being interconnected systems that are influenced by external factors. This
perspective also emphasizes the unplanned nature of change and how an organization’s environment influences its behavior.

**Political.** Political theory focuses on opposition and tension within an organization created by competing value systems and the inevitable conflict of those systems (Kezar, 2014). Some of the assumptions inherent in political theory include:

- change occurs when opposing belief systems come into direct conflict with each other;
- conflict is a natural part of human interaction;
- leaders have important roles in social environments;
- collective action is a necessary part of change;
- conflict of opposing belief systems does not necessarily lead to a better organization;
- organizations are political institutions;
- not everyone has to be a part of the change process, it is assumed that many do not actively participate in the change process;
- social interaction is more important than the organization’s external environment; and,
- change is relationship based (Kezar, 2014).

The change process involves agenda setting, networking, identifying key power brokers in the organization, building coalitions, and other strategies that focus on building a power base to enact change. Some of the limitations of the political theory include:

- it ignores individual’s thought process;
- can misinterpret resistance or fear as conflict;
What sets the political school of thought apart from others is the focus on individual interaction, collective action, and belief systems that influence change. Like scientific management, because it focuses on human interaction and sees change as a process that is managed by change agents, it offers leaders and change agents many practical strategies for creating organizational change.

**Social cognition.** Social cognition theories are drawn from psychology and emphasize the importance of individuals’ thought processes. Kezar (2014) indicated that some of the assumptions inherent in this school of thought include:

- individuals can understand and make change by influencing cognition or individuals’ thought processes;
- individual learning and development are inherent in change initiatives;
- people unknowingly have beliefs that shape the way they see the world (aka paradigms, mental maps, mental models, schema, etc.);
- people’s beliefs are complex and influenced by prior experience;
- information that challenges beliefs can promote change;
- people are more likely to change beliefs if they receive feedback;
- people make logical leaps that mask problems;
- people continuously try to make sense of the world through experience and retrospection; and,
- people interpreting their environment differently interferes with the change process.
Social cognition theories see the change process as focused on how leaders influence the way that individuals think, interpret, and make sense of change. Limitations of social cognition theories include:

- an overly narrow focus on individuals that ignores environmental context and external factors influencing change;
- it ignores irrational and political behavior;
- and assumes that changing people’s beliefs and worldviews is easier than it is in practice. (Kezar, 2014)

What sets social cognition apart from the other schools of thought is the focus on individuals’ importance to the change process, and the differences in how they view and make sense of the organization, problems, and change. It also provides strategies for leaders trying to implement change.

**Cultural.** Cultural theory focuses on the aspects of an organization which makes up its culture including its history, rituals, and values. Kezar (2014) identified the following as assumptions of cultural theories:

- cultural change is a natural response to changes in an organization’s human environment;
- the process is long and slow;
- an emphasis on the symbolic nature of organizations;
- the importance of history and traditions;
- leaders use symbolic actions and metaphors as a catalyst for change;
- legitimacy is the main external force for change;
- cultural change is often overlooked;
• change strategies cannot clash with the underlying organizational culture and be successful; and,
• various groups interpret and experience culture differently.

Cultural theories characterize the change process as non-linear, irrational, unpredictable, ongoing, dynamic, and slow (Kezar, 2014). Change agents need to understand the history, context, and implicit values of the organization in order to ensure that change strategies do not clash with the current culture. Limitations of this school of thought include:

• it provides very little practical advice for managing change; and,
• when change is viewed as non-linear and long-term it is hard to facilitate (Kezar, 2014).

What sets cultural theories apart from other schools of thought is the emphasis on beliefs, history, values, and human nature of change.

**Institutional and neo-institutional.** Institutional theories are drawn from evolutionary and social cognition theories of change but are distinct enough to be considered a distinct school of thought (Kezar, 2014). Some of the assumptions that Kezar (2014) identified for the institutional/neo-institutional theories of change include:

• it questions whether colleges and universities have the agency and ability to change in the face of external factors and internal norms;
• colleges and universities change less often and more slowly than other organizations because of ingrained mission and social goals;
• change occurs when internal and external forces work together to force new ways of thinking and acting; and,
colleges and universities seek to preserve legitimacy and stakeholder support. 
In this school of thought, the change process mirrors the interaction of the organization’s evolutionary adaption and changes in individuals’ ways of thinking. Kezar (2014) identified the following limitations with an institutional/neo-institutional theory:

- evidence supporting the theories are hard to prove because they are either hypothetical or based on second-hand patterns;
- narrowly focuses on macro-level forces shaping organizations;
- overemphasizes the static nature or colleges and universities.

What sets this school of thought apart from the others is that it focuses on higher education institutions; the research supporting it has primarily sought to explain the behavior of colleges and universities. This school of thought is also the only one that has emerged from the interplay of two other theory categories.

**Summary.** What Kezar (2014) advocated for are change processes that draw from multiple theories or schools of thought. The idea is that each school of thought adds to the richness of our understanding of change and provides perspectives and strategies that other theories do not. Thus, using a multi-theory approach provides change agents and leaders a more nuanced and sophisticated change model that more appropriately mirrors the context and conditions necessary for change. What Kezar (2014) seemed to assume is that all theories of change fit nicely into one school of thought because she does not really address hybrid theories – theories that draw from multiple schools of thought – that others have proposed. Kotter’s (2012) change process represents a hybrid theory that takes into account multiple schools of thought.
Kotter’s change model. Kotter’s (2012) model draws from multiple areas that Kezar (2014) identified; specifically, the scientific management, evolutionary, social cognition, cultural, and political schools of thought. This foundational orientation is important because Kezar (2014) stressed the importance of using multiple schools of thought to address change in organizations. The overriding school of thought evident in Kotter’s (2012) change model is scientific management because the steps are rational, linear, and involve leadership throughout the process. The evolutionary theory infused in Kotter’s (2012) model emphasizes how outside forces shape change. Kotter (2012) insists that the need to change and pace of change must increase due to the many macroeconomic and social factors inherent in today’s world. Alignment between Kotter’s (2012) and Kezar’s (2014) models of change are depicted in Table 6.

Table 6

| Alignment Between Kezar’s (2014) Schools of Thought and Kotter’s (2012) Model |
|----------------------------------|------------------|----------------|------------------|------------------|
| Kotter                          | Kezar            | Scientific Management | Evolutionary | Political | Social Cognition | Cultural |
| Model S&P                       |                  | X                      | X              |            |                 |         |
| Step One                        |                  |                       | X              |            |                 |         |
| Step Two                        |                  |                       | X              |            |                 |         |
| Step Three                      |                  |                       |                | X          |                 |         |
| Step Four                       |                  |                       |                | X          |                 |         |
| Step Five                       |                  |                       |                | X          |                 |         |
| Step Six                        |                  |                       |                | X          |                 |         |
| Step Seven                      |                  | X                      |                |            |                 |         |
| Step Eight                      |                  |                       |                |            |                 | X       |

Note. S&P = Structure and Philosophy

Social cognition. Four steps in Kotter’s (2012) model, Urgency (step one), developing the change vision (step three), Communication (step four), Empowerment
(step five), and short-term wins (step six) involve social cognition theory. Social cognition theory focuses on the need to change people’s paradigms or lens through which they view the change initiative. Change agents must think and feel that there is a need to change (Urgency). The vision needs to be clear and compelling enough for change agents to buy-in to the change initiative (developing the change vision). The vision needs to be conveyed in a way that change agents understand and buy-in to the what and the why of change (Communication). Change agents need to think and feel that they are able to make the proposed change happen (Empowerment), and believe that what they are doing is making a positive difference (short-term wins).

**Political.** Step two of the model involves forming a guiding coalition that has the expertise and political power to bring about change within an organization, using political theory. In the case of the redesign, this guiding coalition included DETF, DMRT, and DMCT.

**Scientific management.** Step seven of Kotter’s (2012) model includes restructuring and organizing in order to create more change. The specific focus is removing institutional barriers to change so that reporting lines and institutional incentives are aligned with the change initiative, not competing with it.

**Cultural.** Lastly, the final step in Kotter’s (2012) model involves anchoring changes in the institution's culture drawing from cultural theory. Kotter’s (2012) assumption is that if the change initiative has not become part of the culture of the institution, individuals will revert back to pre-change ways of acting and thinking once there seems to be little institutional support for the initiative.
**Summary.** Using multiple schools of thought, Kotter’s (2012) change framework is aligned with best practices from other change scholars strengthening it as a good choice for this study. Another reason Kotter’s (2012) change framework is a good fit for this study is the longevity of use of the model. Indeed, the book is based on over 15 years of the author’s consulting with hundreds of organizations – it is tried and true. Even though Kotter’s (2012) framework has traditionally been used in the private business sector, Kotter (2012) and Fullan (2001) suggested that business and education are becoming more similar and that theories concerning leadership and change that work well in one context are likely to work well in the other. However, the most compelling reason is that it provides the best framework for analyzing the change process that the VCCS used to complete the developmental math redesign because it aligns with the model they used to implement the redesign.

**Logic Model of the Redesign**

Kotter’s (2012) change model aligns better than other change frameworks with the VCCS’s Developmental Math Redesign. For example, the Redesign started with a sense of Urgency, the first step in Kotter’s (2012) model. Asera (2011) discussed how the Chancellor and the system office decided to publish data that clearly showed the need to focus on developmental education long before any formal committees were formed or mandates were made of colleges. Disseminating the data was enough to get important players across the system to come together and tackle the issue of developmental math. The next step the system took followed Kotter’s (2012) second step to establish a guiding coalition. According to the model, a guiding coalition needs to have members that
possess the expertise to challenge the change initiative and individuals with the political power to make things happen.

The system office intentionally included executive administrators from across the VCCS to show the importance of the initiative; the DMRT, in particular, was co-chaired by a current president and emeritus president to show its importance and provide support for the redesign (Asera, 2011). The DETF developed the vision that guided the work and individual visions of the DMRT and the DMCT, which accomplished the third step in Kotter’s (2014) model. The DMRT and DMCT also had content experts who helped refine the overall vision within the scope of their work and developed strategies to realize their recommendations. Kotter’s (2014) first three steps in the change model were apparent in the first part of the redesign represented by the inputs, and activities of the logic model, which lead to the outputs. See Figure 3.

The outputs of the logic model represent the ways in which the plan was intended to improve outcomes after being implemented at each of the 23 VCCS colleges. For this study, I was specifically interested in evaluating the implementation using faculty perceptions of Urgency, Communication, and Empowerment (Kotter’s (2012) steps one, four, and five). The reason for focusing on those steps was that they are necessary, according to Kotter (2012), for faculty to effectively implement change. Faculty need to think and feel there is a need to change (Urgency). Faculty need to understand the vision of the change initiative, and what they are expected to do (Communication), and faculty need to feel that they have the skills and abilities to successfully implement change (Empowerment). According to Kotter (2012), the three steps this study focused on are those that concentrate on making the implementation successful. Thus, the selection of
the model provides an opportunity to analyze and evaluate the implementation process from a faculty perspective. See the logic model in figure
Figure 3. Logic Model of the Developmental Math Redesign. Sources for the logic model include: “The Turning Point: Developmental Education in Virginia’s Community Colleges” by the Developmental Education Task Force,
Summary

Community colleges are a vital part of the U.S. system of higher education because they offer access to so many. Whether one supports the mission of community colleges or not, these institutions are still the vital entry point for the majority of low-income students and students of color (Dougherty, 1988; Mullin, 2012; NCES, 2015a). However, recent research suggests that community colleges are not necessarily living up to their claims about providing access to degrees and certificates (Brint, 2003). One part of the completion problem is so many students are required to take developmental math courses, but many are not able to make it through the sequence (Bailey, 2009; Bailey et al., 2013; Calcagno & Long, 2008; Martorell & McFarlin, 2007; Martorell & McFarlin, 2010).

If community colleges are going to live up to their claims about being gateways to social and economic mobility, they are going to have to help students succeed in developmental and college-level math. The VCCS developmental math redesign is one response to address this challenge and help improve student outcomes in developmental and college-level math. However, community colleges and systems are going to have to go one step further and focus on the change process to make sure that not only are the campuses implementing the redesign but what they are doing aligns with what we know about effective institutional change. By focusing on faculty opinions regarding three of Kotter’s (2012) steps, leaders in community colleges and systems can better understand how their change process is perceived, and make changes if necessary.
CHAPTER III: METHODOLOGY

The Virginia Community College System was created to provide more Virginians access to a college education that meets their needs. In the early 1960s, Virginia was lagging behind many other states in terms of the number of students that were receiving post-secondary education; community colleges were intended to reverse that trend and ensure the economic future of the state (Vaughn 1987).

The 1966 General Assembly, by passing legislation that would create a statewide system of comprehensive community colleges, took its biggest step in the democratization of post-high school education in Virginia. Virginian’s would be able to develop their talents, no matter where they lived. By calling for comprehensive colleges, the legislators acknowledged that, if their needs were to be met, the citizens must have a choice of what they studied in college. The legislators meeting in 1966 did not have to look far into the past to discover that the comprehensive community college was not a revolution, but another step in the evolutionary process of utilizing the talents of more and more citizens. (Vaughn, 1987, p. 34)

Context

Circa 2009, when the Developmental Education Task Force started its work, the VCCS served approximately 189,273 students at the 23 community colleges that make up the VCCS (SCHEV, 2016). Of those 189, 273 students 66.8% were White, 21.1% were Black, 5.8% were Asian or Pacific Islander, 5.7% were Hispanic, 1.1 % were Foreign,
0.6% were American Indian or Alaskan Native, and 0% were labeled Multi-Race (SCHEV, 2016). Approximately 52% of new VCCS students were placed into developmental math courses, with only 36% able to complete the developmental math sequence and pass a college-level math course (DETF, 2009). Virginia students are doing better in developmental coursework in comparison to the national averages; the DMRT (2010) found 70% of students nationally are required to take at least one developmental math course and only 14% are able to pass a gatekeeper college math course.

In 2015, the VCCS served fewer students (approximately 173,674 at the 23 colleges), but the student body was more diverse than in 2009. Approximately 58.6% were White, 20.2% were Black, 10.2% were Hispanic, 6.5% were Asian or Pacific Islander, 4% were Multi-racial, 1.9% were Foreign, and 0.4% were American Indian or Alaskan Native (SCHEV, 2016). Table 6 provides a side-by-side comparison of the demographics for the 2009-10 and 2015-16 academic years.

### Table 7

**Demographic Characteristics of the VCCS in 2009 and 2015**

<table>
<thead>
<tr>
<th>Year</th>
<th>N Students</th>
<th>White (%)</th>
<th>Black (%)</th>
<th>Hispanic (%)</th>
<th>Asian and Pacific Islander (%)</th>
<th>Multi-racial (%)</th>
<th>American Indian (%)</th>
<th>Foreign (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>189,273</td>
<td>66.87</td>
<td>21.1%</td>
<td>5.7%</td>
<td>5.8%</td>
<td>0.0%</td>
<td>0.6%</td>
<td>1.1%</td>
</tr>
<tr>
<td>2015</td>
<td>173,674</td>
<td>58.6%</td>
<td>20.2%</td>
<td>10.2%</td>
<td>6.5%</td>
<td>4.0%</td>
<td>0.4%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

*Note. From “E22: Fall Headcount: Trends in Race Ethnicity,” SCHEV. 2016*
The 23 colleges in the VCCS are spread throughout the state to ensure that all Virginians have access to postsecondary education within driving distance of where they live (Vaughn, 1987). Figure 4 shows how the VCCS is geographically organized and where each individual college is within the state of Virginia.
1. Blue Ridge CC  
2. Central Virginia CC  
3. Dabney S. Lancaster CC  
4. Danville CC  
5. Eastern Shore CC  
6. Germanna CC  
7. J. Sargent Reynolds CC  
8. John Tyler CC  
9. Lord Fairfax CC  
10. Mountain Empire CC  
11. New River CC  
12. Northern Virginia CC  
13. Patrick Henry CC  
14. Paul D. Camp CC  
15. Piedmont Virginia CC  
16. Rappahannock CC  
17. Southside Virginia CC  
18. Southwest Virginia CC  
19. Thomas Nelson CC  
20. Tidewater CC  
21. Virginia Highlands CC  
22. Virginia Western CC  
23. Wytheville CC

*Figure 4.* Map of the Virginia Community College System Service Areas. Retrieved from the Virginia Community College System website: [http://www.vccs.edu/about/where-we-are/college-locator/](http://www.vccs.edu/about/where-we-are/college-locator/)
Program Description

In 2009 the VCCS started the process of redesigning developmental math courses with the creation of the Developmental Education Task Force (DETF). The Task Force determined that there was sufficient evidence that the VCCS needed to redesign developmental math courses to improve graduation rates across the system. The redesign involved modularizing the developmental math content, creating the Virginia Placement Test to align with the new developmental math modules, mapping students’ developmental math requirements based on program pathways, and including technology-based pedagogical methods. During the Spring 2012 semester, the VCCS implemented redesigned developmental math courses. The developmental math redesign process and redesigned courses were explained in greater detail in Chapter 2.

Participants

The participants in this study included VCCS developmental math and math faculty because both were involved in the system-wide redesign process and both are involved in the implementation. Faculty are the ideal population for evaluating the change processes used during the redesign because they make up the operating core of the college’s developmental math programs (Mintzberg, 1980). Developmental math faculty are almost exclusively responsible for teaching students developmental math concepts, and they are the ones primarily responsible for implementing the redesigned developmental math courses. Math faculty also teach the students who make it through the developmental math sequence, so they directly work with the product of the redesign. However, at many institutions, there is overlap between math and development math
faculty with faculty teaching both. The perspectives of both faculty groups are important in evaluating the change process used during the implementation.

However, because of the specific time frame of the redesign, faculty participants must have been teaching at a VCCS institution sometime between fall 2011 and fall 2013. Currently, in 2016 there were approximately 943 math and developmental math faculty across the VCCS (Marina Bagreev, personal communication, March, 3, 2016). In order to ensure that all participants can accurately answer the survey questions, a question on the survey instrument will first ask if the faculty member taught during the timeframe of focus for this study. Faculty who taught during that timeframe, but who are no longer teaching at the VCCS will not be included.

Data Sources

The focus of this research study was on the evaluation of faculty perceptions of the change process used during implementation of redesigned math courses. Thus, data were collected from faculty members via a survey to determine their perceptions.

The survey instrument used for this study went through multiple iterations. The initial instrument consisted of 30 statements related to Kotter’s (2012) change model. An expert panel was chosen based on their familiarity with the VCCS redesign and content expertise. The breakdown for expert panel members consisted of eight VCCS advisors and counselors who worked during the redesign and eight faculty members from Old Dominion University, The College of William and Mary, and The University of Virginia with expertise in community colleges, higher education, leadership, and survey methods.

The panel reviewed the survey for face validity in November 2013. Feedback provided by the panel was used to help improve the survey. For each proposed survey
question, respondents were asked to select which of the steps in Kotter’s (2012) change model aligned with the statement – Urgency, Communication, or Empowerment. A detailed description was given for all three steps. Respondents were then asked if the statement was clear and given the option to answer yes or no. Lastly, respondents were given the option of providing any comments about the statement. Questions were then eliminated based on the expert panel members’ responses. A total of 12 questions was eliminated based on the expert panel advice. Questions that panel members were not able to identify with the right step, questions that were unclear, and questions that received compelling free responses were either eliminated or rewritten (18 questions were rewritten based on panelist feedback). The response rate for this iteration with the expert panel was 63% (10 of 16 panel members responded). The contents of the first survey instrument can be seen in Appendix A.

The second version of the survey instrument included fewer questions, with a total of 18 survey statements related to Kotter’s steps. These questions were sent to the same expert panel in November of 2014 and again respondents were asked to determine if the statements were clear and were provided comment space for free responses to each of the individual statements. All 18 survey statements were further edited based on the expert panel’s responses. The response rate for the second round of the expert panel was 63% (10 of 16 panel members responded; eight of original 10 panel members responded). The contents of the second survey instrument can be found in Appendix B.

The final survey included the 18 questions from the second version, which have been edited based on the expert panel’s responses. The survey also included six demographic questions to allow for correlation of responses based on demographics and
three questions added by my dissertation committee which asked about participants’ participation in the redesign, the impact of the redesign, and a free response questions that allows faculty to add share any information they would like to about the developmental math redesign.

This study did not utilize a pilot study because the population of math faculty in the VCCS is small enough that eliminating participants during a pilot would make it difficult to receive enough responses to determine whether the survey instrument is reliable. According to F. J. Fowler (2009), the best way to increase survey reliability is improve the reliability of questions by making sure the questions are interpreted similarly by all respondents. Both expert panel reviews focused on ensuring that questions were clear which increases reliability (F. J. Fowler, 2009). The face validity was also improved during the expert panel’s first review because it focused on ensuring that the survey statements aligned with Kotter’s model and were relevant (Gall, Gall, & Borg, 2007).

The alpha reliability of the instruments also provides evidence that the survey development process provided reliable results because alpha reliability was acceptable during both rounds (Gall et al., 2007). The reliability for the first round was $\alpha = .84$ and $\alpha = .86$ in the second round. According to Gliem and Gliem (2003), $\alpha > .7$ is acceptable for research. An $\alpha > .8$ is desirable (Gliem & Gliem, 2003). The contents of the final survey instrument can be found in Appendix C.

Data Collection

The survey instrument was delivered in an online format using Qualtrics. A link to the survey instrument was sent to all 700 VCCS math and developmental math faculty
in the Fall 2016 Semester via email. Respondents were given two weeks to complete the survey from September 19 to October 3. I had planned on partnering with the VCCS system office to distribute the survey instrument to math faculty through their VCCS email accounts, however the VCCS system office does not provide this type of information for research preferring to allow individual colleges the ability to opt in or out of research studies (Catherine Finnegan, personal communication, April, 21, 2016).

To gather contact information for math and developmental math faculty I used class schedules of all developmental and college level math classes at all VCCS colleges for the Spring 2016 semester. I then looked up the individual faculty members contact information on the college’s website to collect all the faculty emails for this study. I was able to gather information for 660 faculty members in this manner. One institution does not list faculty email address on their website, so I worked with the institutional research office to receive contact information for faculty at that college. Through this collaboration, I was able to get contact information for 40 more faculty members, which brought the total sample population to 700. Even though the VCCS provided the figure of 943 unduplicated faculty count, there were only 884 unduplicated faculty that taught a math or developmental math course in spring 2016. Thus, the 700 participant sample population I was able to collect contact information represents 79.19% of the population of faculty that taught in spring 2016.

On September 19, 2016, I sent out an initial email to all 700 faculty asking that they participate in my study. I provided faculty with a short description and link to the survey which was delivered through Qualtrics. All emails were deliverable except for 13.
On September 26 and 29 I sent reminder emails emphasizing that the survey instrument would close on October 3, 2016.

To ensure that respondents met the eligibility requirements for this study, faculty were asked to answer yes or no to a question about whether they taught anytime from Fall 2011 through the Fall 2013 Semesters. If the respondent answered "yes," he or she moved on to the consent form, and if they answer "no," he or she will be thanked for their willingness to participate but told that they do not qualify for the study. Table 8 provides a visual for how survey statements and questions align with answering evaluation questions.

Table 8

*Crosswalk Table: Alignment of Survey Statements and Questions with the Study’s Evaluation Questions*

<table>
<thead>
<tr>
<th>Survey Statements</th>
<th>EQ1</th>
<th>EQ2</th>
<th>EQ3</th>
<th>EQ 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>States based on Kotter’s (2012) Change Framework</td>
<td>S1 –S18</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Demographic Questions</td>
<td>Q1</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Q5</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Q6</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Data Analysis**

The analysis of the data collected in the survey differed based on each of the evaluation questions. A range of analyses was used including descriptive statistics, factor analysis, ANOVAs, and t-tests for independent samples.
Evaluation question one. What factors do development math faculty perceive as critical in the redesign of the math curriculum?

Null hypothesis: Kotter’s (2012) model will not be confirmed using confirmatory factor analysis.

Alternative hypothesis: Kotter’s model will be confirmed using confirmatory factor analysis.

Statistical test: Confirmatory factor analysis (CFA) was used to determine if Kotter’s (2012) model aligns with faculty perceptions of the change process used to implement redesigned developmental math courses (Leech, Barrett & Morgan, 2015; O’Rourke & Hatcher, 2013). The results of the CFA presented in chapter four were used to answer evaluation question one.

Evaluation question two. How do factors differ by demographic characteristics such as:

- gender;
- employment category;
- years of teaching experience; and,
- if the faculty member has taught a college-level math course?

Null hypothesis: Factors will not differ based on the demographic characteristics of faculty members.

Alternative hypothesis: Factors will differ based on the demographic characteristics of faculty members.

Statistical test: Exploratory factor analysis (EFA) was used to determine if there are differences in the factors that faculty see as critical to the developmental math
redesign based on demographic variables. Because CFA and EFA use different assumptions and constraints to confirm a theory, CFA, and to sort factors, EFA, (Matsunaga, 2010; Ward, 2016), an EFA for the total sample population was run. Then the file was split based on demographic variables. EFA (O’Rourke & Hatcher, 2013) was run for each of those different demographic variables to see if there are differences in the way that the factors load based on the difference groups and those factors were compared to each other and the EFA results for the total sample population. The factors that emerged were used to answer evaluation question two in chapter four.

**Evaluation question three.** What are developmental math faculty perceptions of the change process used during the redesign regarding the role of Urgency, Communication, and Empowerment?

Null hypothesis: Faculty perceptions of the change process will be negative or neutral regarding the role of Urgency, Communication, and Empowerment.

Alternative hypothesis: Faculty perceptions of the change process will be positive regarding the role of Urgency, Communication, and Empowerment.

Statistical test: The survey items that are confirmed in the CFA to make up Urgency, Communication, and Empowerment will be combined using the add function in SPSS to create a composite variable representative of each variable. The mean Likert score for each composite variable will be used to answer evaluation question three in chapter four (George & Mallery, 2008).

**Evaluation question four.** How do developmental math faculty perceptions of the role of Urgency, Communication, and Empowerment differ by demographic characteristics such as:
• gender;
• employment category;
• institution;
• years of teaching experience;
• if the faculty member had taught a developmental math course before the redesign;
• and if the faculty member has taught a college-level math course?

Null hypothesis: Faculty perceptions of the change process will not differ based on demographic characteristics.

Alternative hypothesis: Faculty perceptions of the change process will differ based on demographic characteristics.

Statistical Test: ANOVAs and Independent Samples T-test were used to compare the means of the composite variable representing the factors Urgency, Communication, and Empowerment. ANOVAs and T-test allow us to determine if different groups’ responses (within a demographic variable) concerning the factors of Urgency, Communication, and Empowerment differ significantly (George & Mallory, 2008). The independent variables will be the various demographic characteristics. The posthoc analysis is required to understand how the responses differ (George & Mallory, 2008). This study will use the Scheffe method because it is conservative in determining statistical significance and is effective in conducting complex comparisons where groups of three or more different means are compared (George & Mallory, 2008; Stevens, 1999). This will show whether there were significant differences in the ways that various demographic groups perceived Kotter’s (2012) steps.
Table 9

Overview of Data Analysis

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Data Sources</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1</td>
<td>Survey Statements 1 through 18</td>
<td>Confirmatory factor analysis</td>
</tr>
<tr>
<td>Question 1</td>
<td>Survey Statements 1 through 18</td>
<td>Exploratory factor analysis</td>
</tr>
<tr>
<td>Question 2</td>
<td>Survey Statements 1 through 18</td>
<td>Exploratory factor analysis</td>
</tr>
<tr>
<td>Question 3</td>
<td>Composite variables for Urgency (SI 1-6), Communication (SI 7-12), and</td>
<td>Mena Likert score</td>
</tr>
<tr>
<td>Question 4</td>
<td>Empowerment (SI 13-18)</td>
<td>ANOVAs for demographic variables with 3 or more categories and Independent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Samples T-test for demographic variables with 2 categories.</td>
</tr>
</tbody>
</table>

Note. SI = Survey Item

Ethical Considerations

Propriety, usability, feasibility, and accuracy standards were created by the Joint Committee on Standards for Educational Evaluation to ensure that evaluation research is conducted in an ethical, fair, realistic, and accurate manner (Sanders & Sullins, 2006).

**Propriety.** This study meets the propriety standards by focusing on an issue—the change process—that affects all developmental math stakeholders. If programs are not implemented well the program’s outcomes are negatively impacted (Kezar, 2014; Kotter, 2012). This evaluation study not only allows us to better understand VCCS faculty perspectives on the developmental math redesign but also provides a framework for other community colleges and systems for evaluating their change process as well. The assessment will be fair because it is focusing on the perceptions of faculty who are the best qualified to address questions about implementation. This study likewise is fair.
because it is not questioning whether the change occurred, rather whether faculty recognized sound change strategies being used during implementation. The findings will also be presented so that all stakeholders have access to the findings of this evaluation.

**Utility.** This study meets utility standards by identifying stakeholders and addressing questions about the developmental math redesigns that other researchers have ignored.

**Feasibility.** One of the reasons that I want to conduct this study is that it is practical in the sense that it provides a framework for evaluating change that is fairly easy and cost effective which is particularly important for community colleges that tend to operate on tight budgets (Sydow & Alfred, 2013). This study’s practicality and cost effectiveness fit the feasibility standard.

**Accuracy.** This study meets the accuracy standard by giving a full description of the program and its context within the VCCS and the larger discussion concerning the need to change developmental math programs. The purpose and procedures of this study have been outlined and used an instrument to gather information that can easily be examined for reliability and validity. The quantitative analyses proposed in this study are also appropriate to answering the evaluation questions.

**Protection of Human Subjects.** Human subjects were protected in this study by being given the opportunity to opt out of the survey at any time. Participation in the study is unlikely to cause harm because the subject matter does not cover controversial or personal material, and responses will be anonymous. Respondents consent to participate in the study will be gained through the survey instrument, and respondents will be able to end their participation in the study at any time.
The Role of the Researcher. My role in this study is defining the scope of the evaluation, creating the survey instrument, and interpreting the results in as an objective manner as possible.

Design Issues

There were multiple design issues to address; the first was ensuring that there is a large enough sample to meet the requirements for confirmatory and exploratory factor analysis. According to O’Rourke and Hatcher (2013), the minimum sample size is the larger of 100 responses or responses equaling five times the number of questions in the survey (90). This level of data collection requires a response rate of 11% for this survey. This threshold was met.

Another potential design issue was related to not piloting the survey instrument. Even though the two iterations with the expert panels have helped to improve the face validity of the instrument, there is no statistical evidence that the instrument is reliable. Though the instruments used to gather feedback from the expert panel had an alpha reliability of 0.84 and 0.86, which provides evidence that the feedback from the expert panel was reliable.

Summary

The VCCS was created to help Virginian’s have access to higher education. However, access to higher education does not necessarily equate to access to credentials. Developmental math represents one of the barriers for students seeking credentials. There are serious issues inherent in developmental math programs, which are highlighted by the large number of students who need to take developmental math courses and the low number that are able to make it through those courses (Bailey, 2009). Researchers
have emphasized that significant changes are necessary to improve developmental math students’ outcomes (Rutschow & Schneider, 2011). The VCCS used current research, national dialog, and system data as a rational to redesign developmental math system-wide (DETF, 2009; DMRT, 2010). However, researchers studying developmental math have not focused on the change process. This evaluation is intended to address that gap in the literature by looking at how faculty perceived change during the developmental math redesign. This should help stakeholders within the VCCS and without better understand how the change was perceived and provide a framework for others to study the change process during a developmental math redesign.
CHAPTER IV: RESULTS

In this chapter, I present the results of my data analysis. There are seven main sections. Section one describes the study’s sample and the procedures used to obtain it. Sections two presents an a priori breakdown of how the survey items related to Kotter’s (2012) model. Section three presents the results for evaluation question one. Section four presents the reliability statistics of the scale used in the survey instrument based on results of evaluation question one. Finally, sections five through seven focus on the analysis related to evaluation questions two through four, in numerical order.

Sample

Math and developmental math faculty members at all 23 VCCS institutions received an email asking them to participate in this study and to provide their perceptions of the change process used to implement the developmental math redesign at their colleges. The VCCS’s best approximation of full-time and adjunct math and developmental math faculty was 943 (Marina Bagreev, personal communication, March 3, 2016). However, further investigation proved this number was not exact as determining the precise number of math and developmental math faculty at VCCS colleges becomes problematic because faculty members often work at more than one VCCS institution.

To address the potential of a double count of faculty members, I used class schedules of all MTH, MTE, and MTT courses at each of the 23 VCCS colleges during the Spring 2016 semester to collate faculty contact information. Using this strategy
resulted in a faculty member summary of 884 unduplicated faculty that taught at VCCS colleges during this semester. I then looked up email addresses for each faculty member in 22 of the colleges’ individual directories. One college in the VCCS did not list email addresses online, so I worked with the institutional research office to get access to faculty emails at that institution.

Ultimately, I was able to compile email addresses for 700 faculty, which is 79% of the total population that taught during this timeframe. The final sample for the study included 687 math and developmental math faculty across all 23 VCCS colleges (77% of the total population) because 13 of the email addresses bounced back after the survey was emailed. A total of 110 faculty members completed the survey.

Four of the colleges did not have any faculty respond to the survey. These four rural colleges represented among the lowest percentages of the overall population of math and developmental math faculty across the system (i.e., 0.4% to 1.1%, or a total of 2.8% of the entire population). A total of 153 of the 687 faculty members surveyed responded for a response rate of 22.3%. Of those respondents, 20 were not eligible for the study, 5 discontinued after establishing eligibility, and 18 left more than 10% of the survey incomplete and were excluded from analysis. Missing survey responses for respondents that had less than 10% missing data were estimated using the linear interpolation procedure in SPSS.

Any responses to demographic questions that were left blank by the 110 respondents included in the analysis were not estimated. The total number of respondents included in the analysis was 110 or 16.0% of the sample population. Only one institution was underrepresented by more than 5% points (NVCC) and four colleges were not
represented in the sample. As noted above, these four colleges made up a small
percentage of the total sample (ESCC = 0.6%, PDCCC = 0.7%, VHCC = 1.1%, and
WCC = 0.4%). In general, the survey sample was representative of the total population
based on the percentage of respondents by college affiliation. Table 10 summarizes the
sample data and compares the percentage of faculty in the population to the percentage of
respondents.

Table 10

<table>
<thead>
<tr>
<th>College</th>
<th>% of Sample (687)</th>
<th>% of Respondents (110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRCC</td>
<td>1.0%</td>
<td>2.7%</td>
</tr>
<tr>
<td>CVCC</td>
<td>3.0%</td>
<td>3.6%</td>
</tr>
<tr>
<td>DCC</td>
<td>2.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>DSLCC</td>
<td>0.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>ESCC</td>
<td>0.6%</td>
<td>0.0%**</td>
</tr>
<tr>
<td>GCC</td>
<td>7.1%</td>
<td>9.1%</td>
</tr>
<tr>
<td>JSRCC</td>
<td>7.1%</td>
<td>6.4%</td>
</tr>
<tr>
<td>JTCC</td>
<td>6.0%</td>
<td>8.2%</td>
</tr>
<tr>
<td>LFCC</td>
<td>5.9%</td>
<td>5.5%</td>
</tr>
<tr>
<td>MECC</td>
<td>1.9%</td>
<td>1.8%</td>
</tr>
<tr>
<td>NRCC</td>
<td>1.3%</td>
<td>0.9%</td>
</tr>
<tr>
<td>NVCC</td>
<td>26.1%</td>
<td>17.3%*</td>
</tr>
<tr>
<td>PDCCC</td>
<td>0.7%</td>
<td>0.0%**</td>
</tr>
<tr>
<td>PHCC</td>
<td>1.0%</td>
<td>0.9%</td>
</tr>
<tr>
<td>PVCC</td>
<td>2.9%</td>
<td>1.8%</td>
</tr>
<tr>
<td>RCC</td>
<td>0.6%</td>
<td>1.8%</td>
</tr>
<tr>
<td>SVCC</td>
<td>1.4%</td>
<td>4.5%</td>
</tr>
<tr>
<td>SWCC</td>
<td>0.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>TCC</td>
<td>16.4%</td>
<td>19.1%</td>
</tr>
<tr>
<td>TNCC</td>
<td>7.0%</td>
<td>8.2%</td>
</tr>
<tr>
<td>VHCC</td>
<td>1.1%</td>
<td>0.0%**</td>
</tr>
<tr>
<td>VWCC</td>
<td>3.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>WCC</td>
<td>0.4%</td>
<td>0.0%**</td>
</tr>
<tr>
<td>Unknown</td>
<td>0%</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

Note. *Underrepresented by more than 5 percentage points
**Not represented
Full names of colleges found in Appendix E.
Table 11 provides a demographic breakdown of the 110 respondents by gender, employment status, and number of years they have taught in the VCCS.

Table 11

Demographic Breakdown by Gender, Employment Status, and Years of Teaching

<table>
<thead>
<tr>
<th>Gender</th>
<th>Employment Status</th>
<th>Years Teaching</th>
<th>n</th>
<th>n Employment</th>
<th>n Gender</th>
<th>% Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Full-time</td>
<td>3-5</td>
<td>3</td>
<td>27</td>
<td>40**</td>
<td>36.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-10</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11-15</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-20</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20</td>
<td>12**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjunct</td>
<td>3-5</td>
<td>3</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-10</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11-15</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-20</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>6-10</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Full-time</td>
<td>3-5</td>
<td>3</td>
<td>39*</td>
<td>68*</td>
<td>61.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-10</td>
<td>14*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11-15</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-20</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjunct</td>
<td>3-5</td>
<td>5</td>
<td>29**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-10</td>
<td>14*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11-15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-20</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Full-time</td>
<td>16-20</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1.8%</td>
</tr>
<tr>
<td></td>
<td>Adjunct</td>
<td>6-10</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total 110 110 110 100%

Note. Scores rounded to two decimal places.
*Largest Group(s) in column
**2nd Largest Group(s) in column

I was unable to get access to faculty demographic information from the VCCS system office so there is no way to determine whether the sample is representative of the
population as far as employment category and years of teaching, but there is faculty representation for each category except for male adjuncts who have taught between 16 and 20 years. Because I compiled the contact information for 660 of the faculty members that made up the studies sample, I was able to get an idea of the gender make-up of the sample based on the names of faculty members. However, I was not able to draw any information about the 40 faculty members that were provided to me by the institutional research office because I only asked for faculty emails. The demographics show that 56.0% of the sample population was female compared to 62% of respondents, 37.4% were male compared to 36% of respondents, 5.6% were unknown compared to 2% of respondents. Because of the larger percentage of unknown gender in the sample, it is not possible to determine if response bias existed.

**Survey Item’s Relationship to Kotter’s Model**

Table 11 provides a breakdown of how the survey items related to Kotter’s (2012) change model based on an a priori understanding of the model. The factor names, item labels, item abbreviations, and the question they correspond to are included in the table and will be used in all the analysis in this chapter. Asterisks indicate specific survey items that were left out of certain analyses.

For example, responses associated with Urgency 5 and Empowerment 6 were left out of the exploratory factor analysis (EFA), because the confirmatory factor analysis (CFA) found low factoring loadings (<.5) for these variables. Urgency 5 and Empowerment 6 responses were also excluded in the creation of the composite variables Urgency, Communication, and Empowerment used to answer evaluation questions three and four because of their elimination during CFA. Communication 3 and 6 responses
were eliminated from the EFA because of their high correlation (> .9), which can cause problems during an EFA (Leech et al., 2015). However, Communication responses 3 and 6 were not eliminated from any of the other analysis because they were confirmed to be part of the Communication factor using CFA and their inclusion would not negatively impact any of the other analysis.
### Table 12

**Breakdown of Survey Questions and their Relationship to the Factors of Urgency, Communication, and Empowerment**

<table>
<thead>
<tr>
<th>A Priori Factor</th>
<th>Survey Item Label</th>
<th>Survey Item Abbreviation</th>
<th>Survey Item #</th>
<th>n</th>
<th>Survey Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urgency</td>
<td>Urgency 1</td>
<td>U 1</td>
<td>1</td>
<td>110</td>
<td>Prior to the developmental math redesign, developmental math courses were barriers to students’ program completion.</td>
</tr>
<tr>
<td>Urgency</td>
<td>Urgency 2</td>
<td>U 2</td>
<td>2</td>
<td>110</td>
<td>The format of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.</td>
</tr>
<tr>
<td>Urgency</td>
<td>Urgency 3</td>
<td>U 3</td>
<td>3</td>
<td>110</td>
<td>The content of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.</td>
</tr>
<tr>
<td>Urgency</td>
<td>Urgency 4</td>
<td>U 4</td>
<td>4</td>
<td>110</td>
<td>Prior to the developmental math redesign, the developmental math sequence required more time than necessary to complete.</td>
</tr>
<tr>
<td>Urgency</td>
<td>Urgency 5*</td>
<td>U 5*</td>
<td>5</td>
<td>110</td>
<td>It was necessary to redesign the math placement test for students to be placed correctly in math courses.</td>
</tr>
<tr>
<td>Urgency</td>
<td>Urgency 6</td>
<td>U 6</td>
<td>6</td>
<td>110</td>
<td>It was necessary to redesign developmental math courses to improve student learning.</td>
</tr>
<tr>
<td>Communication</td>
<td>Communication 1</td>
<td>C 1</td>
<td>7</td>
<td>110</td>
<td>Leaders at my college used multiple modes of Communication (email, meetings, newsletters, etc.) to inform faculty about changes to developmental math courses.</td>
</tr>
<tr>
<td>Communication</td>
<td>Communication 2</td>
<td>C 2</td>
<td>8</td>
<td>110</td>
<td>Leaders at my college clearly communicated the goals of the developmental math redesign.</td>
</tr>
<tr>
<td>Communication</td>
<td>Communication 3**</td>
<td>C 3**</td>
<td>9</td>
<td>110</td>
<td>Leaders at my college repeatedly communicated the goals of the developmental math redesign.</td>
</tr>
<tr>
<td>Communication 4</td>
<td>C 4</td>
<td>10</td>
<td>110</td>
<td>Leaders at my college communicated their support for increasing developmental math students’ completion rates in college credit-bearing math courses.</td>
<td></td>
</tr>
<tr>
<td>Communication 5</td>
<td>C 5</td>
<td>11</td>
<td>110</td>
<td>Leaders at my college engaged with faculty concerning policy changes to developmental math courses.</td>
<td></td>
</tr>
<tr>
<td>Communication 6**</td>
<td>C 6**</td>
<td>12</td>
<td>110</td>
<td>Leaders at my college engaged in a dialog with faculty during the initial implementation of the developmental math redesign.</td>
<td></td>
</tr>
<tr>
<td>Empowerment</td>
<td>Empowerment 1</td>
<td>E 1</td>
<td>13</td>
<td>110</td>
<td>Faculty are encouraged to use creative instructional methods in redesigned developmental math courses.</td>
</tr>
<tr>
<td>Empowerment 2</td>
<td>E 2</td>
<td>14</td>
<td>110</td>
<td>Redesigned developmental coursework makes it easier for students to learn developmental math content.</td>
<td></td>
</tr>
<tr>
<td>Empowerment 3</td>
<td>E 3</td>
<td>15</td>
<td>110</td>
<td>The main goal of the developmental math redesign is increasing students’ completion rates in college credit-bearing math courses.</td>
<td></td>
</tr>
<tr>
<td>Empowerment 4</td>
<td>E 4</td>
<td>16</td>
<td>110</td>
<td>Redesigned developmental math courses increase students’ completion rates in college credit-bearing math courses.</td>
<td></td>
</tr>
<tr>
<td>Empowerment 5</td>
<td>E 5</td>
<td>17</td>
<td>110</td>
<td>Faculty are provided professional development opportunities on how to facilitate redesigned developmental math courses.</td>
<td></td>
</tr>
<tr>
<td>Empowerment 6*</td>
<td>E 6*</td>
<td>18</td>
<td>110</td>
<td>I am committed to improving developmental math students’ completion rates in college credit-bearing math courses.</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *These survey items were eliminated from Analysis in evaluation questions 2-4 because they were eliminated in the CFA.*

**These survey items were eliminated from the EFA because they were highly correlated to the point redundancy (> .9).**

N includes responses that were supplied using linear interpellation in SPSS
Evaluation Question One

What factors do development math faculty perceive as critical in the redesign of the math curriculum?

Null hypothesis: Kotter’s (2012) model will not be confirmed using confirmatory factor analysis.

Alternative hypothesis: Kotter’s model will be confirmed using confirmatory factor analysis.

To answer evaluation question one I used Amos to conduct a confirmatory factor analysis (CFA) to test the proposed theoretical framework and to determine if Kotter’s model was represented in the data. Four CFA models were analyzed. The first model included Urgency, Communication, and Empowerment as three separate factors with the survey questions associated with each factor structured to explain the variance for their respective step. This model had a poor fit. The modification indices indicated that Urgency, Communication, and Empowerment were highly covaried, which aligns with Kotter’s (2012) model because Kotter expects changes within each step to influence other steps throughout the change process.

Because of the analysis of the first model, the second model was structured with Urgency, Communication, and Empowerment as covaried factors and all the survey items were structured to explain the variance for their respective step. This model also had a poor fit. The modification indices showed that the errors in Communication 5 and 6 had high covariance, which indicated that they should be covaried. Since both survey questions were attached to the same factor, covarying them did not contradict Kotter’s model.
The third model is represented in Figure 5. Figure 5 includes a CFA model that has Urgency, Communication, and Empowerment covaried and aligned with all the survey items from each step, with the errors in Communication 5 and 6 covaried. This model shows how the CFA was structured and the factor loadings. The third model in Figure 5 had good model fit but showed low factor loadings for a survey item associated with Urgency (Urgency 5 = 0.42) and Empowerment (Empowerment 6 = 0.17) Because of the low factor loadings I deleted both items from the model and re-ran the CFA. Figure 6 shows the new CFA structure and factor loadings with the deleted survey items.
Figure 5. Confirmatory Factor Analysis of Structure and Factor Loadings Using All Survey Items for Urgency, Communication, and Empowerment.
Figure 6. Confirmatory Factor Analysis of Structure and Factor Loadings after Urgency 5 and Empowerment 6 were removed.
**Model fit.** The measures I used to establish model fit for the CFA models were CMIN/df, which should be less than 2.0 (Schumacker & Lomax, 2004), CFI which should be greater than 0.9 (Albright & Park, 2009), and RMSEA which is acceptable when less than 0.08, but a score of less than 0.05 is preferred (Ward, 2016). The results of the analysis for both models are included in Table 13, which shows that both models have an acceptable fit.

Table 13

<table>
<thead>
<tr>
<th><strong>CFA Model Fit Summary</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>CFA with all survey items</td>
</tr>
<tr>
<td>(Figure 5)</td>
</tr>
<tr>
<td>CFA with Urgency 5 and</td>
</tr>
<tr>
<td>Empowerment 6 removed (Figure 6)</td>
</tr>
</tbody>
</table>

In order to determine which of the models was a better fit, I used AIC, BIC, and EVCI scores, with lower scores on each measure indicating a better fit (Ward, 2016).

The results of the analyses are provided in Table 14.

Table 14

<table>
<thead>
<tr>
<th><strong>CFA Model Fit Comparison</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>CFA with all survey items</td>
</tr>
<tr>
<td>(Figure 5)</td>
</tr>
<tr>
<td>CFA with Urgency 5 and</td>
</tr>
<tr>
<td>Empowerment 6 removed</td>
</tr>
</tbody>
</table>

*Note.* Lower values in each category suggest a better fit
Based on the analysis for fit, both models had an acceptable fit (see Table 13), but the model in which Urgency 5 and Empowerment 6 were removed had a better fit (see Table 14). Therefore, I am able to reject the null hypothesis and accept the alternative hypothesis that confirms Kotter’s model was recognized as in place by the survey respondents. This confirmation indicates that the math and developmental math faculty identified the areas of Urgency, Communication, and Empowerment during the VCCS math redesign, which aligns with Kotter’s (2012) model of change.

**Model reliability.** I used Cronbach’s alpha (Gliem & Gliem, 2003) to test the instrument’s internal consistency or reliability for all three steps of Kotter’s (2012) change framework and the individual step subscales, which included Urgency, Communication, and Empowerment. Reliability was calculated using the constructs confirmed in evaluation question one (the CFA model that did not include Urgency 5, survey item 5, and Empowerment 6, survey item 18). Table 15 provides the reliability results for the total scale and each subscale of Kotter’s (2012) change framework.

<table>
<thead>
<tr>
<th>Reliability of Total Scale and Proposed Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>All Three Steps</td>
</tr>
<tr>
<td>Urgency</td>
</tr>
<tr>
<td>Communication</td>
</tr>
<tr>
<td>Empowerment</td>
</tr>
</tbody>
</table>
The reliability of the change scale as a whole and the subscales of Urgency, Communication, and Empowerment were all acceptable as they were higher than 0.7 (Gliem & Gliem, 2003; Liu, Ritzhaupt, & Cavanaugh, 2013). The Cronbach α for the combined three steps, Urgency, and Communication were all high (> 0.9), and the Cronbach α for Empowerment was good (> 0.8; Gliem & Gliem, 2003).

**Evaluation Question Two**

How do the factors of Urgency, Communication, and Empowerment differ by demographic characteristics such as:

- gender;
- employment category;
- years of teaching experience;
- if the faculty member taught a developmental math course; and
- if the faculty member has taught a college-level math course?
- and institution.

Null hypothesis: Factors will not differ based on the demographic characteristics of faculty members.

Alternative hypothesis: Factors will differ based on the demographic characteristics of faculty members.

To answer evaluation question two, I used the Principal Axis Factoring method of Exploratory Analysis (EFA) to see how relationships within the data would differ based on demographic characteristics. In this analysis, Urgency 5 (U 5) and Empowerment 6 (E 6) were excluded from the analysis because CFA indicated a better fit without them. Also, Communication 3 and 6 (C 3, C 6) were excluded because they were highly
correlated with other survey items, namely, Communication 3 with Communication 2 and Communication 6 with Communication 5. The correlations between these variables were very high (> .9; Geyer, 2008), and high correlations can cause problems reaching a solution when using EFA (Leech et al., 2015). When completing the EFA, I limited the number of components to three since Kotter’s model was represented by three factors, and excluded loadings below 0.4 using the suppression function in SPSS. The results of the analysis are located in Table 16.
### Table 16

**Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Urgency</th>
<th>Communication</th>
<th>Empowerment</th>
<th>Hybrid Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>FL</td>
<td>%V</td>
<td>F</td>
</tr>
<tr>
<td>Total Sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 2</td>
<td>.884</td>
<td>11.0</td>
<td>E 2</td>
<td>.692</td>
</tr>
<tr>
<td>C 5</td>
<td>.826</td>
<td></td>
<td>E 4</td>
<td>.649</td>
</tr>
<tr>
<td>C 1</td>
<td>.825</td>
<td></td>
<td>E 1</td>
<td>.617</td>
</tr>
<tr>
<td>C 4</td>
<td>.747</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 2</td>
<td>.898</td>
<td>25.3</td>
<td>E 2</td>
<td>.786</td>
</tr>
<tr>
<td>C 1</td>
<td>.814</td>
<td></td>
<td>E 4</td>
<td>.706</td>
</tr>
<tr>
<td>C 4</td>
<td>.777</td>
<td></td>
<td>E 1</td>
<td>.688</td>
</tr>
<tr>
<td>C 5</td>
<td>.762</td>
<td></td>
<td>E 5</td>
<td>.651</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 2</td>
<td>.881</td>
<td>22.7</td>
<td>E 4</td>
<td>.604</td>
</tr>
<tr>
<td>C 5</td>
<td>.868</td>
<td></td>
<td>E 1</td>
<td>.589</td>
</tr>
<tr>
<td>C 1</td>
<td>.831</td>
<td></td>
<td>E 2</td>
<td>.527</td>
</tr>
<tr>
<td>C 4</td>
<td>.703</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment Full-time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 2</td>
<td>.887</td>
<td>23.2</td>
<td>E 1</td>
<td>.634</td>
</tr>
<tr>
<td>C 1</td>
<td>.780</td>
<td></td>
<td>E 2</td>
<td>.604</td>
</tr>
<tr>
<td>C 5</td>
<td>.767</td>
<td></td>
<td>E 5</td>
<td>.603</td>
</tr>
<tr>
<td>C 4</td>
<td>.738</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjunct</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 1</td>
<td>.952</td>
<td>7.2</td>
<td>E 1</td>
<td>.814</td>
</tr>
<tr>
<td>C 2</td>
<td>.917</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.893</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

106
Table 16

*Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Urgency</th>
<th>Communication</th>
<th>Empowerment</th>
<th>Hybrid Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>FL</td>
<td>%V</td>
<td>F</td>
</tr>
<tr>
<td>C 5C 4</td>
<td>.738</td>
<td>U1</td>
<td>.796</td>
<td>E2</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years Taught</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-10</td>
<td>C 5</td>
<td>.920</td>
<td>24.6</td>
<td>E1</td>
</tr>
<tr>
<td></td>
<td>C 2</td>
<td>.887</td>
<td>U1</td>
<td>.796</td>
</tr>
<tr>
<td></td>
<td>C 4</td>
<td>.766</td>
<td>U3</td>
<td>.747</td>
</tr>
<tr>
<td>11-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;20</td>
<td>E4</td>
<td>.789</td>
<td>17.9</td>
<td>U2</td>
</tr>
<tr>
<td></td>
<td>E 1</td>
<td>.655</td>
<td>U3</td>
<td>.801</td>
</tr>
<tr>
<td></td>
<td>E 5</td>
<td>.654</td>
<td>U4</td>
<td>.771</td>
</tr>
<tr>
<td></td>
<td>E 2</td>
<td>.568</td>
<td>U6</td>
<td>.655</td>
</tr>
<tr>
<td></td>
<td>E 1</td>
<td>.567</td>
<td>E 4</td>
<td>.554</td>
</tr>
<tr>
<td>C 2</td>
<td>.892</td>
<td></td>
<td></td>
<td>U 1</td>
</tr>
<tr>
<td>C 1</td>
<td>.829</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 5</td>
<td>.775</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 4</td>
<td>.769</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U 1</td>
<td>.572</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 5</td>
<td>.506</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 16

**Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Urgency</th>
<th>Communication</th>
<th>Empowerment</th>
<th>Hybrid Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F FL %V</td>
<td>F FL %V</td>
<td>F FL %V</td>
<td>F FL %CV n</td>
</tr>
<tr>
<td>T. Dev. Mth</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 2 .888</td>
<td>E 2 .657</td>
<td>U 2 .892</td>
<td>23.9 28.1 64.9 92 .873 .000</td>
</tr>
<tr>
<td></td>
<td>C 5 .856</td>
<td>E 1 .647</td>
<td>U 6 .747</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 1 .826</td>
<td>E 4 .633</td>
<td>U 1 .740</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 4 .762</td>
<td>E 3 .716</td>
<td>U 4 .699</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E 4 .532</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No 18</td>
</tr>
<tr>
<td>T. Coll. Mth</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 2 .891</td>
<td>E 4 .608</td>
<td>U 2 .905</td>
<td>23.8 28.2 65.7 97 .862 .000</td>
</tr>
<tr>
<td></td>
<td>C 1 .826</td>
<td>E 2 .690</td>
<td>U 3 .752</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 5 .812</td>
<td>E 1 .621</td>
<td>U 6 .751</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C 4 .765</td>
<td>E 4 .672</td>
<td>U 4 .622</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E 2 .511</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No 13</td>
</tr>
<tr>
<td>Institution</td>
<td>BRCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSLCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JSRCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JTCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LFCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MECC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

108
<table>
<thead>
<tr>
<th>Variables</th>
<th>Urgency</th>
<th>Communication</th>
<th>Empowerment</th>
<th>Hybrid Factor</th>
<th>%CV</th>
<th>n</th>
<th>KMO</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVCC</td>
<td>U 2</td>
<td>.915</td>
<td>29.0</td>
<td>C 2</td>
<td>.907</td>
<td>19.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVCC</td>
<td>U 3</td>
<td>.876</td>
<td>C 4</td>
<td>.816</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVCC</td>
<td>U 1</td>
<td>.843</td>
<td>C 1</td>
<td>.744</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVCC</td>
<td>U 6</td>
<td>.751</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVCC</td>
<td>U 4</td>
<td>.605</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDCCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SWCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCC</td>
<td>U 2</td>
<td>.894</td>
<td>6.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCC</td>
<td>U 3</td>
<td>.870</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCC</td>
<td>U 6</td>
<td>.681</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCC</td>
<td>U 4</td>
<td>.540</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VWCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 16

Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables
Table 16

Factor Structure and % of Variance Explained from Principal Axis Factor Analysis with Varimax Rotation by Demographic Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Urgency</th>
<th>Communication</th>
<th>Empowerment</th>
<th>Hybrid Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>FL</td>
<td>%V</td>
<td>F</td>
</tr>
<tr>
<td>Un.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Heading abbreviations - F = Factor, FL = Factor Loadings, %V = % of Variance, % CV = % of Cumulative Variance

Variable abbreviations – Years = Years Teaching in the VCCS. T. Dev. Mth = Taught Developmental Math, T. Coll. Mth = Taught College Level Math, Un. = Unknown. Full names of institutions found in Appendix E.

Factor that represents the highest % of Variance bolded for each variable.
Table 17 summarizes the data found in Table 16 and more succinctly shows the factor structures that emerged by each demographic variable.

### Table 17

**Summary of Findings from EFA Analysis**

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>Urgency (U)</th>
<th>Communication (C)</th>
<th>Empowerment (E)</th>
<th>Hybrid</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sample</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>G: Male</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>G: Female</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Emp: Full-time</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Emp: Adjunct</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Emp: Other</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>YT: 3-5</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>YT: 6-10</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>YT: 11-15</td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>YT: 16-20</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>YT: &gt;20</td>
<td>X</td>
<td></td>
<td>UE, CUE</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>TDM: Yes</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>TDM: No</td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>TCM: Yes</td>
<td>X</td>
<td>X</td>
<td>UE</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>TCM: No</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Inst: NVCC</td>
<td>X</td>
<td>X</td>
<td>EUC</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Inst: TCC</td>
<td>X</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>


**Factor structure.** Clear patterns in factor structure emerged across variables as shown in Tables 16 and 17. The factors that emerged for the total sample were intended to be the point of comparison for each demographic variable. The emerging factors for the total sample included a hybrid factor with a mix of Urgency and Empowerment, a Communication factor, and an Empowerment factor. This basic three-factor structure
with one hybrid Urgency/Empowerment factor, one Communication factor, and one Empowerment factor holds true for most of the demographic variables including male, female, full-time, adjunct, 6-10 years of experience teaching, taught developmental math, and taught college math.

The samples for two of the colleges met the requirements to run the EFA in SPSS (NVCC, N=19; TCC, N=21). NVCC’s factor structure was unique with a hybrid factor of Urgency, Empowerment, and Communication, an Urgency factor, and a Communication factor emerging from the analysis. TCC’s factor structure was also unique with a hybrid Communication and Urgency factor, an Empowerment factor, and Urgency factor emerging. Faculty with > 20 years of experience had the unique factor structure that included two hybrid factors one including Urgency and Empowerment, another with Communication, Urgency, and Empowerment, and another factor being Empowerment.

Faculty that taught more than 20 years, and those at NVCC, and TCC produced different factor structures. Faculty that taught more than twenty years had a three-factor structure of Urgency/Empowerment, Communication/Urgency/Empowerment, and Empowerment with Urgency/Empowerment. NVCC faculty responses produced a three-factor structure that included Urgency, the hybrid factor Empowerment/Urgency/Communication, and Communication. TCC faculty responses produced a three-factor structure that included the hybrid factor of Communication/Urgency, Empowerment, and Urgency

**Hybrid factors.** The Hybrid factor of Urgency/Empowerment appeared nine times in the analysis once for the total sample and in eight demographic variables
(including males, females, full-time, adjunct, taught 6-10 years, taught more than 20 years, taught developmental math, and taught college level math). For all those variables except males, Urgency/Empowerment explained the majority of the variance. For males Communication explained the majority of the variance. The Empowerment/Urgency/Communication hybrid factor appeared only once and did not explain the majority of the variance for NVCC faculty, Urgency did. For TCC the Communication/Urgency hybrid factor explained the majority of the variance.

**Urgency/Empowerment.** The Urgency/Empowerment factor was the only hybrid factor to appear with any regularity and it was fairly consistent in its item makeup. Seven of the nine instances it included all five items that comprised the Urgency construct (demographic variables included total sample, females, full-time, adjunct, taught 6-10 years, taught developmental math, taught college math). For males who taught greater than 20 years, survey item one from the Urgency construct was not present (U1 = prior to the developmental math redesign, developmental math courses were barriers to students completion). The items from the Empowerment construct that attached to the Urgency/Empowerment factor appeared with some regularity as well. Five of the nine times it included items E2 and E4 (E2 = redesigned developmental coursework makes it easier for students to learn developmental math content; E4 = redesigned developmental math courses increase students’ completion rates in college credit-bearing math courses). Three times it included E4 alone (males, full-time, and taught developmental math), and one time it included E4 and E1 (E1 = faculty are encouraged to use creative instructional methods in redesigned developmental math courses). Either E4 or E2 appears in every instance of Urgency/Empowerment, and in the majority of instances, both appear. So the
Empowerment portion of Urgency/Empowerment is not comprised of the entire Empowerment construct but a specific portion that is related to student achievement. For instance, E2 focuses on student learning in developmental math courses, and E4 focuses on student completion in developmental math courses.

These results signify that factors loaded differently based on differences in demographic characteristics. These differences in factor structure indicate that groups perceptions of the change process differed based on differences in respondents’ demographic characteristics. I can, therefore, reject the null hypothesis and accept the alternative hypothesis, that change during the math redesign was experienced differently based on demographics.

**Evaluation Question Three**

What are math and developmental math faculty perceptions of the change process during the redesign regarding the role of Urgency, Communication, and Empowerment?

Null hypothesis: Faculty perceptions of the change process will be negative or neutral regarding the role of Urgency, Communication, and Empowerment.

Alternative hypothesis: Faculty perceptions of the change process will be positive regarding the role of Urgency, Communication, and Empowerment.

To answer evaluation question three I averaged the mean scores for each of the items in the subscale. The results are listed in Table 18.
Table 18

Comparison of Factor Means

<table>
<thead>
<tr>
<th>Factor</th>
<th>Survey Items</th>
<th>Mean of the Subscale</th>
<th>Corresponding Survey Response Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urgency</td>
<td>1-4 and 6</td>
<td>3.6836</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Communication</td>
<td>7-12</td>
<td>4.603667</td>
<td>Agree</td>
</tr>
<tr>
<td>Empowerment</td>
<td>13-17</td>
<td>3.6308</td>
<td>Slightly Agree</td>
</tr>
</tbody>
</table>

*Note.* Survey item 5 from Urgency and 18 from Empowerment were omitted from calculating the mean for the subscales because they were omitted in the CFA model.

Faculty responses showed that they slightly agreed that there was Urgency and Empowerment, and agree that Communication occurred in the change process. Based on the results, which are listed in Table 18, I can reject the null hypothesis for Urgency, Communication, and Empowerment and accept the alternative hypothesis that faculty held positive views of the change process.

**Evaluation Question Four**

How do developmental math faculty perceptions of the role of Urgency, Communication, and Empowerment differ by demographic characteristics such as:

- gender;
- employment category;
- years of teaching experience;
- if the faculty member has taught a developmental math course before the redesign;
- if the faculty member has taught a college-level math course;
- and institution?

Null hypothesis: Faculty perceptions of the change process will not differ based on demographic characteristics.
Alternative hypothesis: Faculty perceptions of the change process will differ based on demographic characteristics.

To answer evaluation question four, I used independent sample t-tests for demographic categories with only two options (gender, taught developmental math, and taught college math). One-way analysis of variance (ANOVA) was used for demographic categories with three or more options (employment category and years of teaching experience). I could not analyze the data based on institution because there were missing cases, which would not allow conducting an ANOVA.

For the one-way ANOVAs, the Scheffe method of post hoc analysis was used because it is conservative while remaining flexible when used for simple and complex comparisons of means (George & Mallery, 2008; Stevens, 1999).

Based on my analysis, there were significant differences associated with one factor—Empowerment—related to having taught a developmental math course prior to the redesign, having taught a college math course prior to the redesign, and between full-time and adjunct faculty. The results are represented in Tables 19, 20, and 21.
Table 19

*Results of Independent Samples T-test for Gender, Taught a Developmental Math Course, and Taught a College Math Course.*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>n</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>26.43</td>
<td>8.09</td>
<td>40</td>
<td>.225</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28.30</td>
<td>6.98</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>T. Dev. Math</td>
<td>Yes</td>
<td>27.48</td>
<td>7.74</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>28.36</td>
<td>5.70</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>T. C. Math</td>
<td>Yes</td>
<td>27.33</td>
<td>7.62</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>29.77</td>
<td>5.56</td>
<td>13</td>
</tr>
<tr>
<td>Urgency</td>
<td>Gender</td>
<td>Male</td>
<td>18.35</td>
<td>6.20</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>18.46</td>
<td>6.57</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>T. Dev. Math</td>
<td>Yes</td>
<td>17.95</td>
<td>6.43</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>20.83</td>
<td>5.55</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>T. C. Math</td>
<td>Yes</td>
<td>18.20</td>
<td>6.51</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>20.08</td>
<td>4.99</td>
<td>13</td>
</tr>
<tr>
<td>Empowerment</td>
<td>Gender</td>
<td>Male</td>
<td>17.41</td>
<td>6.46</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>18.57</td>
<td>4.86</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>T. Dev. Math</td>
<td>Yes</td>
<td>17.59</td>
<td>5.34</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>21.06</td>
<td>5.53</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>T. C. Math</td>
<td>Yes</td>
<td>17.74</td>
<td>5.60</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>21.27</td>
<td>3.46</td>
<td>13</td>
</tr>
</tbody>
</table>

*Note.* P < .05*, P<.01**


The statistically significant results of the t-tests show that faculty that did not teach a developmental math course before the redesign felt more empowered during the change process than those that had taught a class before the redesign. Similarly, faculty that did not teach a college level math course prior to the redesign felt more empowered than those that did. For all other comparisons, there is no evidence that the comparison groups felt differently. Responses for males and females concerning Urgency,
Communication, and Empowerment were not significantly different. Likewise, there were no statistically significant differences between the responses of those that taught developmental math and those that did not or those that taught college level math and those that did not for Urgency or Communication.

Table 20

ANOVA Results for Employment Category and Years Taught by Faculty

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor</th>
<th>n</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Category</td>
<td>Communication</td>
<td>110</td>
<td>.466</td>
</tr>
<tr>
<td></td>
<td>Urgency</td>
<td>110</td>
<td>.217</td>
</tr>
<tr>
<td></td>
<td>Empowerment</td>
<td>110</td>
<td>.001**</td>
</tr>
<tr>
<td>Years</td>
<td>Communication</td>
<td>110</td>
<td>.309</td>
</tr>
<tr>
<td></td>
<td>Urgency</td>
<td>110</td>
<td>.542</td>
</tr>
<tr>
<td></td>
<td>Empowerment</td>
<td>110</td>
<td>.116</td>
</tr>
</tbody>
</table>

*Note. P<.01** Significance represents Between Groups analysis. Employment categories included full-time, adjunct, and other.

Table 19 presents the results of the post hoc analysis of the significant difference between employment category groups for the Empowerment factor.

Table 21

Post Hoc Analysis for Significant Between-Groups Results For Employment Category ANOVA

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Error</th>
<th>n</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time</td>
<td>3.36</td>
<td>1.03</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Adjunct</td>
<td>4.10</td>
<td>1.03</td>
<td>41</td>
<td>.002**</td>
</tr>
</tbody>
</table>

*Note. P<.01**

The ANOVA results in table 4.10 show that there was only one comparison that produced significant differences between the groups’ responses. The demographic
variable was employment category and the groups’ responses that were significantly different were full-time and adjunct faculty. The posthoc analysis in Table 19 shows that adjunct faculty felt significantly more empowered than full-time faculty. But, there were no differences concerning Urgency, Communication, and Empowerment based on the number of years a faculty taught in VCCS, and there were no significant differences between faculty responses based on their employment category for Urgency or Communication.

From the analysis, I can reject the null hypothesis and conclude there were significant differences based on demographic variables and how faculty members perceived the change.

Summary

Table 22 summarizes the results of Chapter 4 in detail. For evaluation question one, I was able to find that Kotter’s (2012) model was in effect during the developmental math redesign. Results of Evaluation question two showed that faculty perceived the change process differently based on their demographic background. Evaluation question three indicated that faculty felt Urgency to change developmental math course, that communication concerning the redesign occurred, and that they were empowered to teach redesigned courses. Evaluation question four indicated that there was a significant difference in Empowerment between faculty who had taught a developmental math class prior to the developmental math redesign and those that had not, between faculty who had taught a college-level math course prior to the developmental math redesign and those that had not, and between full-time and adjunct faculty. In each case, the faculty
who had not taught prior to the redesign felt more empowered, and adjunct faculty also felt more empowered.
<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Null Hypothesis</th>
<th>Alternative Hypothesis</th>
<th>Results of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ 1: What factors do development math faculty perceive as critical in the redesign of the math curriculum?</td>
<td>Kotter’s (2012) model will not be confirmed using confirmatory factor analysis.</td>
<td>Kotter’s (2012) model will be confirmed using confirmatory factor analysis.</td>
<td>CFA confirmed Kotter’s (2012) change model allowing me to reject the null hypothesis and accept the alternative</td>
</tr>
<tr>
<td>EQ 2: How do these factors differ by demographic characteristics such as gender; employment category; years of teaching experience; if the faculty member taught a developmental math course; if the faculty member has taught a college-level math course; and institution?</td>
<td>Factors will not differ based on the demographic characteristics of faculty members.</td>
<td>Factors will differ based on the demographic characteristics of faculty members.</td>
<td>EFA confirmed that there were differences in the factors based on demographic characteristics such as institution, and years teaching in the VCCS</td>
</tr>
<tr>
<td>EQ 3: What are developmental math faculty perceptions of the change process during the redesign regarding the role of Urgency, Communication, and Empowerment?</td>
<td>Faculty perceptions of the change process will be negative or neutral regarding the role of Urgency, Communication, and Empowerment.</td>
<td>Faculty perceptions of the change process will be positive regarding the role of Urgency, Communication, and Empowerment.</td>
<td>Faculty perceptions of the change process were positive in the case of Urgency, Communication, and Empowerment so I rejected the null hypothesis and accepted the alternative hypothesis because the results were negative</td>
</tr>
<tr>
<td>EQ 4: How do developmental math faculty perceptions of the role of Urgency, Communication, and Empowerment differ by demographic characteristic such as gender; employment category; years of teaching experience; if the faculty member has taught a developmental math course before the redesign; if the faculty member has taught a college-level math course; and institution?</td>
<td>Faculty perceptions of the change process will not differ based on demographic characteristics.</td>
<td>Faculty perceptions of the change process will differ based on demographic characteristics.</td>
<td>Faculty perceptions of the change process differed significantly based on some demographic characteristics so I was able to reject the null hypothesis and accept the alternative</td>
</tr>
</tbody>
</table>
Chapter 5: Executive Summary

This study focused on using faculty perceptions to evaluate the change process used by Virginia Community Colleges to implement the VCCS redesign of developmental mathematics. Starting in 2009, the VCCS embarked on transforming developmental mathematics from the ground up through a system-wide change effort (Asera, 2011; DETF, 2009). Throughout the process, there were many system-wide changes to the placement process for students into developmental math course and the way that students experience developmental mathematics education (Asera, 2011; DMCT, 2011; DMRT, 2010). Changes included the development and implementation of a new placement instrument and the redesign of developmental courses including their content, delivery method, and course structure.

The Virginia Placement Test (VPT) was designed to test students on specific developmental math content (modules) to accurately assess their developmental math needs. The developmental courses were redesign to be modularized so that students would only need to take a developmental math course that covered specific content areas that they were lacking versus a set of courses required for all students (DMRT, 2010). The mandate leading to the implementation of the VPT and redesigned developmental math courses and policies occurred to assure consistency throughout the VCCS.

Previous research demonstrated the need to redesign developmental math programs (Bailey et al., 2013; Calcagno & Long, 2008; Martorell & McFarlin, 2007; Martorell & McFarlin, 2010), and provided recommendations for how to redesign
courses (Bailey, 2009; Rutschow & Schneider, 2011). However, there is little focus in the literature on the change process used to implement redesigned developmental math programs at the system or campus level. According to Kezar (2014), overlooking the change process is common because leaders often focus on what needs to change rather than how to make the change. This study intends to help fill that gap in the literature by evaluating the change process, thereby focusing attention on change process evaluation and providing a model for change evaluation.

This study used a survey instrument based on Kotter’s (2012) change model to ask faculty about the developmental math redesign in order to evaluate the change process used at VCCS colleges. Faculty perceptions are key to evaluating the success of the process because they are the operating core (Mintzberg, 1980) of developmental education and the primary implementers of redesigned developmental math courses. Research shows that implementers have a huge impact on the success of a change initiative (Black, 2013; Kotter, 2012), making faculty perceptions of the process necessary to both understand and evaluate the change process in this case.

This chapter consists of six sections. The first four sections discuss the evaluation questions, including implications for practice and future research. Section five provides a critique of the study, and section six presents my conclusions.

**Evaluation Question One**

Evaluation question one was: What factors do development math faculty perceive as critical in the redesign of the math curriculum? I used confirmatory factor analysis (CFA) to determine if faculty felt that the change process used for the redesign aligned with Kotter’s (2012) model. In particular, this study focused on Kotter’s steps of
Urgency, Communication, and Empowerment to confirm if these factors were present according to faculty respondents and if respondents perceived them as critical to redesigning developmental math curriculum. The findings confirmed that Urgency, Communication, and Empowerment were factors critical to the developmental math redesign.

**Discussion of the results.** One of my assumptions for this study was that Kotter’s (2012) model is emblematic of an effective change process, and the literature provides evidence for this assumption (Kezar, 2014). Kotter’s (2012) model is robust because it builds on examples from 100s of organizations over years of research. Yet, the change initiative undertaken by the VCCS did not occur with specific attention to the steps of Urgency, Communication or Empowerment and did not involve specific advanced tailoring. What was evident in the creation of the model from the factor analysis was that despite no intentional planning, the redesign process still mirrored the steps outlined by Kotter (2012). Evidence of the change theory in practice supports the assertions made by Kotter (2012) regarding the critical steps required for change initiatives.

Even though researchers have shown that the use of effective change theory is necessary for implementing a successful change process (Black, 2013; Kezar, 2014; Kotter, 2012), it is not necessarily sufficient for helping all change agents view a change effort to be successful. One of the themes repeated by faculty in the free response section of the survey can be summed up in the following representative quotation: “The developmental math redesign was the worst kind of top-down, mandate-driven change.” So while the redesign was modeled on effective change theory, there is a question as to
why the qualitative feedback collected for this study was so overwhelmingly negative toward the redesign.

One possible explanation could be that the guiding coalition step of Kotter’s (2012) model was not included in this study. According to Kotter (2012), this coalition is supposed to represent a range of voices and perspectives to provide broader buy-in to the change initiative. It is also supposed to include members with positional power to help move the change along. Even though there was broad participation within the state-wide task forces that grappled with the redesign, the majority of faculty impacted by the change were not included in this process. Despite the task forces having some faculty representation, this lack of more buy-in highlights a challenge in the process. Kotter’s (2012) change model is grounded in research in the private sector, which does not have a collegial culture like that found in higher education. Businesses with more tightly coupled, top-down, hierarchical organizational structure positions this sector with different leveraging points relative to higher education.

Both Kotter (2012) and Fullan (2001) suggest that businesses and educational organizations are becoming more similar and that theories successfully used in business should successfully translate into educational organizations. However, there are still cultural differences between the two sectors. Institutions of higher education have a historical emphasis on faculty autonomy, which is exemplified by institutional practices such as shared governance, academic freedom, and faculty autonomy (Kim, Twombly, & Wolf-Wendel, 2008).

Another possible explanation for faculty viewing the change process negatively even though it was based on sound change theory is that the redesign threatened faculty
autonomy. Research suggests that faculty autonomy has diminished over time in higher education as a whole and more specifically in community colleges (Kim et al., 2008). According to Kim and colleagues (2008), faculty members were generally satisfied with the autonomy they had to determine course content and methods within their classrooms even though their autonomy as a profession has diminished over time. For the math faculty impacted by the VCCS developmental math redesign, the changes made by the system eliminate much of the autonomy faculty traditionally held in their own classrooms given the prescriptive steps now in place. The developmental math redesign created courses in which faculty have relatively little ability to alter either in content or pedagogy. For example, one faculty member shared that:

Those students for whom only a review is necessary are able to complete the series of redesign math in one semester. This minority of students are the only ones for whom the redesign benefits. The vast majority of students need an instructor who can alter their explanations on the spot to the individual struggling student.

Faculty members noted a lack of flexibility in the currently redesigned process.

If the classroom is one of the last areas within community colleges that faculty feel they have autonomy and control, it is not surprising that infringing on faculty autonomy would produce dissatisfaction with the process among faculty even if sound change principles are used. Kotter (2012) and Kezar (2014) identify loss of power and changing of roles as major reasons that people resist change. The developmental math redesign’s focus on modularization and technology-based instruction significantly limit faculty members’ abilities to differentiate instruction and faculty perceive that the
changes negatively impact students’ ability to succeed in class. One faculty member supported this conclusion:

The students who most need Developmental Math do not benefit from self-paced, teach-it-to-yourself instruction. These students need a lecture format where the mathematical concepts are actually taught. The larger schools were able to offer both the MTE/MTT and lecture formats. However, the smaller schools do not have the student population, faculty or space to offer both.

This faculty member clearly points out the need to vary instruction, but because of the rigidity of the redesign’s class format combined with institutional limitations that is not possible.

Though the majority of the free responses from faculty were negative, it is important to note that there were faculty who believed the redesign improved student learning, and completion. Not everyone viewed the change process negatively. One faculty member, in particular, commended college leaders who helped facilitate a positive change in their colleges.

**Implications for practice.** One significant implication drawn from the change model in place for the VCCS math redesign is the importance of integrating an understanding of institutional culture into the change processes and identifying and ensuring that change initiatives align with implementers’ values (Eckel et al., 1999b; Kezar, 2014). It is important to point out that the rigidity of the curriculum and teaching methods is drawn largely from the effort to standardize and modularize developmental math across the VCCS, and despite faculty complaints, there are some important benefits that come from standardizing developmental math. First, students can take a placement
test at any of the 23 community colleges and their test scores will transfer to any school. The interpretation those VPT test scores is standardized as well so a student has the same developmental math requirements at any of the VCCS colleges. Second, if a student changes VCCS colleges mid-developmental sequence they are not required to redo their developmental math coursework. They can just start working on the next modularized unit they need at then next college. Only one faculty member mentioned that standardization brought about by the redesign was positive stating that “it was actually beneficial and influential, in that there now is a system-wide effort to put order and system-wide similarity in college-level courses.” However, most faculty members did not comment on the advantages of standardizing college-level math course and none discussed the advantages of standardizing developmental mathematics and the placement test.

There are also benefits to using technology-based instruction in the classroom. Both Boatman (2012) and Rutschow and Schneider (2011) indicate that there is evidence that technology-based instruction can improve developmental math student outcomes. However, it does not seem that standardization in curriculum and placement or incorporating technology-based instruction has to be mutually exclusive with providing room for faculty to vary pedagogy and teaching methodologies. As institutions and community college systems seek to redesign their developmental math offerings, they would be wise to incorporate ways to preserve academic autonomy by allowing room in the curriculum for faculty to vary their instruction. If the classroom is the main area that community college faculty still feel they have some autonomy, it would seem unwise to unnecessarily neglect it (Kim et al., 2008).
One issue that might have affected the amount of autonomy faculty have in redesigned developmental math classrooms might have been the makeup of the guiding coalition. As noted, this study did not focus on the guiding coalition step of Kotter’s (2012) change model because faculty did not necessarily have direct interactions with the task force. The DMRT researched and provided recommendations for redesigning developmental math that included modularizing developmental math. But, the committee only included seven math and developmental math faculty out of the total group of 25. Having a higher proportion of math and developmental math faculty on the DMRT might have helped to ensure that faculty autonomy was preserved. It is unclear how the faculty members on the committee represented the opinions of the larger math faculty or how the faculty committee members conveyed task force information to the larger group of math faculty.

**Future research.** Two different lines of research can build on the findings from this study. The first is to further research the effectiveness of Kotter’s (2012) change model in community colleges. I imagine that the effectiveness of the change model in community college settings will differ based on the type of change initiative. Because community colleges are inherently bureaucratic institutions (Kim et al., 2008), administrators increasingly control decision-making. In this scenario, Kotter’s (2012) stage model may provide a good fit given its structure.

However, when change fails to incorporate cultural aspects and values that are particularly salient to the primary implementers (in this study, campus-based math faculty), there are going to be negative consequences for the outcomes of the change initiative (Eckel et al., 1999b; Kezar, 2014; Kotter, 2012). The second area for future
research should focus on the influence of faculty member’s autonomy on change initiatives. This line of inquiry could include researching how the faculty make-up of a guiding coalition affects the preservation of faculty autonomy.

**Evaluation Question Two**

Evaluation question two was – How do the factors of change differ by demographic characteristics such as gender; employment category; years of teaching experience; if the faculty member taught a developmental math course; if the faculty member has taught a college-level math course; and institution? For evaluation question two, I used exploratory factor analysis to determine if the latent factors would load differently based on specific demographic variables. I found that there were differences in the structure of the factors that emerged based on demographic characteristics. Specifically, there was evidence of faculty members differing based on demographics in how they identified the factors of Urgency, Communication, and Empowerment. Most groups showed a preference for at least two of the factors (Urgency, Communication, or Empowerment), which resulted in the emergence of a hybrid factor. Analysis showed that differences in factors occurred based on demographic variables (which are displayed in Table 17).

**Discussion of the results.** I used exploratory factor analysis to determine if differences based on demographics existed. CFA, which was used to answer evaluation question one, is a special case of EFA with specific constraints on the number of factors, and the assignment of elements (survey items) to factors (Ward, 2016). EFA, instead, contributes to understanding the underlying structure of the data and relationships between survey items and latent factors (Leech et al., 2015).
Urgency, Communication, and Empowerment were all present in the analysis. However, hybrid factors including survey items from two or more constructs emerged that included Urgency/Empowerment (nine times), Communication/Urgency (one time), Communication/Urgency/Empowerment (one time), and Empowerment/Urgency/Communication (one time). The difference between Communication/Urgency/Empowerment, and Empowerment/Urgency/Communication is which construct contributed most to the hybrid factor. In each case, the order of the names indicates which constructs contribute most in descending order. Of the hybrid factors, Urgency/Empowerment appeared the most by far in this analysis. It appeared nine times in total, both as part of the total sample and associated with eight of the different demographic variables including males, females, full-time, adjunct, taught 6-10 years, taught greater than 20 years, taught developmental math, and taught college level math. Urgency/Empowerment explained the most variance for each group except males (for whom communication explained the most variance).

The emergence of Urgency/Empowerment as a factor that explains the majority of variance for the total sample and many of the demographic categories was unexpected, but ultimately not surprising. I expected Urgency to explain the most variance because Kotter (2012) argues that it is the most important step in his change process because all the other steps are dependent on change agents believing that there is a need to change, which is Urgency. The appearance of Empowerment with Urgency is not surprising, however, because of the items from Empowerment that factored into Urgency/Empowerment and the historical nature of this study.
As discussed earlier, the time period for this study required participants to answer questions from Fall 2009 to Fall 2013, or between three and seven years ago. As a result, faculty participated in retroactive sensemaking in which they reflected on their experience and answered questions about it. In this case, I believe that perceptions about the success of the developmental math redesign were influencing perceptions of Urgency. Two aspects of Empowerment regularly factored with Urgency, namely, survey item 14 (redesigned developmental coursework makes it easier for students to learn developmental math content) and survey item 16 (redesigned developmental math courses increase students’ completion rates in college credit-bearing math courses). Both of these factors deal with the success of the change initiative by asking about student achievement in learning and completing developmental math. It makes sense that individuals’ perceptions of the need to change would be influenced by perceptions of a change initiative’s success. In this case, the success of the change initiative was directly linked to student achievement in learning and completion of developmental math.

The emergence of hybrid factors brings into question the veracity of Kotter’s (2012) steps as discrete constructs when conducting a historical study that asks participants to retroactively make sense of their experience. In particular, the emergence of Urgency/Empowerment as a factor provides a compelling example of how retroactive sensemaking influences perceptions of discrete constructs such as Urgency. The emergence of hybrid factors also highlights how differences in institutional context and leadership may influence perceptions of change. For example, the two colleges included for analysis of EFA results exhibited differences in the factors that emerged and the factors that explained the most variance. For NVCC, Urgency, Communication, and
Empowerment/Urgency/Communication factors emerged with Urgency explaining the majority of the variance. For TCC, Urgency, Empowerment, and Communication/Urgency emerged with Communication/Urgency explaining the majority of the variance instead. The differences in how faculty at each institution perceived change was very likely influenced by leaders at those college because as Eddy (2010) observed, “when leaders frame information in different ways, it results in different interpretations by followers” (p. 63). These differences in perception provide evidence that implementation was different at NVCC and TCC and may provide evidence that leaders at those colleges were framing the change initiatives differently and thus changing faculty perceptions in the process.

**Implications for practice.** It is important to note why there are differences between the CFA and EFA results in this study. The outcomes are not the same due to the different basis of analysis for the two procedures. On the one hand, CFA is primarily responsible for confirming a priori theories in which the researcher models the theory by structuring constructs within the model and relationships between those constructs. Often researchers will structure the model in different ways to find the best fit. This logic can be seen in the progression of the CFA model in chapter 4. However, even though a model is confirmed as having good model fit does not mean it is the best fit for the data. EFA, on the other hand, is designed to organize the data in a way that uncovers the latent factors within the data. The differences in results of the two analyses occur because they have different objectives and means of analysis of the data. Therefore, the CFA analysis found that the Kotter (2012) model was evident in the VCCS redesign effort and the EFA analysis uncovered the explanatory power of hybrid factors of change for variance.
Kotter (2012) continually reinforces the idea that Urgency is the most important step in his model because people will not change if they do not think there is a need to change. This feature of the model is particularly important in the beginning of a change initiative and throughout the work of implementation. Urgency as a factor was confirmed using CFA and many of the items measuring it emerged as part of the hybrid factor Urgency/Empowerment that explained the most variance in the EFA. Because faculty members were thinking back on the change process, the elapse of time allowed for retroactive sensemaking (Weick, 1995). Over time, faculty members’ perceptions of Urgency may have changed as they participated in the redesign and felt that the change effort was not positively impacting student outcomes.

Kotter (20102) proposes that before or during the implementation of a change initiative, Urgency should be expected to explain the most variance because it is considered the most important step. However, when looking back after the change occurred with the redesign, Urgency/Empowerment may offer a better explanation of the differences between faculty perceptions because it couples their observations of the change initiative’s success with their perceptions about why the change was needed. It seems fair to assume that the actual success of a change effort may affect faculty members’ perceptions about the need for the change initiative in the first place. If the factors that impact perceptions of change during implementation and after implementation are primarily completed, evaluation methods of the change initiative should be matched to look for the factors that best explain faculty perceptions.

One of the purposes of this study was to evaluate a complex, large-scale change initiative using fairly simple means so that leaders would be able to meaningfully and
easily gather actionable feedback on their change initiatives and to tweak their change efforts as needed. The emergence of Urgency/Empowerment as part of the retroactive sensemaking process for math faculty provides an area for further evaluation efforts because it explained the vast majority of variance in the sample population. If leaders are interested in evaluating faculty perceptions of redesign initiatives after implementation is complete, using the hybrid factor of Urgency/Empowerment, in which the outcomes aspect of empowerment is included with Urgency, Communication, and Empowerment, may be a better model to employ compared to using Urgency, Communication, and Empowerment as separate factors for explaining change.

**Future research.** Further research is required concerning faculty perceptions of developmental math redesigns, specifically regarding the factors that explain how those perceptions change as the initiative progresses. Conducting a longitudinal study would provide the opportunity to track how views change over time. Starting at the beginning of implementation and surveying throughout the process would allow for a comparison of the factors that emerge over time and allow researchers to draw more inferences about the factors that affect faculty perceptions of change. One could use a survey based on any change model, but when appropriate, replicating the use of a survey instrument based on a Kotter’s (2012) model would further validate or invalidate the use of the model by community college leadership. The intention would be to see if the model is confirmed with CFA, while also using EFA to better understand the factor structures that emerge from faculty responses and establish comparisons between groups over time. Throughout the change process, faculty could be re-surveyed to see what factors they see as important to the change process. This type of investigation would give us a better understanding of
what factors are considered critical to change as change unfolds while also providing information about differences about faculty responses based on demographic variables.

**Evaluation Question Three**

Evaluation question three was: what are developmental math faculty perceptions of the change process during the redesign regarding the role of Urgency, Communication, and Empowerment? To answer evaluation question three, I computed the mean scores of composite variables representing Urgency, Communication, and Empowerment. The composite variables were created from the survey items that were confirmed to represent Urgency, Communication, and Empowerment in the CFA. The mean scores showed that faculty slightly agreed that there was evidence of Urgency, agreed that there was evidence of Communication, and slightly agree that there was evidence of Empowerment.

**Discussion of the results.** The mean results regarding evidence of the change factors were also reflected in the faculty members’ free responses. Even though there is no evidence from faculty members’ commentary that they felt there was a need to change the developmental math program before the change was implemented, there was evidence that faculty understood the benefit of the redesigned curriculum and therefore the need to make the changes. For example, one faculty member offered:

The biggest benefit from the redesign was breaking the courses into smaller chunks (5-week sessions). Students are no longer overwhelmed by the amount of material (most of the time). They can still see a way to recover if they fall behind on material.
Another faculty member pointed out that redesigned developmental math courses “provided [students] an easier and less restrictive path to enrollment eligibility for the follow-on math credit courses.” The fact that faculty see students benefiting from the redesigned curriculum by not falling behind and more easily enrolling in college-level math courses is an indication that they feel there was a need to change, which is the essence of Urgency. The evidence of Urgency also ties into the findings in evaluation question two that uncovered the emergence of Urgency/Empowerment. This hybrid factor showed a clear linkage in Urgency and portions of Empowerment related to faculty perceptions of the redesign’s success in helping students learn developmental math content and succeed in college-level math classes.

Even though the data suggests that faculty saw evidence of Urgency in the developmental math redesign’s change process, it is important to still question the level of urgency felt by the faculty regarding change. Kotter (2012) suggests that the most important aspect of the change model is Urgency because all the other steps’ success depends on implementers believing that there is a need to change. Without Urgency, Kotter (2012) argues, it is difficult for implementers to overcome the institutional inertia that keeps change initiatives from being successful, and he further suggests that Urgency should be high among about 75% of change agents. Though it is clear that faculty slightly agreed that there was Urgency, it is not clear whether or not Urgency is as high as Kotter would have expected for a change initiative to be successful.

The mean score for faculty responses regarding Communication showed evidence that good practices were used to communicate about the redesign. One faculty member
pointed out, “Everyone who wanted to participate in this college's redesign was welcome to do so.” Another faculty member stated that:

We are fortunate to have an outstanding leader at our college who has led the way in the redesign. We have had ample professional development, had input at every step of the way, have "tweaked" the program as necessary and have attempted to do what is best for our student community throughout the redevelopment stages.

There is both quantitative and qualitative evidence that faculty perceived that leaders communicated with faculty. It is important to note, however, that faculty members had very different experiences. For example, a faculty member described the experience in this way: “We were asked how we should implement the change and we gave many suggestions that were completely ignored. In fact, the person in charge of asking faculty for suggestions fell asleep in the meeting.” However, this experience was not typical of for faculty across the VCCS, which indicates that implementation was different at different institutions.

Like Urgency, Communication is vital to any change effort (Kotter, 2012). According to Kotter (2012), communicating the vision of the change effort to faculty needs to occur. Communication is necessary for faculty members to feel empowered because, according to Kotter (2012), Empowerment is comprised of feeling like you are able to make change happen and feeling that change is happening. Communication and framing are how leaders help faculty and other campus community members make sense of the change initiative. Communication in general and framing, in particular, have been shown to impact the way that stakeholders perceive a change initiative (Eddy, 2010). It is also impossible to feel like you are able to make change happen if you do not
understand what is required of you. An important aspect of the Communication process includes feeling like you were involved. Communication cannot just relay information you need, it has to be two-way (Kotter, 2012). According to the survey data and the comments from faculty, there is evidence that the majority of faculty were involved in a dialog with institutional leaders, and communication was beneficial even though that might not have been every faculty members’ experience.

As a group, faculty slightly agreed that there was evidence of Empowerment. As quoted above, one faculty member discussed the positive impact of leaders at their institution that focused on providing professional development and allowing faculty flexibility to provide feedback and tweak aspects of the redesign. Both professional development and the ability to influence and change the redesign are important aspects of Empowerment, providing further proof of how institutional leaders helped to empower faculty.

Though faculty as a group saw evidence of Urgency, Communication, and Empowerment, another issue that VCCS faculty members noted was inequality across the system in how redesigned courses were implemented differently at different colleges. For example, one faculty member discussed some of the limitations at the college level, “Our college cannot form classes by one specific unit in one class. Lecturing in the class when you have students in a few different units [is] creating more problems for our students.” Another faculty member pointed out that “The larger schools were able to offer both the MTE/MTT and lecture formats. However, the smaller schools do not have the student population, faculty or space to offer both.” Both quotes discuss how
differences in institutional capacity and resources affected the smaller VCCS colleges in particular.

**Implications for practice.** Of all the evaluation questions, evaluation question three provides the most direct implications for practice. Though this study focused on asking faculty about the redesign after it happened, it would be easy to survey faculty during a change initiative and determine if they see evidence of Urgency, Communication, and Empowerment. If there is evidence that a change initiative is lacking Urgency, Communication, or Empowerment, leaders would be able to tweak their change process to make sure that those factors are incorporated in the process. Leaders and institutional research (IR) offices could partner together to ensure that the change process is appropriately assessed, and the survey methodology used in this study makes it fairly easy to implement. Leaders involved in system-wide change efforts should also be cognizant of issues of equity in implementation and how institutional capacity and resources will affect implementation and success of redesigned developmental math course.

**Future research.** Kotter (2012) argues that change initiatives will not be successful if they lack Urgency, Communication, and Empowerment. The majority of the research that supports this is qualitative research done after the completion of a major change effort. However, most community colleges do not have the time, or personnel to devote to a large-scale qualitative assessment of change. The use of survey methods provides more opportunities for investigating the change process given issues of time and funding. Knowing more about what works in a change process allows institutions to better understand their change initiatives, tweak them, and ensure they are successful.
Evaluation Question Four

Evaluation question four reviewed how developmental math faculty perceptions of the role of Urgency, Communication, and Empowerment differed by demographic characteristic such as gender; employment category; years of teaching experience; if the faculty member has taught a developmental math course before the redesign; if the faculty member has taught a college-level math course; and institution? Differences based on demographics occurred for the construct of Empowerment. Significant differences in faculty perceptions existed based on three demographic variables: whether the faculty member taught a developmental math course before the developmental math redesign, whether the faculty member taught a college level math course before the redesign, and between adjunct and full-time faculty.

Discussion of the results. Faculty that taught a developmental math course or a college math course prior to the developmental math redesign felt significantly less empowered according to the independent sample t-tests that were run. While one might think that more seasoned teachers should feel more capable of teaching redesigned courses because of their experiences, this result actually aligns with the change literature (Kezar, 2014; Kotter, 2012). One of the few things that there is a universal consensus about in the change literature is that it is hard (Black, 2013; Drucker, 1994 Kezar, 2014; Kotter, 2012). In the case of those that taught a developmental math course or a college-level math course before the redesign, they had to actually change the way that they taught developmental math, which is hard to do because they have established ways of teaching, and ways of thinking about developmental mathematics that they need to alter.
On the other hand, those that had not taught developmental math or college level math did not need to change. They simply needed to learn how to teach redesigned developmental math course, and even though this might be difficult, it is easier than changing established ways of thinking and acting (Black, 2013; Kotter, 2012). However, though there were significant differences, it is important to note that the number of those that did not teach either developmental math of college math prior to the redesign is much lower than the number of those did teach (Taught Developmental Math: Yes = 92, No = 18; Taught College Math: Yes = 97, No = 13). The difference in sample size makes the significant result less reliable. This sentiment that change is hard was not specifically addressed by faculty comments but is well established in the change literature (Black, 2013; Eckel et al., 1999a; Kezar, 2014; Kotter, 2012).

The ANOVA showed that adjunct faculty felt significantly more empowered than their full-time counterparts. Like the comparison of those that taught developmental and college math, this result seems incongruous. On the one hand, full-time faculty who teach more, are more integrated into the institution, and are more likely to be connected to the change process and should feel more empowered. On the other hand, faculty commentary proved this assumption wrong. Many faculty members commented that the change occurred in a top-down fashion, that they were not being listened to, and that they have little power to make changes. Full-time faculty may feel they have more agency, and therefore assume they will have more of a voice in the change process. The portrait painted by these comments highlights that some faculty felt frustrated and alienated during the change process and not empowered (Kotter, 2012).
I envisage also that part of the difference in perceptions of Empowerment between full-time and adjunct faculty links to expectations of the change process. I assume that full-time faculty would feel the need to have some freedom in developing, implementing, and delivering developmental math coursework. However, the developmental math curriculum and delivery were mandated by the system and in technology delivered courses in which there is little room for faculty to affect the way that developmental math courses are taught. In essence, the faculty members act more as embedded tutors or facilitators rather than teachers. It seems arguable that the restrictions placed on faculty and lack of involvement in the process would lead full-time faculty to feel disempowered. Alternatively, these aspects of the VCCS redesign might not bother adjunct faculty because they did not have the expectation of being highly involved in the process. This difference in expectations could also explain the difference in Empowerment for faculty that had previous experience teaching developmental math and those that did not.

**Implications for practice.** The results of evaluation question four highlight the importance of providing professional development and support whenever faculty members are required to implement redesigned developmental math courses. This training should be focused on all faculty, not just adjunct and inexperienced faculty, since those that felt least empowered were those that had previous experience teaching developmental and college level math classes and were full-time. Since full-time faculty and faculty with previous teaching experience felt significantly less empowered, it would be prudent to focus professional development on the needs of specific faculty groups. Full-time faculty and faculty that have previous experience may have different
expectations or need different content in their professional development to feel as empowered as adjunct faculty and faculty that have not taught a developmental or college-level math course. Support for these different groups should take into consideration differences in need and expectations. Of note, faculty members commented that they felt the redesign was not working, but evidence by Edgecombe (2016) clearly illustrates improvements in student success. The mismatch of these two conclusions highlights the need for leaders to better frame the change process and outcomes.

**Future research.** Research should be conducted to better understand the professional development needs of faculty. If faculty need to feel empowered, as Kotter (2012) suggests, it makes sense to focus on what institutional support faculty needs to feel empowered and to provide that support. It was interesting that only one faculty member (quoted earlier in this chapter), mentioned professional development. In that same quote, the faculty member mentioned that professional development was ongoing as developmental education has been tweaked throughout the change process. A change effort on the scale of the developmental math redesign needs to make sure that it does not neglect amply preparing faculty to actually implement redesigned courses or the investment into redesigning the courses in the first place is a waste.

**Critique of this Research Study**

There are three main areas of this study that need to be critiqued. They include the sample, the methodology, and execution.

**Sample.** A larger sample would have been preferable. In order to run CFA and EFA, I needed to have at least 100 respondents (O’Rourke & Hatcher, 2013). I was able
to get 110 respondents, but it is better to have a large a sample as possible for both CFA and EFA (O’Rourke & Hatcher, 2013). Having more representation of each demographic variable would have been better as well. There was some analysis that would not run for both EFA and ANOVA because of a small group size or missing cases. Having representation of those groups would have made the analysis more robust. Lastly, it would have been preferable to have more demographic information about the total population to better assess for response bias.

**Methods.** An online anonymous survey methodology was chosen because of the ease of access for the population (all VCCS faculty have an email address) and because of the sensitive nature of the study. This study asked faculty to respond honestly to questions about the developmental math redesign, which in many cases could be critical of the redesign. Therefore, I wanted to make sure that anonymity was preserved because F. J. Fowler (2009) indicates that when responses are anonymous they are more likely to be honest if the survey requests sensitive information. However, one criticism of methods that solicit volunteer feedback is that it is impossible to know the respondent's motivation for participating in the study (F. J. Fowler, 2009). In this study, I would imagine that strong opinions on the subject would be a significant motivator for participation, and this rationale could result in possible response bias (in this case negatively bias results).

**Execution.** I made one notable mistake when conducting the study. I left off the free response question for the first 30 respondents. The free response question, which asked faculty if they had anything else to share about the developmental math redesign provided valuable information and insight to how faculty felt about the process. While
this did not invalidate the results of the study, I think that this study missed an opportunity to capture valuable feedback that group of early responders had to share.

**Conclusion**

As the literature suggests, change is difficult (Black, 2013; Drucker, 1994 Kezar, 2014; Kotter, 2012), and developmental math is an area that needs to be improved though change efforts because it has been shown to be ineffective (Bailey, et al., 2013; Calcagno & Long, 2008; Martorell, 2007; Martorell & McFarlin, 2010). The VCCS should be commended for grappling with this problem in such a comprehensive manner because it was no easy undertaking.

One important positive finding for the developmental math redesign is that this study confirmed that the initiative was grounded on sound change theory and faculty recognized it. Kezar (2014) suggests that most leaders do not even acknowledge the change process or rely on overly simplistic theories of change. This was not the case for the developmental math redesign. The emergence of Urgency/Empowerment also provides some evidence that Kotter’s (2012) steps may need to be rethought when used as a framework for studies that involve retroactive sensemaking.

However, there was evidence that faculty did not approve of the change process, and do not feel that the redesigned courses are positively impacting students. In fact, the majority of faculty who participated in the free responses indicated that they felt redesigned courses produced negative outcomes for students, faculty, and their institutions. This is not necessarily the case because, as noted in Chapter 2, there is empirical evidence showing positive outcomes for students. I believe that part of the disconnect between faculty perceptions and the initial data has to deal with the findings
from the VCCS IR Office where the number of students passing gatekeeper courses has increased, but the percentage of students completing developmental math has decreased.

As discussed earlier, some faculty members saw inequalities between institutions within the system concerning their ability to offer developmental math course. These claims were supported by the VCCS IR Office report because while the overall system completion rate was only down slightly completion of gatekeeper courses varied dramatically between institutions. I believe that this explains the disconnect between the positive results reported by the VCCS IR Office and faculty perceptions.

The evidence of wide variation in students’ completion of gatekeeper courses between institutions suggests that the redesign was not implemented in a uniform manner. Faculty free responses about differences in developmental math offerings between colleges provide evidence of differences in implementation. Also, the differences in EFA results between NVCC and TCC indicate that implementation and possibly leaders framing of the change process was different between colleges. Framing, in particular, seemed to be a missed opportunity throughout the redesign. While the VCCS reports written by task forces and teams associated with redesigning developmental math show clear evidence of framing the need for change—based on the large number of students needing developmental math and the small number of students completing it—there is little evidence that there was a specific effort by the system office to frame the results of the developmental math redesign in a positive light.

For example, the VCCS IR report on the outcomes of the developmental math redesign really just focused on the data without an intentional focus on framing the developmental math redesign as a success. Eddy (2010) indicates that framing impacts
perceptions and can help produce positive outcomes. So it is concerning that there was not an intentional focus on framing the success of the redesign. This could have been done by focusing on the positives and pushing an intentionally framed narrative of the redesign’s success. This intentionally framed narrative from the system office would have also helped frame the success of the redesign for institutional leaders. In turn, institutional leaders could have used the system office message to frame their messages about the success of the developmental math redesign to faculty at their institutions. This not only has the added benefit of improving institutional outcomes simply because discussion about the redesign is positive, but promotes a shared perception between all VCCS Colleges which could help lead to a more uniform implementation system wide.

Qualitative data in the form of success stories could have also provided some more personal evidence that the developmental math redesign was working and further supported the success narrative.

Kotter and Cohen (2002) suggest humanizing data or providing concrete examples to illustrate the need to change can help facilitate changing individuals’ behavior and reduce resistance. Sharing stories of students that were struggling in developmental math courses and the barriers they needed to overcome could have helped humanized the data and helped faculty feel a sense of Urgency about change. The emergence of Urgency/Empowerment further supports the importance of framing change as successful because the Empowerment portion of the hybrid factor specifically focused on perceptions of the change initiatives success. If perceptions of success influence beliefs about Urgency as this study suggests then positive framing is extraordinarily important in improving participation in a change initiative. So framing needs to be a
priority when engaged in change because positive framing positively influences outcomes (Eddy, 2010).

Framing also needs to take into account the needs of specific different demographic groups. As shown in the significantly different results between full-time and adjunct faculty regarding Empowerment. This shows that different groups may need the message framed differently in order to view it positively and feel that there is a need to change and that they have the ability to make necessary changes. Evaluating the change process as it is unfolding can allow leaders to better know which groups are lacking in Urgency, Communication, and Empowerment, and allow them to tailor their messages to individual groups within the campus community.

The second recommendation would be to focus on preserving faculty autonomy within classrooms. Allowing faculty to retain the ability to differentiate instruction and meet students’ needs within curricular reform efforts would allow this to occur. Another way would be to include more math and developmental math faculty on the guiding coalition. Faculty comprised approximately a third of the DMRT, and this group made most of the recommendation for redesigned math courses. Increasing that group to include approximately half math and developmental math faculty could have helped or simply providing a vetting process so that more math and developmental math faculty were able to comment on and influence the policy recommendations before they were set in stone.

Improving the change process by intentionally, positively farming outcomes of change initiatives and by not ignoring important cultural aspects such as faculty autonomy, in this case, could have had a positive effect on the redesign’s outcomes.
Other colleges and systems that decide to redesign developmental math or engage in any large-scale curriculum change effort would be wise to focus on evaluating the change process from faculty’s perspective to ensure that there is Urgency, Communication, and Empowerment. System leaders should recognize the power of intentionally framing system-wide changes as a success, and the positive effect that framing could have on institutional leaders, faculty, and ultimately student outcomes system wide.
APPENDIX A

FIRST SURVEY

Introduction: In 1995, John Kotter developed an eight-step change framework based on his analysis of change efforts at many different institutions over approximately 15 years time. The framework was designed as a leader's guide for effective change. In 2009, the Virginia Community College System (VCCS) started a reengineering initiative that involved redesigning developmental math courses. There are 30 statements in this survey based on three steps of Kotter's eight step change framework. The statements will be used to develop a survey that will assess faculty perceptions concerning the implementation of the developmental math redesign at VCCS institutions. This survey is intended to provide content validation of potential survey statements.

Consent: The general nature of this study entitled “Perceptions of change in the Virginia Community College System developmental mathematics redesign”, conducted by Michael Adkins, has been explained to me. I understand that I will be asked to review potential survey statements. These statements will be used to create a survey, which will assess faculty perceptions concerning the implementation of the developmental math redesign at VCCS institutions. There are no expected risks associated with this research. My participation in this study should take a total of about 30 minutes. I understand that my responses will be confidential and that my name will not be associated with any results of this study. I know that I may refuse to answer any question asked and that I may discontinue participation at any time. Potential risks resulting from my participation in this project have been described to me. I am aware that I may report dissatisfaction with any aspect of this experiment to the Chair of the Protection of Human Subjects Committee by phone at 1-855-800-7187 or consent@wm.edu. I am aware that I must be at least 18 years of age to participate. My selecting to participate below signifies my voluntary participation in this project.

- I consent to participate in this research study

Example: Respondents were provided the following question cluster (Directions, Statement, Question 1, Question 2, Question 3, and Question 4) for each potential survey question.

Directions: You will be provided a statement and asked to respond to four different questions about the statement. The questions include: Question 1: Which of Kotter's steps do you think best represents the statement? Question 2: How relevant do you think the statement is to the step it represents? Question 3: Is the statement's language clear? Question 4: Do you have any comments? You will be required to answer questions one through three. Question four is optional. Please answer each question to the best of your ability.
Statement: I think that prior to the developmental math redesign developmental math courses were barriers to students’ program completion.

Question 1: Which of Kotter's steps do you think best represents the statement?
- Establish a sense of urgency: Establishing a sense of urgency requires that a large majority of participants in the change process agree that there is a need to change.
- Communicate the vision: Communicating the vision effectively requires that communication is clear, continuous, positive, and utilizes multiple vehicles (such as emails, meetings, newsletters, etc.). There should be dialog concerning the change process.
- Empower others to act on the vision: Empowering others to act on the vision requires that participants in the change process understand the goals of change, are provided with training, are committed to change, and are encouraged to develop innovative practices. Changes in policies and practices must align with the goals of the change initiative.

Question 2: How relevant do you think the statement is to the step it represents?
- Highly relevant
- Somewhat relevant
- Not at all relevant

Question 3: Is the statement's language clear?
- Yes
- No

Question 4: Do you have any comments?

Other Statements included in the survey

I think that it was necessary to redesign the content of developmental math courses to improve student completion rates in developmental math courses.

I think that it was necessary to redesign the format of developmental math courses to improve student completion rates in developmental math courses.

I think that prior to the developmental math redesign there was a disconnect between the content of developmental math courses and the math competency required for students to be successful in college credit-bearing math courses.

I think that at least 75% of faculty believe that developmental math courses needed to be redesigned.

I think that it was necessary to redesign the format of developmental math courses to improve student completion rates in college credit-bearing math courses.
I think that it was necessary to redesign the content of developmental math courses to improve student completion rates in college credit-bearing math courses.

I think that prior to the developmental math redesign the developmental math sequence required more time to complete than necessary.

I think that it was necessary to redesign the math placement test for students to be placed correctly in math courses.

I think that it was necessary to redesign developmental math courses to improve student learning.

I think that leaders within my college used multiple vehicles (such as emails, meetings, newsletters, etc.) to communicate changes in developmental math courses.

I think that the goals of the developmental math redesign were clearly communicated.

I think that the goals of the developmental math redesign were repeatedly communicated.

I think that leaders within my college actively communicate their support for achieving the goals of the developmental math redesign.

I think that some leaders within my college do not communicate their support for achieving the goals of the developmental math redesign.

I think that leaders have demonstrated how faculty should facilitate redesigned developmental courses.

I think that policy changes concerning developmental math courses are communicated in a way that encourages dialog between leaders and faculty members.

I think that leaders engaged in a dialog with faculty concerning the initial implementation of the developmental math redesign at my college.

I think that leaders explain any inconsistencies in the policies concerning the redesigned developmental math courses.

I think that leaders communicate their expectations for developmental math faculty performance.

I think that instructors are encouraged to use creative instructional methods in redesigned developmental math courses.

I think that MTT coursework is aligned with the goals of the developmental math redesign.
I think that MTE coursework is aligned with the goals of the developmental math redesign.

I think that I understand the goals of the developmental math redesign.

I think that I am committed to the goals of the developmental math redesign.

I think that leaders in my college are committed to the goals of the developmental math redesign.

I think that faculty were trained how to facilitate MTT courses.

I think faculty were trained how to facilitate MTE courses.

I think that faculty were trained how to facilitate Hybrid MTT courses.

I think I am successful as an instructor facilitating redesigned developmental math courses.
APPENDIX B
SECOND SURVEY

Introduction: In 1995, John Kotter developed an eight-step change framework based on his analysis of change efforts at hundreds of institutions over approximately 15 years time. The framework was designed as a leader's guide for effective change. In 2009, the Virginia Community College System (VCCS) started a reengineering initiative that involved redesigning developmental math courses. There are 18 statements in this survey based on three steps of Kotter's eight step change framework. This survey is intended to better understand how faculty would evaluate the change process used by the VCCS during the developmental math redesign.

Consent: The general nature of this study entitled "A Faculty Change Process Evaluation of the VCCS' Developmental Math Redesign", conducted by Michael Adkins, has been explained to me. I understand that I will be asked to respond to survey statements. These statements will be used to assess faculty perceptions concerning the implementation of the developmental math redesign at VCCS institutions. There are no expected risks associated with this research. My participation in this study should take a total of about 10-15 minutes. I understand that my responses will be confidential and that my name will not be associated with any results of this study. I know that I may refuse to answer any question asked, and that I may discontinue participation at any time. Potential risks resulting from my participation in this project have been described to me. I am aware that I may report dissatisfaction with any aspect of this experiment to the Chair of the Protection of Human Subjects Committee by phone at 1-855-800-7187 or consent@wm.edu. I am aware that I must be at least 18 years of age to participate. My selecting to participate below signifies my voluntary participation in this project.
- I consent to participate in this research study

Example: Respondents were provided the following question cluster (Directions, Statement, Question 1, and Question 2) for each potential survey question.

Directions: The survey statement below appears as it will on a finalized survey which will be sent to math faculty. You do not need to answer whether or not you agree or disagree with the statement. Please indicate whether the statement's language is clear and provide any comments you may have.

Statement: I think prior to the developmental math redesign, developmental math courses were barriers to students’ program completion.
- Strongly Agree
- Agree
- Somewhat Agree
- Somewhat Disagree
- Disagree
- Strongly Disagree

**Question 1:** Is the survey statement's language clear?

- Yes
- No

**Question 2:** Do you have any comments?

**Other Statements included in the survey**

I think the format of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.

I think the content of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.

I think prior to the developmental math redesign, the developmental math sequence required more time than necessary to complete.

I think it was necessary to redesign the math placement test for students to be placed correctly in math courses.

I think it was necessary to redesign developmental math courses to improve student learning.

Leaders at my college used multiple modes of communication (email, meetings, newsletters, etc.) to inform faculty about changes to developmental math courses.

I think leaders at my college clearly communicated the goals of the developmental math redesign.

Leaders at my college repeatedly communicated the goals of the developmental math redesign.

I think leaders at my college communicated their support for increasing developmental math students’ completion rates in college credit-bearing math courses.

Leaders at my college engaged in dialog with faculty concerning policy changes to developmental math courses.

Leaders at my college engaged in dialog with faculty during the initial implementation of the developmental math redesign.
Instructors are encouraged to use creative instructional methods in redesigned developmental math courses.

I think redesigned developmental coursework makes it easier for students to learn developmental math content.

I think the main goal of the developmental math redesign is increasing students’ completion rates in college credit-bearing math courses.

I think that redesigned developmental math courses increase students’ completion rates in college credit-bearing math courses.

Faculty are trained how to facilitate redesigned developmental math courses.

I am committed to improving developmental math students’ completion rates in college credit-bearing math courses.
APPENDIX C

FINAL SURVEY

Introduction: In 2009, the Virginia Community College System (VCCS) started a reengineering initiative that involved redesigning developmental math courses. This survey is intended to evaluate the change process used during the Developmental Math Redesign based on VCCS developmental math and math faculty perceptions of the change process. The survey is 28 questions long.

Eligibility: This study is limited to math and developmental math faculty who were teaching at a VCCS college anytime from the Fall 2011 to the Fall 2013 semesters. Were you teaching at VCCS college anytime from the Fall 2011 to the Fall 2013 Semester?

☐ Yes
☐ No

Consent: The general nature of this study entitled “An Evaluation of the VCCS Developmental Math Redesign from a Faculty Perspective”, conducted by Michael Adkins, has been explained to me in the introduction. I understand that I will be asked to respond to survey questions. These questions will be used to assess your perceptions of the implementation of the Developmental Math Redesign at VCCS institutions. There are no expected risks associated with this research. My participation in this study should take a total of about 10 minutes. I understand that my responses will be anonymous and that I will not be associated with any results of this study. I know that I may refuse to answer any question asked, and that I may discontinue participation at any time. Potential risks resulting from my participation in this project have been described to me. I am aware that I may report dissatisfaction with any aspect of this experiment to the Chair of the Protection of Human Subjects Committee by phone at 1-855-800-7187 or consent@wm.edu. I am aware that I must be at least 18 years of age to participate. My selecting to participate below signifies my voluntary participation in this project.

☐ I consent to participate in this research study (1)
☐ I do not consent to participate in this research study (2)

Directions: Please indicate whether you strongly agree, agree, somewhat agree, somewhat disagree, disagree, or strongly disagree with the following statements. Your responses should be based on your opinions, and perceptions of the implementation of the Developmental Math Redesign at a VCCS college where you worked sometime between the Fall 2011 and Fall 2013 Semester. If you worked at multiple VCCS colleges, please use your experience from your primary institution as the basis for all your answers.
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree (6)</th>
<th>Agree (5)</th>
<th>Somewhat agree (4)</th>
<th>Somewhat disagree (3)</th>
<th>Disagree (2)</th>
<th>Strongly disagree (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to the developmental math redesign, developmental math courses were barriers to students’ program completion.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The format of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The content of developmental math courses needed to be redesigned to improve student completion rates in college credit-bearing math courses.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior to the developmental math redesign, the developmental math sequence required more time than necessary to complete.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was necessary to redesign the math placement test for students to be placed correctly in math courses. It was necessary to redesign developmental math courses to improve student learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaders at my college used multiple modes of communication (email, meetings, newsletters, etc.) to inform faculty about changes to developmental math courses.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly agree (6)</td>
<td>Agree (5)</td>
<td>Somewhat agree (4)</td>
<td>Somewhat disagree (3)</td>
<td>Disagree (2)</td>
<td>Strongly disagree (1)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>--------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Leaders at my college clearly communicated the goals of the developmental math redesign.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Leaders at my college repeatedly communicated the goals of the developmental math redesign.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Leaders at my college communicated their support for increasing developmental math students’ completion rates in college credit-bearing math courses.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Leaders at my college engaged with faculty concerning policy changes to developmental math courses.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Leaders at my college engaged in a dialog with faculty during the initial implementation of the developmental math redesign.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Faculty are encouraged to use creative instructional methods in redesigned developmental math courses.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Redesigned developmental coursework makes it easier for students to learn developmental math content.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>The main goal of the developmental math redesign is increasing students’ completion rates in college credit-bearing math courses.</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly agree (6)</td>
<td>Agree (5)</td>
<td>Somewhat disagree (4)</td>
<td>Somewhat agree (3)</td>
<td>Disagree (2)</td>
<td>Strongly disagree (1)</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>--------------------</td>
<td>--------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Redesigned developmental math courses increase students’ completion rates in college credit-bearing math courses.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Faculty are provided professional development opportunities on how to facilitate redesigned developmental math courses.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am committed to improving developmental math students’ completion rates in college credit-bearing math courses. (18)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
**Directions:** Please indicate whether you were extremely involved, moderately involved, slightly involved, or not involved. Your response should be based on your opinions and perceptions of the implementation of the Developmental Math Redesign at a VCCS college where you worked sometime between the Fall 2011 and Fall 2013 Semester. If you worked at multiple VCCS colleges, please use your experience from your primary institution as the basis for your answer.

<table>
<thead>
<tr>
<th>How involved were you in the redesign process?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Involved (4)</td>
</tr>
</tbody>
</table>

**Directions:** Please indicate whether the changes were extremely impactful, moderately impactful, slightly impactful, or not impactful. Your response should be based on your opinions and perceptions of the implementation of the Developmental Math Redesign at a VCCS college where you worked sometime between the Fall 2011 and Fall 2013 Semester. If you worked at multiple VCCS colleges, please use your experience from your primary institution as the basis for your answer.

<table>
<thead>
<tr>
<th>How do you judge the impact of the changes made to developmental math on your campus?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Impactful (4)</td>
</tr>
</tbody>
</table>

**Free response question:** Is there anything else you would like to share about The Developmental Math Redesign?

**Directions:** The following questions involve demographic information. Please answer them to the best of your ability.

What is your gender identity?
- [ ] Male
- [ ] Female
- [ ] Other

What is your employment status?
- [ ] Full-time faculty
- [ ] Adjunct faculty
- [ ] Both
Please select the primary college you taught at during the fall 2011 – fall 2013 time frame.

- Blue Ridge Community College
- Central Virginia Community College
- Dabney S Lancaster Community College
- Danville Community College
- Eastern Shore Community College
- Germanna Community College
- J Sargeant Reynolds Community College
- John Tyler Community College
- Lord Fairfax Community College
- Mountain Empire Community College
- New River Community College
- Northern Virginia Community College
- Patrick Henry Community College
- Paul D Camp Community College
- Piedmont Virginia Community College
- Rappahannock Community College
- Southside Virginia Community College
- Southwest Virginia Community College
- Thomas Nelson Community College
- Tidewater Community College
- Virginia Highlands Community College
- Virginia Western Community College
- Wytheville Community College

If you taught at more than one college from fall 2011 - fall 2013, please select your secondary college.

- Blue Ridge Community College
- Central Virginia Community College
- Dabney S Lancaster Community College
- Danville Community College
- Eastern Shore Community College
- Germanna Community College
- J Sargeant Reynolds Community College
- John Tyler Community College
- Lord Fairfax Community College
- Mountain Empire Community College
- New River Community College
- Northern Virginia Community College
- Patrick Henry Community College
- Paul D Camp Community College
- Piedmont Virginia Community College
- Rappahannock Community College
Southside Virginia Community College
Southwest Virginia Community College
Thomas Nelson Community College
Tidewater Community College
Virginia Highlands Community College
Virginia Western Community College
Wytheville Community College

How many years have you been teaching in the VCCS?
- 3-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- More than 20 years

Did you teach a developmental math course prior to spring 2012?
- Yes
- No

Have you taught a college level credit-bearing math course?
- Yes
- No
APPENDIX D

EMAILS SENT TO FACULTY DURING DATA COLLECTION

Appendix D contains the content of the emails sent to faculty to solicit their participation in this study.

First Email: Sent on September 19, 2016

Good Morning,

My name is Mike Adkins and I have been an academic advisor for over four years at Thomas Nelson Community College. For my dissertation research as a doctoral candidate at The College of William and Mary, I am examining math and developmental math faculty perceptions of the change processes used at VCCS institutions during The Developmental Math Redesign from Fall 2011 to 2013. Because you are a math or developmental math faculty, I am inviting you to participate in this research study by completing the survey which can be accessed by clicking on the link below.

The survey will require approximately 10 minutes to complete. There is no compensation for responding nor is there any known risk. The survey is anonymous, so any answers you provide will not be attributed to you. Please answer all questions as honestly as possible. Participation is strictly voluntary and you may refuse to participate at any time.

Thank you for taking the time to assist me in my educational endeavors. The data collected will allow us to better understand how faculty perceived the change processes used at their colleges during The VCCS Developmental Math Redesign. If you would like a copy of this study please email me at mfadkins@email.wm.edu. If you require additional information or have questions, please contact me at mfadkins@email.wm.edu or 757-345-1576.

Thanks,

Mike

Follow this link to the Survey:
${l://SurveyLink?d=Take the survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}
Second Email: Sent on September 26, 2016

Good Evening,

This is Mike Adkins again, and I wanted to thank those that have taken the time to complete my dissertation research survey.

I will close the survey in one week on Monday, October 3, 2016, at midnight. If you have not completed the survey, I would really appreciate your participation in my study. You can access the survey by clicking on the link below. It should only take about 10 minutes to complete.

Your input is critical to better understanding how faculty perceived the change processes used at VCCS institutions during The Developmental Math Redesign. The survey is anonymous, so any answers you provide will not be attributed to you. Thank you in advance for participating in my research.

If you have any questions, please email me at mfadkins@email.wm.edu.

Thanks!

Mike

Follow this link to the Survey:
${l://SurveyLink?d=Take the survey}

Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Follow the link to opt out of future emails:
${l://OptOutLink?d=Click here to unsubscribe}

Third Email: Sent on September 29, 2016

Good Evening,

I wanted to say thank you again to those that have taken the time to complete my survey.

I also wanted to send one final reminder that I will be closing the survey on Monday, October 3, 2016, at midnight. If you have not completed the survey, I would really appreciate your participation in my study. You can access the survey by clicking on the link below. It should only take about 10 minutes to complete.

Your input is critical to better understanding how faculty perceived the change processes used at VCCS institutions during The Developmental Math Redesign. The survey is anonymous, so any answers you provide will not be attributed to you. Thank you in
advance for participating in my research.

If you have any questions, please email me at mfadkins@email.wm.edu.

Thanks!

Mike

Follow this link to the Survey:  
${l://SurveyLink?d=Take the survey}

Or copy and paste the URL below into your internet browser:  
${l://SurveyURL}

Follow the link to opt out of future emails:  
${l://OptOutLink?d=Click here to unsubscribe}
APPENDIX E

VCCS COLLEGE ABBREVIATIONS AND FULL NAMES

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full College Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRCC</td>
<td>Blue Ridge Community College</td>
</tr>
<tr>
<td>CVCC</td>
<td>Central Virginia Community College</td>
</tr>
<tr>
<td>DCC</td>
<td>Danville Community College</td>
</tr>
<tr>
<td>DSLCC</td>
<td>Dabney S. Lancaster Community College</td>
</tr>
<tr>
<td>ESCC</td>
<td>Eastern Shore Community College</td>
</tr>
<tr>
<td>GCC</td>
<td>Germanna Community College</td>
</tr>
<tr>
<td>JSRCC</td>
<td>J. Sargent Reynolds Community College (Reynolds)</td>
</tr>
<tr>
<td>JTCC</td>
<td>John Tyler Community College</td>
</tr>
<tr>
<td>LFCC</td>
<td>Lord Fairfax Community College</td>
</tr>
<tr>
<td>MECC</td>
<td>Mountain Empire Community College</td>
</tr>
<tr>
<td>NRCC</td>
<td>New River Community College</td>
</tr>
<tr>
<td>NVCC</td>
<td>Northern Virginia Community College</td>
</tr>
<tr>
<td>PDCCC</td>
<td>Paul D. Camp Community College</td>
</tr>
<tr>
<td>PHCC</td>
<td>Patrick Henry Community College</td>
</tr>
<tr>
<td>PVCC</td>
<td>Piedmont Virginia Community College</td>
</tr>
<tr>
<td>RCC</td>
<td>Rappahannock Community College</td>
</tr>
<tr>
<td>SVCC</td>
<td>Southside Virginia Community College</td>
</tr>
<tr>
<td>SWCC</td>
<td>Southwest Virginia Community College</td>
</tr>
<tr>
<td>TCC</td>
<td>Tidewater Community College</td>
</tr>
<tr>
<td>TNCC</td>
<td>Thomas Nelson Community College</td>
</tr>
<tr>
<td>VHCC</td>
<td>Virginia Highlands Community College</td>
</tr>
<tr>
<td>VWCC</td>
<td>Virginia Western Community College</td>
</tr>
<tr>
<td>WCC</td>
<td>Wytheville Community College</td>
</tr>
</tbody>
</table>
APPENDIX F

PERMISSION TO USE COPYRIGHTED MATERIAL FOR TABLE 5

Email Response from Adrianna Kezar

4/5/2017  William & Mary Mail - Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ ref:00D300eGz_500a01JE3LH:ref ]

Mike Adkins <mfadkins@email.wm.edu>

Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ ref:00D300eGz_500a01JE3LH:ref ]

Adrianna Kezar <kezar@rossier.usc.edu>  To: Mike Adkins <mfadkins@email.wm.edu>  Wed, Apr 5, 2017 at 10:43 AM

No problem I give you permission to use it but only in your dissertation. Best of luck and glad to see you are using it!

Adrianna Kezar, PhD, Professor, USC, Co-director Pullias Center and Director Delphi Project

See info on Delphi Project on Changing Faculty and Student Success at -- www.thechangingfaculty.org
See info on my change and leadership research at - http://www.adriannakezar.com/
Or follow us on Twitter: @DelphiEdu
Email to Adrianna Kezar

4/5/2017  William & Mary Mail - Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ref: _00D30oeGz_500a01JE3LH:ref]

Mike Adkins <mfadkins@email.wm.edu>

Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ref: _00D30oeGz_500a01JE3LH:ref]

Mike Adkins <mfadkins@email.wm.edu>  To: KEZAR@rossier.usc.edu

Wed, Apr 5, 2017 at 12:12 AM

Hello Dr. Kezar,

I am trying to get permission to use an adapted version of Table 2.1 from pages 24 and 25 of your book How Colleges Change: Understanding, Leading, and Enacting Change in my dissertation. I followed the process outlined by the Taylor & Francis website but they told me to contact the copyright owner directly (I've included the response in the email below). I am assuming that is you but wasn't sure because they didn't explicitly state who the copyright holder was. I have attached a copy of the Table I plan on using in my dissertation. I would greatly appreciate your permission. If I should be contacting someone else, please let me know and I won't bug you again.

Thank you!
Mike Adkins
[Quoted text hidden]

Adkins_Table5_Kezar.pdf
328K

Email Response from Taylor & Francis

4/5/2017  William & Mary Mail - Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ref: _00D30oeGz_500a01JE3LH:ref]

Mike Adkins <mfadkins@email.wm.edu>

Case #00289720 - Permission to include an adapted copyrighted table in my dissertation [ref: _00D30oeGz_500a01JE3LH:ref]

info@copyright.com <info@copyright.com>  To: mfadkins@email.wm.edu <mfadkins@email.wm.edu>

Tue, Apr 4, 2017 at 10:55 PM

Dear Mike Adkins,

Thank you for contacting Copyright Clearance Center (CCC). CCC provides permission for the reproduction and distribution of copyrighted materials in print and electronic formats on behalf of copyright owners who list their titles with us.

CCC does not currently handle the type of use you are requesting for this particular title. Please contact the copyright owner directly for permission and feel free to include this letter in your correspondence with them for further clarification if necessary:

permissionrequest@tandf.co.uk
Taylor & Francis Group
4 Park Square
Milton Park
Abingdon
Oxfordshire
United Kingdom
OX14 4RN

If you have any further questions regarding CCC’s services, please contact a Customer Service Representative at 855-239-3415 Monday-Friday, 24 hours/day or email info@copyright.com.

170
Email to Taylor & Francis for Permission to Use Copyrighted Material

-------- Original Message --------
From: Mike Adkins [mfadkins@email.wm.edu]
Sent: 4/4/2017 8:22 PM
To: info@copyright.com
Subject: Permission to include an adapted copyrighted table in my dissertation

Good Evening,

My name is Mike Adkins and I am a doctoral student at the College of William and Mary. I wanted to get permission to include a table I adapted from a table in the book How Colleges Change: Understanding, Leading, and Enacting Change. I have included the recommended information from the Taylor & Francis website below:

https://mail.google.com/mail/u/0/?ui=2&ik=77d00ce5358&prev=search&inbox&view=pt&search=all&smi=15bc377baa68&cb=0

4/5/2017 William & Mary Mail - Case #00285720: Permission to include an adapted copyrighted table in my dissertation [ref: 00D300exG2_500a0UE3LH ref]
- Title and author of the work from which you wish to reprint: How Colleges Change: Understanding, Leading, and Enacting Change by Adrianna Kezar
- ISBN/ISSN: 978-0415532068
- The imprint: Routledge, Taylor & Francis
- Page number of table: Table 2.1 pages 24 and 25. I have adapted it to use in my dissertation
- Title and publisher of your book, proposed date of publication, print run and price:
- An Evaluation of the VCCS Developmental Math Redesign from a Faculty Perspective (It’s a Dissertations), ProQuest: Dissertation and Thesis Complete, May 2017 (ASAP), no print run, $0
- Requested rights (translation, e-book, etc.): I want to include an adapted version of Kezar’s Table 2.1 in my dissertation.
- Territories of distribution for which you require permission (US, North America, world, etc.): Distribution would be worldwide to any college that pays to us the ProQuest Dissertation and Thesis Complete database.

Let me know if you have any questions.

Mike Adkins
REFERENCES


VITA

Michael F. Adkins II
Born 9/27/1984 in Arlington, VA

Education


The University of Virginia, Charlottesville, VA, (M.Ed.) Master of Education in Higher Education specialization in Student Affairs Practice in Higher Education (2011)

Christopher Newport University, Newport News, VA, (BA) Bachelor of Arts in Philosophy (2009)

Employment

Northwest College, Powell, WY (January 2017 – Present)
Academic and Career Advising Coordinator

Thomas Nelson Community College, Hampton, VA (January 2012 – January 2017)
Academic Advisor at the Historic Triangle Campus – Williamsburg, VA

Piedmont Virginia Community College, Charlottesville, VA (August 2010 – May 2011) Student Success Advising Intern

Christopher Newport University, Newport News, VA (January 2009 – May 2009)
Writing Assistant