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THE ROLE OF TEACHER EDUCATION PROGRAMS IN FOSTERING PRE-SERVICE TEACHERS' SELF-EFFICACY IN MATHEMATICS

A dissertation submitted in fulfillment
of the requirements for the degree of

DOCTOR OF EDUCATION

to the faculty of the

DEPARTMENT OF ADMINISTRATIVE AND INSTRUCTIONAL LEADERSHIP

of

THE SCHOOL OF EDUCATION

at

ST. JOHN'S UNIVERSITY
New York
by
Christina A. Miller

Date Submitted 5/11/2021 Date Approved 5/19/2021

Christina A. Miller	Dr. Stephen Kotok

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ABSTRACT

THE ROLE OF TEACHER EDUCATION PROGRAMS IN FOSTERING PRESERVICE TEACHERS' SELF-EFFICACY IN MATHEMATICS

Christina A. Miller

The purpose of this study is: (1) To examine the perceptions of preservice teachers in teacher education programs in relationship to self-efficacy with the focus on mathematics, (2) Compare student's self-efficacy based upon the year in college, (3) Compare student's self-efficacy based upon their concentration, and (4) Compare student's self-efficacy based upon the program they are enrolled in. With the Common Core State Standards in Mathematics (CCSSM) being introduced and implemented in 2010, many preservice teachers currently enrolled in college courses would not have been exposed to said standards while students in elementary school. Therefore, with their first introduction to pedagogy and vocabulary for CCSSM likely occurring during their college mathematics methodology classes and through their student teaching experiences, there is a deficiency of foundational knowledge to draw upon. The study participants were students enrolled full-time from the School of Education who will be entering their sophomore, junior or senior year, all concentrations, and in the elementary or adolescent education program. Based upon the results of the Mathematics Teaching Efficacy Beliefs Instrument, the results showed that there were no significant differences based upon the year within the program nor program type. However, participants with concentrations in mathematics scored higher than those with "other" concentrations.

DEDICATION

I would like to dedicate this paper to my family beginning with my parents, Grace and George, who taught me the importance of an education, perseverance, and dedication from the very beginning. It is these qualities, and so many more, that by their example has made me into the person I am today.

To my son, George, who has been a witness to and a supporter of my education these 8 years, thank you for always cheering me on and talking to me through this journey. I only want you to be proud of your mother and be a positive influence in your life as you set off to fulfill your dreams.

To my brother, Thomas, in heaven, who always "had my back" growing up, I know you are watching from above with a smile on your face and a cigarette in your mouth. Hope you are proud. Still miss you.

To my sister, Lisa, and my brother, David, I am so glad that you are in my life. I have felt your support and it has helped me more than you know. And this includes Ryan, Sean, Rick, Casey, Tammy, Alex, and Rebecca as well, as you are all part of my family.

To my cousin, Nancy, for helping with personal issues that came up during this time. Your assistance took the pressure off when I needed it. Wish you lived closer.

ACKNOWLEDGEMENT

As I complete this chapter in my life, I must acknowledge those who have gotten me here. First and foremost, God, because through him all things are possible and I am an example of that.

To my mentor, Dr. Kotok, who worked with me and assisted me in every step of this process. You have been patient with me this entire time-thank you. To my friend, Dr. Avalos-Louie, for suggesting that I earn a doctorate so many years ago and then sticking by me through every course and every phase, being my soundboard, my guide. Your help has been unmeasurable. To my fellow doctoral candidates – Claudia, Lenny, Jonathan, Leah, Francesca, Nia, Asher, Sr. Agnes, and Ambeeka- we made it through the data classes helping each other out. You were my classmates who became friends. To the faculty and staff at the School of Education as your positive words have always given me confidence to continue.

I would be remiss if I did not include my friends as I am blessed to have a support group, a village, with their hands on my back, gently pushing me along, listening to my ideas, comforting me through challenging times, always accepting me for who I am. To "The Italians" – Patty, Josephine, Theresa, and Laurie- and Eileen, we met through St. John's University and have been close ever since. To my "Soul Sistas" – Lisa, Ronni, Liz, and Annemarie- I think the name says it all. To "The Prepsters" – Santina, Elaina, Jennifer, Dana, Doris, Liz, Rich, Joe, Danny, Albert, Tom, Danielle, and Lisa- you knew me when and still going strong. To "Jumpstart" – Olivier, Jasmine, and Joery- my newest friends, well-wishers, colleagues. To Marni- we have accomplished a lot this year and we will keep moving forward. To Janine- because there are no words.

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CHAPTER 1

Introduction

With the implementation of the Common Core State Standards in Math (CCSSM) in 2010, there has been on-going discussions surrounding the advantages and disadvantages of this deeper understanding of mathematical concepts. The standards look to make connections across grade levels, building upon the foundation already established with new understanding (Bay-Williams, 2016) and looked to increase students' understanding of mathematical content and skills (Faulkner, 2013; Porter, McMaken, Hwang, & Yang, 2011). Hence, educators addressing this so-called deeper, more authentic comprehension of mathematical topics must be able to address CCSSM's components of conceptual understanding, procedural skills and fluency, and application equally (Bay-Williams, 2016). Results from a national teacher survey found that although teachers were spending more time on conceptual understanding and real-world applications, the aligning of materials and assessments to the CCSSM were only done by a small fraction of teachers. Bay-Williams (2016) noted that teachers are trying to find that balance of conception, procedure, and application.

Purpose of the Study

With limited exposure to CCSSM as elementary students themselves, preservice elementary teachers have been presented with the standards of CCSSM during their two required mathematics methodology courses. With the likelihood that these future in-service teachers will be teaching mathematics in their self-contained classrooms, this study looks to examine the role these courses, within the education program, have on the self-efficacy of the preservice teachers at a private, northeastern university. Specifically, I examine their efficacy in relation to teaching mathematics topics. Studies have been

conducted noting the need for strong mathematical content background in teachers. Hill (2010) implied that teachers with this stronger background afforded their students more opportunities to learn the content as they went beyond simple problem solving. This stronger background lends itself to formidable pedagogy and less fear in students' questioning.

Although the university requires students to take two mathematics courses in addition to the two required methodology courses, the content presented often do not pertain to what the preservice teachers will be teaching in the elementary classroom. Additionally, if the CCSSM are not addressed, a further disconnect exists. We are then relying on the two semesters of mathematics methodology courses to proficiently attend to this gap in experience, knowledge, terminology, and methods for elementary education students regardless of their concentration/ minor.

Given the timeline when CCSSM was released, students enrolled in the adolescent education program with a minor in mathematics likely had an exposure to the CCSSM topics while in junior high and high school themselves. This firsthand experience, at about the age of 12, could lead to greater sense of self-efficacy when compared to the elementary education counterparts who never experienced CCSSM as elementary students themselves. The adolescent preservice teachers have, then, familiarity with CCSSM terminology and methodology and can draw from these personal experiences as they begin teaching.

Teacher education programs, therefore, in an effort to support their preservice teachers, need to sufficiently prepare them for successful classroom experiences by providing preservice teachers with multiple situations in which to demonstrate and

develop what is being taught in the college courses. That preparation will add to their beliefs in their abilities to be efficacious within their future classrooms, which, in turn, can affect students' motivation. These beliefs, then, can positively influence their personal self-efficacy, contributing to their motivation, and impact their actions.

This study will seek to ascertain the university program's role on preservice teachers' self-efficacy in teaching mathematics as they move through the program, gaining more experience and knowledge, and deduce possible program improvements.

Theoretical/ Conceptual Framework

Bandura's (1977) self-efficacy theory posits that a person's conviction of their abilities influences choices and amount of effort one will apply to challenging situations. The greater the perceived self-efficacy in accomplishing a task, the greater the likelihood for the task to be completed. Increased self-efficacy stems from four distinct sources of information: performance accomplishments, emotional arousal, vicarious experience, and verbal persuasion (Bandura, 1977). Performance accomplishments or mastery experiences are deemed most influential through successful performance which leads to an increase in self-efficacy and the perception of future accomplishments will be repeated. "Mastery expectations influence performance and are, in turn, altered by the cumulative effects of one's efforts" (Bandura, 1977, p. 142).

With performance accomplishments providing direct influence on one's self-efficacy, emotional arousal can be influential to an individual. The effects of emotions from experiences can either produce a positive or a negative result on the individual. Success attributed to ability increases efficacy whereas if it is associated with luck, that increase may not exist. Through the observance of modeled behavior, vicarious

experience connects the observer with increased self-efficacy. The greater that connection is between the observer and the model, the person being observed, the greater the influence on the observer's efficacy. If the model demonstrates success in a task, the observer feels the possibility of comparable successes through relatable similarities (Bandura, 1977).

Verbal persuasion has its greatest impact on self-efficacy through feedback. The influence from feedback to increase self-efficacy may include exploration of new techniques as constructive suggestions are provided. However, this impact is dependent upon the perception of the persuader. Bandura (1977) spoke of the persuader's prestige, expertise, and trustworthiness in having the greatest effect on efficacy change.

The same holds true for those in education. Knoblauch & Woolfolk Hoy (2008) spoke about a connection between how a teacher perceives their teaching capabilities and their teaching effectiveness. This, in turn, can affect student achievement as well as student behavior (Putnam, 2012). As the demands of updated curriculum are implemented within classrooms, teachers are faced with new challenges of reaching the diverse learners in front of them. Brown, Lee, and Collins (2015) found a connection between a teacher's self-efficacy and sense of preparedness on their ability to meet and deal with the challenges associated with the profession and their eventual success in this career.

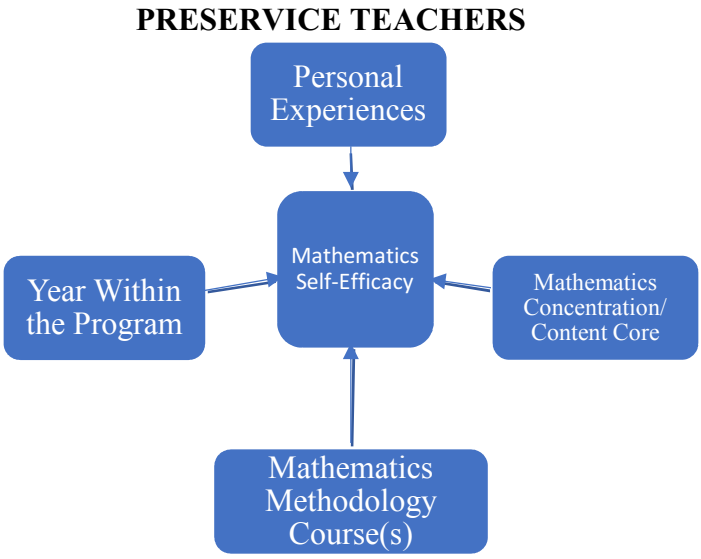
In order for teachers to reach their students, they must possess both pedagogical and subject content knowledge. Schmidt (2012) described pedagogical knowledge as classroom and instructional knowledge – motivation, lesson planning, classroom management. It can also include psychology, methods, and student understanding of

mathematics. How much teachers know regarding subject content knowledge is not clearly defined. Ball, Thames, & Phelps (2008) wrote that teacher's need to understand the curriculum as teaching involves not only demonstrating problem solving and inspecting their student's work, but having the capability of answering their questions. Mathematical knowledge for teaching (MKT) combines content knowledge with this ability to dissect student thinking and representations known as specialized content knowledge (SCK). Without SCK, teachers will be slow to respond to the soundness of the thinking strategy as it is a key factor of comprehension (Swars & Chestnutt, 2016).

An individual's sense of self-efficacy, and more directly a pre-service teacher's sense of self-efficacy in mathematics, can be fostered through personal experience infused with formal education. Through mastery experience, vicarious experience, verbal persuasion, and emotional arousal at various times within the teacher education program, the development of positive self-efficacy can occur (Figure 1).

Figure 1

Conceptual Framework



Significance of the Study

With the need to increase comprehension of mathematical content and understanding of topics with the implementation of the CCSSM, teachers must not only possess a strong mathematical background but the skills in which to teach the content. Based upon a study conducted on the PROM/SE project, it was found that elementary teachers lacked confidence to teach the content found in CCSSM and had less content knowledge based upon the proportion of mathematics majors or minors held by the elementary teachers. It has been suggested that not only the candidates for teaching have stronger mathematical backgrounds, but college preparation courses mimic the level found in high-achieving countries from TIMSS (Schmidt, 2012). This study addressed the notion that additional mathematical knowledge, in this case stemming from students having additional coursework with their mathematics concentration , provided confidence by increasing their self-efficacy.

The study also looked to see a connection between the educational program that currently exists within the university and the preparedness of the pre-service teachers in sophomore, junior, and senior year. As students progress through the program, students should become equipped with positive mastery experiences, vicarious experiences, verbal persuasion, and emotional arousal that will add to their self-efficacy and build a strong foundation for future success. With a strong foundation for teaching, teacher retention can increase. The implications of the study looked to address the need to modify the existing program and to postulate on the path that elementary education may need to go with regards to mathematics education in creating a strong foundation for elementary students provided by knowledgeable teachers. Teachers' self-efficacy not only affects

teacher attrition but ultimately and, maybe more importantly, affects student achievement and our educational system as a whole within the United States.

Connection with Social Justice and/ or Vincentian Mission in Education

As a university located in an area with diverse demographics in a large metropolitan city, it is imperative to prepare students for real-life situations within the classroom as we look to decrease teacher attrition and teacher turnover rates as their teacher candidates go on to serve students from various socioeconomic settings. With teacher turnover rates as high as 16% (Carver-Thomas & Darling-Hammond, 2017), new teachers must be supplied with the necessary skills to work with children. Carver-Thomas and Darling-Hammond (2017) reported that schools that consisted predominately of students of color or in low socioeconomic were often taught by newer and less experienced teachers. Teacher education programs are then obligated to be current in pedagogy and methodologies to ensure success for both teachers and students. Better preparation for our teacher candidates can instill confidence and self-efficacy as they embark on their teaching careers here or elsewhere, continuing with the objective that all students deserve to be educated regardless of race or socioeconomic status.

Given St. John's mission statement to foster a learning environment that is not only rich with scholarly exploration but imaginative in its methodology, this study looked to address any interruptions or disparities in these goals coming to fruition in the university studied. If there are improvements to be made for the betterment of the students we seek to educate, it is our duty to do so.

Research Questions

The study looked to add to the research on preservice teachers' self-efficacy with its focus on teaching mathematics. As students maneuver through teacher education programs, their skills should increase while gathering insights from classroom and field experiences. Students with concentrations in mathematics are exposed to up to 36 more credits than students from other concentrations, creating a more rigorous foundation.

Research Questions

1) To what extent does efficacy differ based upon the year within the program?
2) How does the self-efficacy of math concentration students compare with the self-efficacy of students with other subject concentrations on mathematics teaching?
3) How does the self-efficacy of elementary education preservice teachers compare with adolescent education preservice teachers?
4) What are the perceptions of preservice teachers in teacher education programs in relationship to self-efficacy?

Research Design and Data Analysis

The design of this study is concurrent triangulation. Both quantitative data, collected from the results of the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI), and qualitative data from participant interviews were collected and analyzed. Also known as convergent parallel, the results were assessed to examine a relationship between the results of both the quantitative and qualitative data to see if the program and/ or mathematics methodology courses affected their MTEBI scores.

An ANOVA was conducted to see if there was a significant difference between the scores on the MTEBI based upon the year within the program – sophomore, junior, or senior. An independent samples T-Test was conducted to compare the scores based upon the concentration of the participants, designated as either mathematics or "other." An independent samples T-Test was also conducted to see if there was a significant difference based upon the type of program enrolled – elementary or adolescent – of the MTEBI scores.

The participants' interviews were conducted remotely via TEAMS. They were transcribed and coded through two rounds; first coded through structural coding, a second time through pattern coding. Through the responses, themes emerged identifying the preservice teachers' perceptions on their mathematics methodology courses and education program.

Participants

The participants for both the MTEBI survey and the interview were taken from the School of Education at a large northeastern university which is comprised of two campuses. The participants were full-time enrolled students, beginning their sophomore, junior, or senior year in September of 2020. School email addresses were obtained after receiving IRB approval. Both the MTEBI survey and interview requests were sent out electronically via Qualtrics using their school email address. The responses for the MTEBI survey were collected through Qualtrics and then downloaded by the researcher into SPSS version 26. The results of the interview request were collected by the researcher and then scheduled when the participant was available.

Instruments

The Mathematics Teaching Efficacy Belief Instrument (MTEBI) was used for the quantitative portion (Appendix C) which consists of 21-item survey detailing participants responses in two subscales of Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE) using a 5-point Likert Scale created by Enochs, Smith, and Huinker (2000).

For the participant interviews, a semi-structured protocol was followed using questions found from a similar study regarding mathematics self-efficacy. Once permission from the author was obtained (Brinkman, 2019), the questions and responses were recorded and coded (Appendix E). The format allowed for clarifying questions to be asked by the researcher.

Procedures

After obtaining IRB approval and procuring the participants' school email addresses, the MTEBI survey was distributed through a link attached to a consent form through Qualtrics. After 3 weeks, a reminder email was delivered to those that either had not completed the survey in its entirety or had begun the survey. The results were collected through Qualtrics and exported to SPSS version 26. From there, the data analysis was conducted.

The same list of students received an email requesting participation in an interview which would be conducted remotely. The interviews were scheduled by the researcher and recorded in TEAMS. The interviews were then transcribed and coded where themes emerged.

Definition of Terms

Mathematics Teaching Efficacy Belief Instrument (MTEBI) - Instrument created from the modified Science Teaching Beliefs Instrument (STEBI) as a means of measuring pre-service teachers' beliefs on teaching mathematics in the future (Enochs, Smith, & Huinker, 2000).

Common Core State Standards in Mathematics (CCSSM) – detailed standards directed at providing a consensus on what mathematical content and skills are to be taught in grades K – 12 across the nation (Porter, McMaken, Hwang, & Yang, 2011).

Self-Efficacy - A person's beliefs that can influence their perseverance and motivation when confronted with challenging situations (Bandura, 2012).

CHAPTER 2

Introduction

This chapter will explore past studies that examined the effects of in-service teachers' and preservice teachers' beliefs regarding the teaching of mathematics and efficacy. Specifically, I examine what influences preservice teachers' self-efficacy from coursework to fieldwork and what interventions may have impacted self-efficacy beliefs. In addition, Bandura's personal self-efficacy theory (1977) will be discussed as the basis for the study as it links personal beliefs to effort and perseverance.

Theoretical Framework

The impact of teacher efficacy permeates all aspects of the teaching profession. "Efficacy affects the effort they invest in teaching, the goals they set, and their level of aspiration" (Tschannen-Moran & Woolfolk Hoy, 2000). This effort influences their student motivation and achievement as teachers with high self-efficacy introduce more varied forms of teaching methods to support their students. "The strength of people's convictions in their own effectiveness is likely to affect whether they will even try to cope with given situations" (Bandura, 1977). Personal self-efficacy, as described by Bandura (1977) has influence on one's actions and efforts on various activities and in differing situations. The magnitude, generality, and strength of efficacy expectations influence an individual's performance and future execution of behavior.

Efficacy expectations are affected by different forms of information provided by an individual's experience. Successes from performance accomplishments are most influential as the personal mastery experiences are reinforced as the fear of failures is reduced. Regardless of the difficulty of the experience, perseverance can overcome the occasional failure and actually strengthen the individual (Bandura, 1977).

Vicarious experience, although not as dependable as mastery experience, allows an individual to compare themselves to others while observing their behavior. Through these observations, perceived improvements on one's abilities can be created and increase performance on similar tasks furthering an individual's sense of self-efficacy and success.

If we base effective teacher education programs on Bandura's sources for influencing a preservice teacher's self-efficacy, mastery experience, vicarious experience, and verbal persuasion would need to be integral aspects of the program. Is it possible to foster these efficacy expectations in teacher education programs as it influences preservice teacher self-efficacy? Preservice teachers surveyed at the end of their teacher education programs and student teaching experiences were found to have significant correlation between these three sources of self-efficacy and scores on the *Teacher's Sense of Self-Efficacy Scale* and four scales of the *Preservice Teacher Survey* (Clark & Newberry, 2019

With verbal persuasion, through social discourse, efficacy expectations are enhanced. Although a weaker influence than others, Bandura (1977) perceived that one's self-efficacy are more apt to change when verbal persuasion is provided by a person deemed credible and trustworthy. Therefore, the amount of influence is dependent upon the individual providing feedback.

Situations can invoke emotions within individuals causing arousal of their emotions. Depending upon their sense of capabilities and ability to differentiate between threats and potential success, emotional arousal can affect perceived self-efficacy. Heightened emotions of tension and anxiety create stress and fear of failure, whereas expectations of success can modify avoidance behavior.

Self-efficacy beliefs by teachers contribute to the educational environment they create within their classrooms. Teachers with strong self-efficacy provide academic instruction infused with student interests, creating mastery experiences (Bandura, 1993). Ashton and Webb (1986) noted the relationship between student achievement and teacher self-efficacy. Regardless of the students' entering ability at the beginning of the year, a teacher's self-efficacy beliefs will predict their students' level of achievement in both mathematics and language (Bandura, 1993). It is not enough to just acquire skills and facts as self-efficacy is the transference of that knowledge into application (Maier & Curtin, 2005).

With the implementation of the Common Core State Standards in Mathematics in grades kindergarten through twelfth grade, the readiness of teachers to successfully execute these standards were met with some apprehension as there was a need for professional development to increase their preparedness. Through two surveys distributed by the RAND corporation in 2015, the American Teacher Panel (ATP) and American School Leader Panel (ASLP), teachers expressed their understanding of the standards and the type of professional development they required. Mathematics teachers in CCSS states felt less prepared to teach their students, especially high school teachers. As for professional development, differentiation and topics associated with CCSS Standards or Mathematics practice, such as problem solving and perseverance along with real-world situations, were particularly mentioned (Hamilton et al., 2016).

Efficacy and Coursework

As state requirements for teachers are both broad and diverse, the teacher education programs that exist within colleges and universities are just as varied. At a

local university to the one in this study, students are required in the elementary/ childhood program to take a mathematics for elementary teachers and a teaching mathematics course. A more urban college, about 14 miles away, requires two mathematics content classes based upon NCTM recommendations and a mathematics methodology course. The university within the study requires two mathematics methodology courses and two content mathematics classes as part of the core classes needed for the program.

The addition of extra mathematics courses can address missing information on content knowledge but may not address an individual's confidence in teaching the subject matter. If the course content cannot effectively link knowledge and efficacy or provide pedagogical alternatives, they may be irrelevant.

Participants from the Rocky Mountain Middle School Math and Science Partnership (RM-MSMSP) were surveyed using a modified version of the Science Teaching Efficacy Belief Instrument (STEBI-B) to include questions on mathematics as well as student motivation and teaching English as Second Language Learners (ESL). Increasing both the subject-matter content knowledge and pedagogical knowledge of middle school teachers was the goal of the RM-MSMSP (Swackhamer, Koellner, Basile, & Kimbrough, 2009). Through this increase in subject-matter content, there would be an increase in teachers' self-efficacy beliefs. The participants had taken at least one of the 15 courses offered through the program with the average number of courses between 3 and 4. Independent samples T-test were conducted to differentiate between those that had taken more courses. Coding of two-post survey questions were categorized into subgroups of intrinsic and extrinsic motivation. Ultimately two groups were created with

teachers placed in High Efficacy/ High Theme and High Efficacy/ Low Theme with theme referring to the number of courses taken. The results indicated that the teachers who took four or more courses were more likely to have higher Teacher Outcome Expectancy (TOE). Furthermore, they valued the coursework for providing increased conceptual understanding and student-centered material (Swachhamer et al, 2009).

Teachers' beliefs, like self-efficacy, can have an impact on their teaching. For students to understand the topic conceptually, it is imperative that teachers understand it in this manner as well. Ambrose, Clement, Phillip, & Chauvot (2004) remarked that this understanding can lead to identifying gaps in their own mathematical understanding. In a study, thirty preservice teachers comprised the class that looked to reconstruct mathematical topics learned procedurally in the past thus presenting it in a more meaningful way (Stohlmann, Moore, Cramer, & Maiorca, 2014). A pre- and post- survey was conducted online regarding their beliefs as well as a reflection assignment after the fraction division lesson.

While at the beginning of the course the preservice teachers focused on procedural knowledge and demonstrated the belief that memorization of mathematical procedures was as important as conceptual understanding (Stohlmann, et al, 2014), there was a dramatic change in their perceptions and beliefs. These percentages would change for Belief 2 (One's knowledge of how to apply mathematical procedures does not necessarily go with understanding of the underlying concepts) from 11% to 67% and Belief 3 (Understanding mathematical concepts is more powerful and more generative than remembering mathematical procedures) from 24% to 76%. For Belief 4 (If students learn mathematical concepts before they learn procedures, they are more likely to

understand the procedures when they learn them) the percentage doubles from 36% to 72% (Stohlmann, et al, 2014). Hopefully, these beliefs will be put into practice.

It is not enough for teachers to have knowledge of mathematical content; teachers must be able to make connections and demonstrate relevancy for true understanding. During a 15-week methods course, research was conducted on pre-service math teachers on developing mathematical reasoning techniques to be applied to their future math lessons as mathematical reasoning activities should permeate the lessons in teaching the standards (Davis & Osler, 2013). Writing prompts were distributed and responses were coded and categorized for the over 25 participants. It was concluded that pre-service candidate's (PSC) "images of mathematical reasoning" (Davis & Osler, 2013) will affect their understanding of their student's mathematical reasoning. The results provided were not surprising. Teacher education must align with the Standards for Mathematical Practice. The result will yield instructional practices that are then aligned with these standards (Davis and Osler, 2013). In addition, communication and providing a variety of representations, along with a nurturing environment, will assist in creating and maintaining an atmosphere of mathematical reasoning. The PSC's responses reflected the before-mentioned statements and further exploration of practices will need to be conducted in the future.

At the collegiate level, the question of content connections from mathematics taught in teacher preparation classes to CCSSM comes into focus. Olson (2016) acknowledged the connection between content knowledge and connections to student learning and added the necessity for preservice teachers to understand the connection that exists between their current coursework to what they will be teaching in the future. A

survey was created by professors of pre-service mathematics teacher's (PSMT) preparation programs and then distributed to those professors that teach secondary mathematics content classes. The surveys, that consisted of content clusters, asked if the PSMTs saw the connection between the college-level math courses they were taking/ took to the CCSSM content clusters.

The implication to increase mathematical coursework to preservice teachers (PST) was suggested after preservice teachers reported an adequate level of readiness to teach mathematics from a survey created by faculty from Ohio called the Ohio Preservice Teachers' Beliefs on the Integration of Mathematics Topic in Instruction. The survey began administration in 2004 to preservice teachers consisting of questions and statements that included their perceptions of the program and professional knowledge. Teacher efficacy and overall concerns about teaching were built in (Rosas & West, 2011). The results from the participants that were comprised from both public and private teacher education programs found that overall, they were adequately prepared to teach mathematics and indifferent on the integration of mathematics in instruction.

The number of mathematics content courses required in teacher education programs also vary depending upon school and location. Mathematics methodology courses can provide preservice teachers with the pedagogical knowledge needed to teach mathematics content. Mizell and Cates (2004) found that when preservice teachers were enrolled in three extra math classes geared specifically for teachers- Algebra for Teachers, Geometry for Teachers, and Probability and Statistics for Teachers- they felt more confident in teaching mathematics than preservice teachers not enrolled. In another study, preservice teachers taking a constructivist-based mathematics methodology class

along with fieldwork demonstrated positive self-efficacy on the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Giles, Byrd, & Bendolph, 2016).

In an effort to determine the effect of a specialized mathematics course on pre-service teacher's mathematics content knowledge and their attitude towards teaching mathematics, a study was conducted in a large Midwestern University. Using a control group -those that had taken a general math class- and an experimental group – those enrolled in the specialized Logic of Arithmetic course, the preservice teachers comprising the experimental group were exposed to a deeper understanding of natural numbers and other bases (Matthews & Seaman, 2007). There was a significant difference on the scores of both instruments used, the Mathematics Content Knowledge for Elementary Teachers test and the Aiken's Revised Mathematics Attitude Scale, between the two groups.

Through a mixed method study comprised of a survey, observations, and interviews, Althauser (2018) looked to see the effects of a mathematics methodology course on preservice teachers' mathematics self-efficacy. Devoting the class format to the 5E Instructional format (Althauser, 2018), comprised of stages to assist the preservice teachers in a complete understanding of a lesson, the preservice teachers were introduced to constructivist pedagogy. The time spent in the classroom allowed for direct application of instruction and real-life teaching. The personal interviews afforded the researcher changes in the preservice teacher's conception of methodologies, content knowledge, and student interactions.

Pre- and post-test scores showed an increase in the Math Teacher Efficacy survey at the termination of the mathematics methodology course. Moreover, their beliefs about

math teaching evolved from their previous notions based upon personal experiences as students themselves to understanding the intricacies involved in teaching.

However, other studies have shown that program content may not be as conclusive. General education and special education preservice teachers were found to have no significant difference in mathematics teaching efficacy (Flores, Thornton, Franklin, & Strozier, 2014) while a study involving a cohort for Teach for America found that there was a significance difference between those individuals with backgrounds in mathematics as having higher mathematics content knowledge, there was no difference in self-efficacy for those with either mathematics or liberal arts backgrounds (Evans, 2010).

Efficacy and Field Experiences

Field experiences often permeates teacher education programs prior to student teaching as a means for students to observe and acquire active teaching observation hours. Accessibility to these classroom proceedings allows for preservice teachers to gain vicarious experience as they observe their cooperating teachers in a live setting, providing potential knowledge for future use.

Capraro, Capraro, and Helfeldt (2010) examined whether or not the type of setting for field experiences affected preservice teachers' confidence levels. Students were placed in three model settings- traditional schools, professional development schools (PDS), and inquiry focused, PDS based schools - for the duration of the semester prior to their student teaching semester. Professional development schools stress the need to create a partnership between the university, cooperating teachers, and the preservice teachers themselves as a means of fostering learning environments. The inquiry focused,

PDS based model includes preservice teachers learning how to implement inquiry-based procedures and an inquiry-based project into their time within the classroom.

135 preservice teachers were surveyed on their perceived readiness utilizing specific standards from the Interstate New Teacher Assessment and Support Consortium (INTASC), focusing on standard 5 (Learning Environment), standard 7 (Planning for Instruction), standard 8 (Student Assessment), and standard 9 (Reflective Practice). These standards were chosen as there could be a direct link between the results and the influence from the field experience model (Capraro, Capraro, & Helfeldt, 2010). The results yielded a statistically significance difference of the inquiry-based students of their perceived readiness over both the professional development and traditional model students, prompting the idea that the experience within an inquiry-based setting can link university coursework with real-world teaching.

An effective component of field experience utilized in teacher preparation programs involves student teaching as a means for preservice teachers to receive first-hand daily experience in the classroom. Traditional student teaching involves one semester, about 10 weeks, where preservice teachers work with a cooperating teacher in a classroom five days a week, teaching lessons and performing other duties common to daily routines. These mastery experiences contribute to the preservice teacher's sense of sense efficacy, putting theory into practice, and can foster their beliefs in future successes.

The student teaching experience, whether it is in the United States or in other countries, can mold pre-service teachers for their future profession through a variety of experiences. Through a series of interviews conducted in Cyprus and a modified use of

the *Teachers' Sense of Efficacy Scale* (TESES), seniors enrolled in two 6-week courses of student teaching provided insight on their efficacy beliefs in teaching mathematics during fieldwork. Following Bandura's (1977) theoretical framework on self-efficacy, the teaching of mathematics lessons to students added to their self-confidence with the constant opportunity to explore ideas and teaching styles. Their teacher mentors that demonstrated lessons with the use of manipulatives and numerous methodologies awarded the preservice teachers with positive motivation. However, mentor feedback had both positive and negative effects during fieldwork when preservice teachers' classroom performance was assessed. Interactions with other preservice teachers and discussing similar experiences and providing feedback impacted their self-efficacy. The possibility for self-efficacy to change over time and without uniformity was uncovered by Charalambous, Phillippou, and Kyriakides (2008) and the influences differed based upon their importance and the individual themself.

When comparing preservice and in-service teachers at a Midwestern university, Putnam (2012) had divided the participants into 4 groups: preservice teacher – prior (no student teaching), preservice teacher – post, in-service teacher – novice (3 years or less of teaching experience), and in-service teacher – experienced, with preservice teachers enrolled in undergraduate programs and in-service teachers enrolled in a masters of arts graduate program. Using the Teachers' Sense of Efficacy Scale (TSES), the results indicated that the in-service teachers – experienced held the highest self-efficacy scores of the groups. The other three groups scored significantly lower without a great variance between them.

Following Bandura's (1977) belief that mastery experience delivers the greatest influence over an individual's self-efficacy, the results from Putnam's (2012) study comparing preservice teacher's self-efficacy to those of novice, inservice teachers was not unexpected. After administering the *Teachers' Sense of Efficacy Scale (TSES)* to undergraduate and graduate students grouped into four categories- preservice teacher – prior (to student teaching), preservice teacher – post (student teaching), in-service teacher – novice, and Inservice teacher – experienced (three or more years of teaching experience) – results showed that the experienced inservice teachers scored significantly higher than the other three groups. The novice inservice teachers followed next, holding higher self-efficacy than the two groups of preservice teachers. The closeness in the scores had the author postulating on other factors that could influence the participants' self-efficacy.

Although the coursework for elementary general education and special education preservice teachers may be similar, the type of fieldwork for both groups may provide different experiences, affecting mathematics self-efficacy. Flores, Thornton, Franklin, and Strozier (2014) looked at comparing the two groups in both mathematical knowledge relating to computation and problem-solving skills and teaching efficacy and teaching outcome efficacy. The preservice undergraduate and graduate teachers involved in this study showed no significant difference in computation skills and teaching efficacy. Special education students did outperform the general education students in problem-solving skills. However, for teacher outcome efficacy, there was a significant difference between preservice general education teachers and special education. It was postulated that the fieldwork of the general education students had been focused as they spent time

in a mathematics classroom with access to observing teaching methodologies. The time spent in fieldwork for special education preservice teachers are more generic in content which may have led to the discrepancy in scores.

The concept of sharing teaching responsibilities in a co-teaching paradigm can offer pre-service teachers another variation of teaching, adding to their repository of skills. Yopp, Ellis, Bonsangue, Duarte, and Meza (2014) investigated a co-teaching model utilized by the California State University, Fullerton, Mathematics Teacher and Master Teacher Fellows (MT2) Project. This alternative student teaching project paired teaching fellows (Mathematics Teacher) with experienced teachers (Master Teaching Fellows) in an effort to encourage STEM preservice teachers to work in high-need urban schools as middle school or high school mathematics teachers (Yopp, et al., 2014). Through surveys and interviews, input on the positives and negatives of the seven co-teaching strategies were offered by both the teaching fellows and Master Teaching Fellows). The overall findings of this study found that the co-teaching model of student teaching provided a positive shared experience in developing and implementing teaching strategies drawn from their diverse backgrounds and various experiences. This model assists new teachers in cultivating professional relationships.

Other Factors Influencing Efficacy

Connections have been found between preservice teachers' beliefs in doing mathematics and their beliefs in teaching mathematics. A study conducted at a Midwestern university found a relationship between preservice teacher's confidence surrounding their mathematical ability in both tasks and courses and their ability to teach mathematics to children (Bates, Kim, & Latham, 2011). When the Basic Skills Test was

administered, there were significant differences between the preservice teachers within the mathematics low self-efficacy group and those within the high mathematics self-efficacy group with the latter receiving higher scores.

Associations between past experiences and attitudes towards teaching mathematics have been found. In Australia, preservice teacher's recollections of being chastised or singled-out by their teachers for lack of mathematical knowledge or quick recall of facts were reported (Itter & Meyers, 2017) which produced responses of 111 out of the152 participants to be deemed neutral, somewhat negative, or negative attitudes towards teaching mathematics. Recommendation on teacher education programs addressing said negativity were made to alter continuation into future classrooms. Similar findings were obtained in Turkey with current math anxiety being associated with past experiences of preservice teachers in their elementary mathematics classrooms (Bekdemir, 2010). Math anxiety was rooted in classroom experiences surrounding teacher behavior, test anxiety, and peer pressure; the worse the experience(s), the higher the math anxiety. It was questioned whether this would transfer to their teaching of mathematics when they have their own classroom.

In another study that looked at preservice teacher's mathematical disposition (MD) – their beliefs in mathematics, its learning, and perseverance in its success (Cruz, Wilson, & Wang, 2019)- and self-efficacy, the influence of past mathematical teachers impacted their MD. Preservice teachers, that had stated their former teachers were a positive influence, scored higher on the MD scale than those that claimed the influence was neutral. Interestingly enough, this difference was not replicated by the preservice teachers that reported past negative influences by their mathematics teachers. This

positive influence of mathematics disposition encouragingly affected their self-efficacy for teaching mathematics as well, showing a correlation between the two.

Past experiences also had an effect on pre-service teachers' motivational profiles which is comprised of their self-efficacy beliefs and learning goals (Phelps, 2010). Both self-efficacy beliefs and learning goals, which develop over time, can influence their perception of their mathematical ability and their potential for mathematics mastery. Referencing Bandura's (1993) self-efficacy influences, interviews were conducted discussing situations where past experiences and verbal persuasion provided both positive and negative effects on the pre-service teachers. The college-level mathematics courses taken by the pre-service teachers also added to their motivational profile. The author found that the expectations of the mathematics courses and their actuality could also positively or negatively affect their self-efficacy. It was commented that these expectations of mathematics courses in view of their future in teaching mathematics may have started much earlier and, thus, continued as they proceeded through college.

An individual's sense of motivation can affect their self-efficacy whether it is extrinsic or intrinsic. With extrinsic motivation revolving around such ideas as monetary rewards and anxiety, intrinsic motivation in teaching stems from the passion of the profession itself. Kim and Cho (2014) conducted a study of 533 pre-service teachers using the *Work Tasks Motivation Scale for Teachers* (WTMST) and the *Teachers' Sense of Efficacy Scale* (TSES) to investigate how their motivation and teaching efficacy shape the realities of teaching as compared to the envisaged of teaching. The pre-service teacher's experience within the program ranged from "undecided" to "completed practicum II", a second required course where students are placed within schools as a

means of completing their program (Kim & Cho, 2014). The results indicated that pre-service teachers that encapsulated both high intrinsic motivation and a high sense of teaching efficacy were able to reduce the reality shock. It was imperative that an individual had both as the results were not the same for those with high intrinsic motivation and low efficacy. Additionally, the level of reality shock varied as students progressed through their teacher education program indicating as the pre-service teachers gained more practical experience, their understandings of the teaching profession increase.

When examining the pathway chosen to become a teacher, Forsbach-Rothman, Margolin, and Bloom (2007) surveyed preservice teachers in an undergraduate and graduate program as well as first-year teachers in an alternative route program to determine similar levels of self-efficacy. Using a subscale of the *Teacher Efficacy* Scale, the undergraduate preservice teachers' scores were significantly higher on the *Personal Teaching Efficacy* subscale than both the graduate preservice teachers and the alternate route teachers. When asked about aspects of the teacher preparation program they valued, both the undergraduate and graduate preservice teachers mentioned coursework and course content as positive portions of the program. However, for the teachers in the alternate route program, classroom management techniques and camaraderie with fellow alternate route teachers. This camaraderie allowed for discussion on all topics associated with teaching, engaging in opportunities to provide and receive feedback, and ultimately learn new techniques from other alternate route teachers.

Anxiety was found to affect preservice teachers' confidence to teach mathematics and science based upon their Mathematics anxiety in a study conducted in the United

States. Employing three different measurement instruments- *Revised-Mathematics Anxiety Survey (R-MANX), the Science Teaching Efficacy Beliefs Instrument (STEBI), and the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)* – the participants were surveyed at the end of a semester consisting of a mathematics, science, and social studies methodology course. The participants were grouped based upon their scores on the R-MANX into low, medium, and high anxiety. Although all the preservice teachers within the study demonstrated some confidence in teaching mathematics based upon the MTEBI, students with low mathematics anxiety exhibited higher confidence levels within their responses (Bursal & Paznokas, 2006) and 90% agreeing with all the statements.

Conclusion

With self-efficacy having the potential to be fostered through personal and professional experience, and its prospective impact on the application of mathematical topics and student achievement, college education programs can provide a foundation in which to build stronger and more positive belief in teaching ability. This study looks to continue with past research on preservice teacher's self-efficacy in teaching mathematics based upon the teacher education program to which they are enrolled. However, with current preservice elementary teachers having either no or limited exposure to CCSSM as students themselves, basic foundational knowledge and experience are absent. This study looks to examine the possible effects of this deficiency on their self-efficacy.

CHAPTER 3

Introduction

My study aims to better understand what factors influence mathematics efficacy of preservice teachers through a mixed methods approach. I utilized the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) and individual interviews. The higher the score on the MTEBI, the greater the sense of self-efficacy. The interviews conducted provided insight as to how specifically the required mathematics methodology classes influenced the preservice teachers' self-efficacy towards teaching mathematics in the future. This chapter will focus on the methodology and procedures used within the study.

Research Questions and Null Hypotheses

This dissertation is guided by four questions, three quantitative and one qualitative. The questions are shown here with their null hypotheses, as appropriate.

Question 1. To what extent does efficacy differ based upon the year within the program?

***H*01:** There is no significant difference between the year within the program and the teacher self-efficacy score as measured by the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI).

Question 2. How does the self-efficacy of mathematics concentration students compare with the self-efficacy of students with other subject concentrations on mathematics teaching based upon the MTEBI?

***H*02:** There is no significant difference between mathematics concentration student's scores and other concentration student's scores as measured by the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI).

Question 3. How does the self-efficacy of elementary education preservice teachers compare with adolescent education preservice teachers?

***H*03:** There is no significant difference between elementary education preservice teacher's scores and adolescent education preservice teacher's scores as measured by the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI).

Question 4. What are the perceptions of preservice teachers in teacher education programs in relationship to self-efficacy?

This question was answered qualitatively, as such no hypotheses are merited.

Research Design

The design of this mixed method study is concurrent triangulation design as it combines the quantitative and qualitative collected data in an effort to provide a more complete understanding of the topic (Kroll & Neri, 2009). Also referred to as convergent parallel design, both the quantitative and qualitative sections share equal importance and are used "to triangulate the methods by directly comparing and contrasting quantitative statistical results with qualitative findings for corroboration and validation purposes" (Creswell & Plano Clark, 2018). The MTEBI survey and interview invitation were distributed during the FALL 2020 semester.

Since the results were analyzed, with no random assignment of participants, the study design was a non-experimental study investigating the possible relationship between the variables - year in school, subject concentration/ content core, and level of self-efficacy on the MTEBI. The MTEBI consists of a composite score from two subscales based upon teaching efficacy beliefs and their beliefs on affecting student outcomes, using a 5-point Lickert scale.

The criterion variable was the results from the MTEBI and the independent variables were the year they are within the program, subject concentration/ content core, and program type. The year in school was an ordinal variable indicating the year in the program from when they started college. Subject concentration/ content core was a categorical variable indicating whether the participants are grouped as having mathematics as their subject concentration (elementary education)/ content core (adolescent education) or other. In addition, program type was another categorical variable as participants can either be in the elementary program only or the adolescent education program.

After receiving permission from the institution's IRB, the invitation to participate in individual interviews was distributed through Qualtrics, scheduled, and were conducted via Microsoft TEAMS, an on-line video streaming service. Due to the COVID-19 pandemic, interviews needed to be conducted virtually as a means of following the university and CDC guidelines to maintain the health of both the interview participants and the researcher. A semi-structured protocol was used for the six questions allowing for further clarification if necessary and recorded by the researcher. Questions were taken from a previous study with obtained permission from the author (Brinkmann, 2019).

The participant interviews were conducted and recorded during an approximately 45-minute session using a semi-structured protocol. This interview format allowed for the researcher to ask follow-up questions for clarification or extension of their responses. Pseudonyms were used during the writing of their responses to maintain anonymity.

Reliability and Validity of the Research Design

With the non-experimental design of the study, threats to both internal and external validity exists. There is no random selection as the participants are grouped depending upon their year within the program, program type, or concentration. The sample size was representative of the students enrolled within the programs at the university.

The methods used to distribute and collect the data were consistent and the conditions were maintained as participants were allowed to complete the survey individually using their smartphones or computers.

The Sample and Population

The study participants were a convenience sample of upcoming sophomores, juniors, and seniors at two campuses of a private, northeastern university that were currently enrolled in a teacher education program as seen in Table 1. Included in the sample were students with concentrations in all subject matter as well as students with a mathematics concentration. The study participants were taken from both the elementary and adolescent education programs. With teacher education programs varying from school-to-school, the results from the study may be difficult to generalize to other institutions.

Table 1

MTEBI Survey Participants

Group		N
Year in Program	Sophomore	16
	Junior	11

	Senior	14
Program	Childhood Education	29
	Adolescent	12
Concentration	Mathematics	12
	"Other"	29

Content Analysis

In addition to relevant studies collected, the researcher analyzed the university's degree requirements for both the elementary childhood education program and the adolescent education program. Both programs require two mathematics content core classes and two mathematics methodology courses for all students enrolled. For those students in the elementary childhood education program with mathematics as their content, will need to complete from 24 to 30 credits in mathematics. Adolescent education students take up to 36 credits in their mathematics concentration .

Data Collection and Procedures

The researcher gained permission to conduct the initial study by submitting the necessary documentation to the Institutional Review Board (IRB). This IRB included the collection and analysis survey data from teacher education students at the university as seen in Appendix B. An IRB modification was submitted to include an interview portion to the study.

Survey Instrument

The quantitative portion of this study used results from the Mathematics Teaching Efficacy Belief Instrument (MTEBI) which was administered at the beginning of the Fall

semester via email. The MTEBI consists of 21-item survey detailing participants responses in two subscales of Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE) using a 5-point Likert Scale created by Enochs, Smith, and Huinker (2000). Statements such as "I will continually find better ways to teach mathematics" and "I will generally teach mathematics ineffectively" was rated by the participants and scored by the researcher. Statements pertaining to the subscales PMTE and MTOE were amalgamated and reverse scoring was implemented on certain numbers to maintain the efficacy ratings. It was found that the alpha coefficient was 0.88 for PMTE and alpha coefficient of 0.75 for the MTOE based upon the reliability analysis (n=324) (Enochs, Smith, & Huinker, 2000).

Survey Data Collection

Upon IRB approval, the university email addresses of the study participants from the university School of Education were provided. The participants received an email explaining their voluntary participation in the study with no obligations nor repercussions for non-completion. The MTEBI was distributed to the participants via Qualtrics and was given eight weeks to complete the survey anonymously. A reminder email was sent to the survey participants after four weeks from the original email as well as one the day prior to the due date. The researcher was in charge of the collection of the responses and uploading the data into SPSS.

Although 511 emails were distributed approximately two weeks prior to the beginning of the fall semester, the researcher only received 41 MTEBI survey completions, which is 8% of those enrolled. A possible explanation for the low response rate could be from the education courses at the university being held either in a hybrid

format or completely virtual due to CDC restrictions regarding COVID-19 making communication via email prevalent and the likelihood for the survey request to be overlooked.

Interview Protocol

A semi-structured protocol was used for the six questions allowing for further clarification if necessary and recorded by the researcher. Questions were taken from a previous study with obtained permission from the author (Brinkmann, 2019) as seen in Appendix E. The questions revolved around what they considered were positive and negative aspects of their coursework and how well prepared they feel in their preparedness to teach mathematics.

Interview Data Collection

Upon IRB modification, an interview invitation was distributed via Qualtrics. The individual interviews were scheduled and conducted using Microsoft TEAMS due to COVID-19 restrictions. The researcher conducted the individual interviews, recorded, and transcribed them as well. Two rounds of coding were used beginning with structural coding, ideal for semi-structured protocols and interview transcripts, which compares and contrasts the data corpus. Pattern coding was used for the second round of coding, reducing the information into smaller units of themes and categories.

Research Ethics

Although the researcher is a full-time employee of the university, steps were taken to ensure participant confidentiality following IRB guidelines. The design of the quantitative section of the study allowed for the survey to be completed by the participants on their own. Although specific questions included identifying the year in

school, program, and concentration of the participants, names and university identification were not included for anonymity. Interview responses were collected by the researcher and destroyed upon completion of the study. Consent for participation were obtained electronically and pseudonyms were used in the writing of this paper.

Data Analysis

Research Questions 1, 2, and 3

An ANOVA was conducted to determine if there is a significant relationship between the year within the program and their level of self-efficacy on the MTEBI. An independent sample T-test was conducted between the participants that are mathematics concentration and those of other-subject concentrations. In addition, an independent samples T-test was conducted between elementary education preservice teachers and adolescent education preservice teachers to see if the possible exposure to CCSSM by the adolescent education preservice teachers has a significant effect on their MTEBI rating. SPSS 26 was utilized to conduct the data analysis for research questions 1, 2, and 3.

Research Question 4

Individual interviews were conducted and recorded via Microsoft TEAMS using a semi-structured format for the qualitative section. The interviews were transcribed verbatim and the data was broken down and categorized using structural and pattern coding. Structural coding used in the first round of coding benefits from semi-structured interviews and when questioning revolves around a certain topic, comparing and contrasting the data corpus. For the second round of coding, the researcher utilized pattern coding as a means of identifying themes within the data.

Conclusion

This chapter detailed the design of the concurrent triangulation study along with the data analysis that was conducted. The original design of the study was modified to include a qualitative section which was comprised of individual interviews. Procedures for consent and collection of the data followed IRB guidelines in addition to upholding research ethics.

CHAPTER 4

Introduction

This mixed method study included both a qualitative and a quantitative section as the number of survey participants was under 50, following the concurrent triangulation/ convergent parallel study design. Through this type of study, both the quantitative and qualitative sections share equal importance, merging the results for complete understanding of the study topic. The MTEBI survey was distributed and collected through Qualtrics, exported, and the data analysis was conducted using SPSS version 26. The individual interviews were scheduled through Qualtrics and conducted via Microsoft TEAMS. Transcripts from the interviews were first coded through structural codes then coded a second time with pattern coding to distinguish themes and/ or patterns.

Survey Findings

The quantitative portion of the study centered around the MTEBI survey that was distributed to 511 enrolled students within the School of Education in both the undergraduate and elementary and adolescent programs. From the 511, the primary researcher received 41 respondents. The 41 survey participants consisted of 16 sophomores, 11 juniors, and 14 seniors. 29 students were enrolled in the Childhood Education program and 12 in the Adolescent Education program. 12 had mathematics as their subject content/ concentration and 29 had chosen “other.”.

The six participants of the interview portion were comprised of two juniors and four seniors. One of the juniors had taken the first of the two mandatory mathematics methodology courses and the other had not taken either. The four seniors had completed

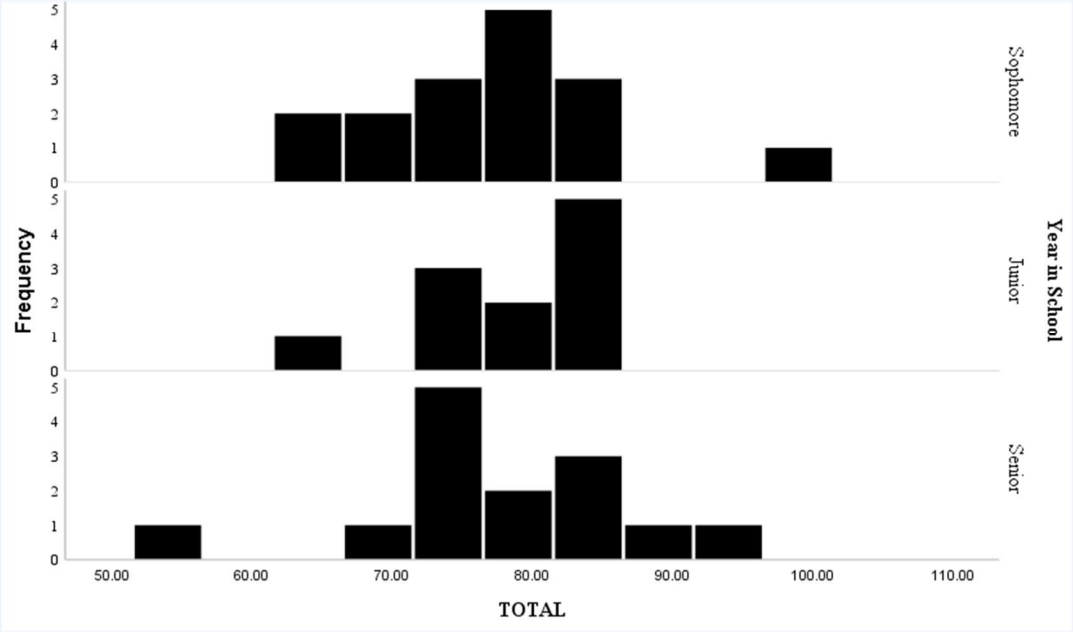
both courses. The interviews were conducted in a semi-structure protocol using questions with obtained permission from the author, Jodie Brinkmann (2019).

Research Question 1

The data analysis began with comparing the results of the MTEBI based upon the year within the program to see if more time spent attending the program would have an impact on their scores. A one-way ANOVA was conducted. The participants were sophomores (n = 16), juniors (n = 11), and seniors (n=14). There were two outliers as assessed by boxplots (Figure 3) and the values remained as their removal did not alter the results. The data was normally distributed for each group, as assessed by Shapiro-Wilk's test ($p > .05$) (Table 2); and there was homogeneity of variance, as assessed by Levene's test for equality of variance ($p = .426$) (Table 3).

Figure 2

Frequency of MTEBI Scores Based Upon Year Within the Program



The MTEBI scores increased from sophomores (n = 16, M = 75.5, SD = 8.7) to juniors (n = 11, M = 78.4, SD = 6.1) then decreased to seniors (n = 14, M = 78.0, SD 9.8) as shown in Table 4. The variance in the scores is not statistically significant based upon the year within the program, F(2,38) = .191, p = .827 (Table 5). Therefore, we maintain the null hypothesis that there is no significant difference between MTEBI scores based upon the year within the program.

Figure 3

Range of MTEBI Scores Based Upon Year Within the Program

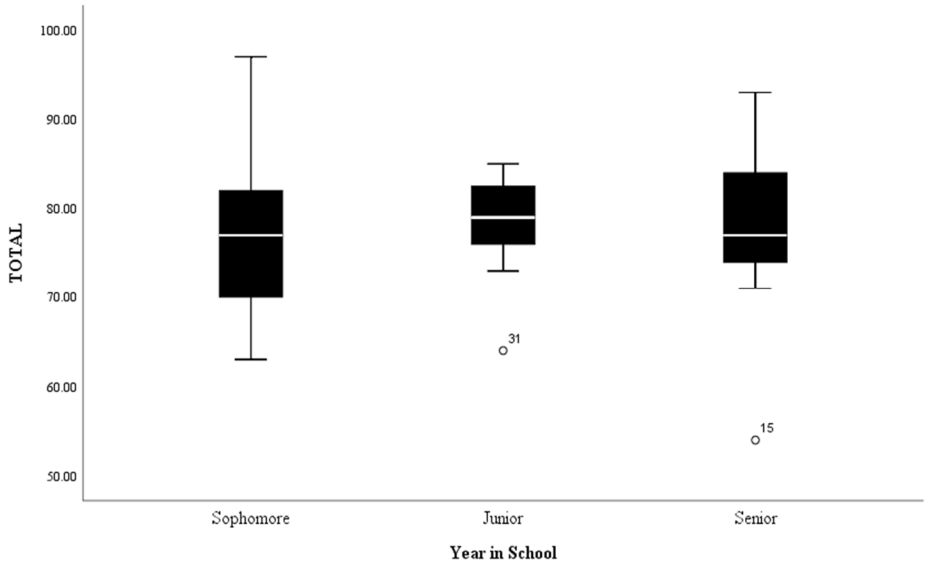


Table 2

Tests of Normality

Year in Program	Statistics	Shapiro-Wilk df	Sig.
Sophomore	0.965	16	0.751
Junior	0.887	11	0.127
Senior	0.927	14	0.272

Table 3

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
TOTAL	Based on Mean	.874	2	38	.426
	Based on Median	.864	2	38	.430
	Based on Median and with adjusted df	.864	2	34.107	.431
	Based on trimmed mean	.958	2	38	.393

Table 4

Means and Standard Deviations of Year in Program Scores on the MTEBI

Year in Program	N	Mean	Standard Deviation
Sophomore	16	75.5	8.7
Junior	11	78.4	6.1
Senior	14	78.0	9.8

Table 5

ANOVA Results Based Upon Year Within the Program

TOTAL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.698	2	13.849	.191	.827
Within Groups	2752.545	38	72.435		
Total	2780.244	40			

Research Question 2

An independent T-test was conducted to compare the MTEBI scores of mathematics concentration/ content core students to the scores of students with other concentrations. MTEBI scores for each level of concentration/ subject matter were normally distributed as assessed by Shapiro's-Wilk's test ($p > .05$). There was homogeneity of variances for MTEBI scores for mathematics concentration/ content core and other subject concentrations, as assessed by Levene's test for equality of variances ($p = .079$). There were 12 mathematics concentration/ content core students and 29 with other subject concentrations. The scores were higher for those with mathematics ($M = 82.42$, $SD = 4.78$) to those with other subject concentrations ($M= 75.48$, $SD = 8.72$), $t(39) = 2.590$, $p = .013$, rejecting the null hypothesis (Table 6).

Table 6

Group Statistics – Concentration

Concentration	N	Mean	Standard Deviation
Mathematics	12	82.4	4.8
Other	29	75.5	8.7

*p <.05

Research Question 3

In order to see if there is a significant difference between the MTEBI scores of the elementary education preservice teachers and the adolescent education preservice teachers, an independent T-test was conducted. MTEBI scores for each level of program were normally distributed as assessed by Shapiro's-Wilk's test ($p > .05$). There was homogeneity of variances for MTEBI scores for program types, as assessed by Levene's

test for equality of variances (p = .576). There were 29 students enrolled in the elementary education program and 12 enrolled in the adolescent education. There was no significant difference between the MTEBI scores of the preservice teachers in the elementary education program and the adolescent program, $MD = 4.376$, $t(39) = 1.556$, $p = .128$ (Table 7).

Table 7

Group Statistics – Type of Program

Program	N	Mean	Standard Deviation
Elementary	29	78.8	8.7
Adolescent	12	74.4	6.8

*p<.05

In conclusion, the higher the scores on the MTEBI, the greater the individual's self-efficacy. The scores were statistically significant for groups based upon concentration only. Scores based upon year within the program or type of program were found to not be significant, maintaining the null hypothesis. Following are the results of the interviews conducted for the qualitative section of the study.

Participant Interviews

The interviews were conducted during the winter break between the fall 2020 and spring 2021 semesters. Table 8 displays the demographics of the participants for the interviews which were broken down into four seniors and two juniors, although Annemarie would be a first-semester senior in the spring of 2021. Four were enrolled in the university's 5-year program and zero of the participants were from the adolescent program. One participant, Marni, was in a year-long program where she had started

student teaching in September of 2020 and would be finishing in May of 2021. All but one, Veronica, had taken at least one of the two required mathematics methodology courses and Annemarie was scheduled to begin the second course in the Spring.

Table 8

Interview Participants - Demographics

Participant	Year Within Program	Program	Major	Concentration
Janine (1)	Senior	5-Year/ Elem.	Special Ed.	English
Marni (2)	Senior	5-Year/ Elem.	Childhood Ed.	Spanish
Lisa (3)	Senior	Elem. Ed.	Childhood Ed.	Psychology
Veronica (4)	Junior	Elem. Ed.	Childhood Ed.	Math
Annemarie (5)	Junior	5-Year/ Elem.	Special Ed.	Psychology
Elizabeth (6)	Senior	Elem. Ed.	Childhood Ed.	English

For the qualitative data, the interviews were recorded than transcribed verbatim. The interview participants were given pseudonyms based upon when they interviewed as Janine (1), Marni (2), Lisa (3), Veronica (4), Annemarie (5), and Elizabeth (6).

From the analysis of the participant interviews, four themes emerged on the students' perceptions of their teacher education programs on their self-efficacy: *Efficacy, Role of Instructor, Independent Work, and Areas of Need.*

Efficacy

A participant's response was coded for *Efficacy* as it related to their overall conception on implementing best practices in mathematics in the future. A person's sense

of self-efficacy can not only affect current actions but future actions by the individual as well in similar situations. Therefore, understanding that their beliefs in their capabilities as a future teacher of mathematics is vital to future success. Five of the six student felt prepared/ somewhat prepared to teach mathematics. Janine stated, "I feel prepared to the extent of what I know. Use prior knowledge as our professors were telling us." Marni responded positively that "I have become better prepared. I have been given a mathematical mindset in my content courses on how mathematics works." Lisa commented, "I feel somewhat prepared. Well, I feel that the classes that I took sort of showed me some good ways to connect with my students but I feel that they were old practices, not really modern anymore." As for Veronica, the lack of completion of the mathematics methodology courses led her to comment, "To be honest, not prepared as of right now. I have not taken a course yet on how to teach math."

Annemarie's personal experiences as an elementary student had a positive impact on her sense of self-efficacy and future teacher of mathematics. "I had an IEP {Individualized Educational Plan} …so I was able to experience all the different methods of teaching math and really working with each student and their individuality." Elizabeth's personal experience came at the university level when students were assigned a mathematics question after watching a video in a mathematics methodology course. They were then asked to write a report on how a family member answered that question. The response made a positive impact on Elizabeth saying, "I really liked that. I felt it is really enjoyable to take something that we watched and then apply it."

Role of Instructor

Participants' remarks regarding the least and most beneficial components of their mathematics methodology courses directly led to the next three themes as each were stressed repeatedly and contained both positive and negative feedback. The *Role of Instructor* could be associated with verbal persuasion as feedback from their instructors can influence a student's efficacy expectation. Annemarie commented:

> "{The} Fall semester, I had my first semester of math methods. I enjoyed the class. It was very difficult though because it was...the professor is very nonchalant and very easygoing so everything was due the last day of class. So, there wasn't a lot of feedback. So now that I am going into the Spring semester, I don't know how I will be able to adjust from that setting to a new professor. I am a little bit worried."

Four out of the five students that had taken a mathematics methodology course found the demonstration of manipulatives by their instructors to be beneficial. Manipulatives are hands-on activities utilized by students as a concrete representation of concepts such as Cuisenaire rods or pattern blocks. Three of the four found this experience to be positive and beneficial for future use in the classroom. Elizabeth relayed that her professor for the second methodology class "was helpful in finding different ways to use manipulatives in math. Helped us relax. It is not as scary as it seems." Veronica commented on a core mathematics class for elementary educators that she took stating that although some topics seemed not relatable, "the most beneficial was how she would incorporate activities that we could do with the students." This sub-category of *Differentiation/ Manipulatives* can also be seen as Lisa added that in her second methodology course, the most beneficial was "…getting to see different manipulatives because that was something that they talked about a lot and that is something that I really

didn't think about before." Janine had remarked, "I think for differentiation, we were only given a couple of instances where we use that but it was never really addressed or [addressed] in depth."

Independent Work

Five of the six interviewees remarked that they looked to compensate the information that had been provided in their classes based upon their needs and add to their knowledge base. This generated the theme of *Independent Work.* "I feel that most of the stuff we learned was from bouncing [ideas] off each other and not from being instructed" was stated by Janine. She would add doing research to keep "up-to-date since I am going to be in a classroom really soon" as she is graduating in May of 2021 and hopefully having a classroom of her own. Marni added that with regards to differentiation, "I don't know if I necessarily learned that in my classes. I just think that , as teachers, we are told differentiate so we kind of think of that on our own."

Common Core state Standards in Mathematics (*CCSSM)*, another sub-category that emerged from the interviews, was mentioned by Lisa. "I was literally planning on buying, looking for a book on like Common Core and seeing specific things from it." Annemarie commented on CCSSM that she was the year before everything was put into place and did not see it first-hand. "But I have seen it through helping my little brother and stuff."

Annemarie remarked that, with her mathematics methodology class being conducted fully remote, it was necessary to research educational options. "I think in this semester, you really had to work on your own and not necessarily have your teacher as your guide just because of the disconnect and it is impossible to really communicate thoroughly." She included that "having a mother who is a special education teacher as well was

extremely helpful" and utilizing online resources as a guide provided her with different resources to draw upon.

After discussing factors that could be categorized as university program experiences and their individual perseverance to add to those experiences, it became apparent that there were areas in which practices and applications were lacking. This became the fourth theme from the data which involved what the participants saw as essential.

Areas of Need

Areas of Need focused on how the classes and essentially the program could improve for the students. All the participants commented that the classes needed to incorporate more current practices and current topics. Annemarie commented:

> "We watched a ton of videos and the majority of them were based in the 1980's and 1990'so I think, and I don't think it is necessarily a problem that one class has. I kind of see it as overall, that a lot of the videos we do watch are based upon years and years ago. Even the early 2000's [is] considered outdated now. There are so many things that have been added."

Janine remarked on more structure and real-life situations. "I think they need to like give us the specific things that we need for like teaching scenarios. Like I feel right now it is kind of like learning from a textbook and we are not having real-life scenarios applied to it." Marni had a similar comment with "Needs more hands-on, more direct. Very philosophical. Would like to see it in practice."

Lisa commented on *Areas of Need* with " I guess to talk about common core and use examples of how common core has changed [mathematics]." Veronica's expectations for her upcoming mathematics courses involved the Common Core State Standards in Mathematics as she admitted that she is 100% intimidated by the Common Core. She would like to see, " How to do step-by-step with like Common Core questions probably

and word problems, maybe how to teach that to elementary students." Elizabeth would add that although her professor had them working in groups and using manipulatives, a connection between what was done in class with manipulatives and the Common Core seem to be missing. "I don't think it really showed me what Common Core was necessarily."

Only Lisa mentioned improving the use of technology as an *Area of Need*, which was somewhat surprising given the predominately virtual platform the university was under during the time of the study.

Although the participants presented a range of positive and negative aspects of their mathematics methodology courses in relation to their preparedness to teach mathematics in the future, and for the university program, all exhibited self-efficacy. Regardless of their concentration and personal experiences, the participants demonstrated self-confidence during the interviews, understanding that teaching mathematics will be both difficult and exciting.

Conclusion

The data analysis began with the comparison of the MTEBI scores based upon the year within the program: sophomore, junior, or senior. With the assumptions met, and the outliers not affecting the results, an ANOVA was conducted. The results were found not to significant, $F(2,38) = .191$, $p = .827$, and the null hypothesis was maintained. Similar results were found with the independent T-test performed based upon the type of program – childhood education or adolescent education. However, students with a mathematics concentration scored higher on the MTEBI than students with "other" concentrations, $MD = 6.9$, 95% CI, $t(39) = 2.590$, $p = .013$.

Although all from the childhood education program, the concentrations of the six interview participants varied and included mathematics, English, psychology, and Spanish. Four were seniors and had taken both required mathematics methodology courses. One of the juniors had taken one of the classes, taking the second methodology course in the Spring, and the other was to start with the first course in the Spring.

Two rounds of coding were conducted, structural coding and pattern coding respectively, and four themes emerged from the participants' responses: *Efficacy, Role of Instructor, Independent Work, and Areas of Need*. Their sense of *Efficacy* in their preparedness to teach mathematics was positive as three of the seniors were starting student teaching in January. Veronica, the junior who had not taken a mathematics methodology class at the time the interview was conducted, expressed lack of confidence even though she had the concentration in mathematics. Participants appreciated the introduction and use of manipulatives by their professors in *Role of Instructor* but included improvement suggestions as in updating techniques and subject matter.

Whenever possible, the participants seemed to compensate for what was lacking in their classes through either research or discussions with classmates. This trait may be inherent in the individuals themselves as they pursue a profession in education.

For *Areas of Need,* as in *Role of* Instructor, topics taught in class needed to revolve around more current teaching methods and incorporate real-world situations. The inclusion of CCSSM was mentioned as all spoke of their personal exposure came in junior high at the earliest. Hence, all elementary preservice teachers, at the time of this study, were missing that foundation to draw upon and were introduced to CCSSM

methods during their mathematics methodology courses or through classroom observations.

Of the six interviewed, only four had completed the survey. The results from the interviews did not conclusively explain the results from the data analysis of the MTEBI where the significant difference was found based upon concentration. More research would need to be conducted to see if there is a connection and if students begin the programs with an elevated sense of self-efficacy. Overall, the students interviewed felt confident and excited to teach mathematics in the future regardless of their comments.

CHAPTER 5

Introduction

A concurrent triangulation study was conducted to examine the role of a teacher education program had on the self-efficacy of pre-service teachers in teaching mathematics at a large northeastern university. Concurrent triangulation, also referred to as convergent parallel study design, allows for both the quantitative and qualitative sections to not only share equal importance but to be conducted simultaneously. The data analysis from both sections of the study provides a deeper understanding of the topic.

The survey participants were full-time students enrolled in the school of education's elementary education or adolescent education programs and beginning their sophomore, junior, or senior year in September of 2020. The participants completed the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) which consists of a 21-item survey using a 5-point Likert scale. Interview requests were distributed to the same population via email through Qualtrics. Dates and times were selected and the interviews were approximately 45 minutes in length using a semi-structured protocol to allow for further questioning by the researcher and clarification by the participants.

The participants interviewed had varied concentrations as well as varied personal experiences as mathematics students prior to their entrance into the university program. Only one of the six interviewed had a concentration in mathematics and another one admitted to having an Individualized Educational Plan (IEP) while in school. One of the six was enrolled in a program at the university in which her student teaching experience began in September of 2020 and would continue through May of 2021. Three of the remaining five would be entering their student teaching experience in January of 2021.

The study was conducted during the 2020 – 2021 academic year during the COVID-19 pandemic. Because of the unique situation with schools closing their doors across the nation in what was first perceived as a temporary situation, the university discontinued face-to-face classes beginning in March of 2020 and intermittently brought them back in September of 2020. The school of education remained fully remote throughout the 2020-2021 academic year, with some student teachers having in-person student teaching experiences in the Spring of 2021. Only one of the six interviewed had both mathematics methodology classes in person. Three out of the six had started their first methodology class in person during the Spring 2020 semester but was switched to fully remote in March and their second methodology class held remote and synchronous in the fall of 2020. One of the interview participants had her first mathematics methodology class remote and synchronous in the Fall of 2020 and would be taking her second in the same manner in the Spring of 2021.

Education has gone through a transformation. Because of the COVID-19 pandemic, the use of technology and online forums have truly shattered the conventional ways of teaching and future teachers, as well as current teachers, will need to have the technological knowledge and skills necessary to navigate through these once unchartered waters. We have learned that teaching can have other platforms and make use of time beyond the standard day.

Implications of Findings

An individual's self-efficacy, as described by Bandura (1977), influences the behavior of the individual on future situations in similar scenarios. Through mastery experience, vicarious experience, verbal persuasion, and emotional arousal, self-efficacy

will either increase in a positive direction or the opposite can occur, diminishing an individual's belief in their success. With the expectation that all of these experiences are present within the existing educational programs, this study looked to see this influence on the students with a focus on the two required mathematics methodology courses particularly.

Quantitative Findings

The results of the MTEBI survey yielded a significant difference between the scores from students with Mathematics concentrations and the scores from those with "other" concentrations. This gives credence to the studies that found additional mathematics content courses had a positively effect on self-efficacy (Davis & Osler, 2013; Mizell & Cates, 2004). The additional courses that mathematics concentration students are required to complete as degree requirements can provide a stronger understanding of mathematical concepts, adding to their efficacy beliefs. It may be necessary, therefore, as I will speak about later on, that the teaching of mathematics, especially at the elementary level, should be conducted solely by those with a mathematics concentration, utilizing the rich foundation afforded through the extra coursework.

This study found that there was no significant difference between the scores results based upon type of program – elementary childhood or adolescent education. Additionally, there was no significant difference based upon the year within the program. These findings were somewhat surprising as there was an expectation to see seniors, who have been enrolled within the program the longest and who are typically older than the others, to have higher scores than the other survey participants. With the ages ranging

from 19 to 21 for the students who were surveyed, adding in the amount and type of coursework plus experiences, there was a presumption by the researcher that the MTEBI scores of the seniors would be significantly higher than the juniors and sophomores. The researcher postulated if ending the previous term and starting the new term under the COVID-19 pandemic with remote learning affected their perceptions of their future teaching.

Mastery Experience

Mastery experience, the most influential source of efficacy expectations, was made available during the mathematics methodology courses but was infrequent as the participants made little mention of opportunities to demonstrate lessons. Student teaching, with the placement of students within a classroom five days a week, would truly afford the greatest deliverance of mastery experience. With one of the participants student teaching, the effect was slightly tenuous as it was conducted remotely due to the COVID-19 pandemic. Three of the six interview participants were starting their student teaching experience in the Spring of 2021.

Vicarious Experience

Effects on self-efficacy through vicarious experience could best be seen through the *Role of Instructor*. Through modeling of mathematical pedagogy in class, the interview participants had mixed remarks regarding the influence of their instructors. The introduction and demonstrations in the use of manipulatives in mathematics lessons was deemed beneficial by three of the six interview participants as it is a component of CCSSM. My recommendation would be for the instructors to investigate current classroom practices for using the various manipulatives in order for preservice teachers to

become familiar and comfortable with their application. Continued and extensive use would dissipate any fears and make their utilization a common practice.

Experiences with Common Core State Standards in Mathematics was found in *Areas of Need* as there was concern for the lack of exposure within their mathematics methodology courses. Real-life scenarios and hands-on experiences were cited as improvements to the classes to put theory into practice. Integrating more demonstration lessons, discussions surrounding CCSSM, and student-choice scenarios should be included throughout the program, adding to all self-efficacy expectations. While only one interview participant expressed the need for more technology to be incorporated within the methodology classes, with the expectancy of implementing standards associated with technology in their future mathematics classrooms and their current acquaintance with technology being used in their college courses and in schools for teaching purposes due to the pandemic, inclusion of these topics could increase self-efficacy. The introduction of virtual platforms such as Google Classrooms or Pear Deck to the preservice teachers as potential programs for use in classrooms would be beneficial as remote learning will continue to some extent in the future.

Verbal Persuasion

The impact of *verbal persuasion* can be substantial when it comes from a prestigious and credible source (Bandura, 1977). Therefore, the course instructors can be a major source for change in efficacy for the students within their classes. Lack of feedback from the instructor during their mathematics methodology course as mentioned, reduces this potential positive impact. This could have been the result of the format in which the class was conducted – fully remote - as added by the participant.

Discussions with classmates provided ideas and reactions for the students. In *Independent Work*, this was mentioned as a positive influence as a means of expanding their pedagogical foundation. Universities should create spaces and schedule time for students to congregate and share strategies on lesson implementation as well as overall concerns and forms of assessments. This collaboration of designs and recommendations would furnish the preservice teachers with resources they can draw upon.

Emotional Arousal

Emotional arousal has the ability to either create tension or modify avoidance behavior stemming from the particular circumstance encountered. High stress levels can lead to thoughts of failure when dealing with future situations. Therefore, perceptions of success can come from the lack of aversive arousal and thoughts of competency when confronted with taxing situations (Bandura, 1977).

Applying classroom content affected five of the six participants through positive personal experiences with the application of methods learned. These experiences seemed to lessen the fear of teaching mathematics in the future. Only the one participant, who had not taken the mathematics methodology classes, expressed apprehension, regardless of her mathematical background or mathematics concentration.

Relationship to Prior Research

The results of the data analyses conducted on the scores of the MTEBI showed a significant difference based upon the concentration of the participants. Students with a mathematics concentration scored higher on the MTEBI than those participants that chose "other" on the demographic's portion of the questionnaire. The scores were higher for those with mathematics ($M = 82.42$, $SD = 4.68$) to those with other subject

concentrations (M= 75.48, SD = 8.72), p = .013. The results of the study support the results of Mizel and Cates (2004), Giles, Byrd, & Bendolph (2016), and Matthews and Seaman (2007) who found positive correlations between pre-service teachers taking specific mathematics courses and positive responses on self-efficacy instruments.

Neither the year within the program – sophomore, junior, or senior- nor the educational program – elementary childhood education or adolescent education – resulted in significance. Similar findings by Flores et al. (2014) found no significance in mathematics teaching efficacy based on the type of program, elementary education, and special education. One possible explanation could stem from the unchallenged confidence that the students possess as they begin and continue through the program. Their perceived abilities to teach mathematics may only come to fruition when they have opportunities to demonstrate their knowledge, skills, and pedagogy in the mathematics methodology courses and student teaching.

Limitations of the Study

With the study limited to two campuses of one university, the convenience sample restricts the generalizability of the findings. The sample size and demographics provide an inadequate representation of the students enrolled within the educational programs at the university. In addition, not including freshman negates whether or not pre-service teachers enter higher education with a strong sense of self-efficacy from the beginning. Including pre and post surveys, the impact of the mathematics methodology courses could be monitored more closely, determining if one provides more efficacy expectations.

The COVID-19 pandemic forced the university to conduct classes fully remote in the Spring of 2020. For the Fall of 2020, the mathematics methodology classes were held in a synchronous format, limiting interactions and personal experiences. It is difficult to measure the impact this distance learning had on the participants especially on the categories discussed during the interview process. In addition, participation in the study was not a priority for the students which could account for the low percentage of survey completions. However, as more and more students take online classes, this study is indicative of the current educational practice with the addition of technology in learning at all grade levels. Improved communicative measures such as timely feedback, opportunities to connect one-on-one remotely, and virtual group participation will be necessary if this educational platform is to continue.

The credibility of the study is based upon the data and methodological triangulation. Previous studies have examined pre-service teacher's self-efficacy in teaching mathematics exploring different facets that can contribute to it. Combining both quantitative and qualitative portions within the study allows for a deeper understanding. The transferability, as mentioned previously, is limited as the questions postulated were specific to the programs at the university and the required methodology classes.

Recommendations for Future Practice

The majority of preservice teachers surveyed carried a strong sense of self-efficacy towards teaching mathematics in the future and there is the expectation that this will continue. However, unlike students enrolled in the adolescent education program who will be teaching one subject every period of every day, elementary childhood education students are expected to teach all subjects regardless of their concentration.

They are expected to be able to convey material proficiently, relate new material to old, answer questions posed, and assess student achievement while implementing the Common Core State Standards. With little or no exposure to the Common Core state Standards in Mathematics, this could be a daunting task for someone without a strong foundation in mathematical methodologies. The preservice teachers enrolled within the elementary childhood education program interviewed commented that their first exposure to CCSSM came in their junior high years, missing entirely the grades they will be teaching.

As found within this study, there was a significant difference in the MTEBI scores between students with mathematics concentrations and those with "other" concentrations. Besides the three required core mathematics classes and the two mathematics methodology courses, those with the concentration in mathematics can potentially take up to eight more classes, providing a deeper understanding of concepts. Consequently, this deeper understanding could lead to more in-depth discussions and connections between topics.

For college teacher education programs, core mathematics classes need to be offered which include Common Core State Standards applications on the concepts that preservice teachers will be teaching in the future as the absence of this knowledge was mentioned by the preservice teachers interviewed. This would provide preservice teachers with either an introduction to CCSSM methods or revisit past student experiences. The methodology courses should include multiple opportunities for students to demonstrate lessons within the class, adding to their self-efficacy through mastery

experiences and verbal persuasions, up-to-date teaching strategies, and the inclusion of technology and teaching software.

For elementary schools, creating departmentalized settings in the early grades will allow for teachers with mathematical degrees and/ or backgrounds to teach mathematics to the children, as well as teachers of other subjects to teach their specialty. With the focus solely on one subject, teachers are able to explore content more efficiently and lesson the stress of teaching unfamiliar subject matter.

With the limitation on in-person experiences due to the COVID-19 pandemic for three semesters, the preservice teachers saw a reduction in mastery and vicarious experiences which may impact their self-efficacy as they begin their in-service teaching. These limitations could potentially affect their readiness for certification requirements. Furthermore, employing technological resources and addressing any breaks in communication must be addressed as this fusion of expertise and knowhow and new educational instruments have now generated an innovative phase in education.

Recommendations for Future Research

Future research on preservice teacher's self-efficacy towards teaching mathematics should begin with analyzing their efficacy as they embark on their college experience and subsequently examined throughout their teacher education programs. Do future teachers carry an innate sense of being able to teach effectively in spite of their backgrounds and education? This could be monitored yearly as a longitudinal study to determine if it is maintained and possibly increased as they continue through the program. The information provided could assist the university in determining where improvements or modifications are needed.

A comparison of students enrolled within a year-long student teacher course as opposed to a one-semester course could provide valuable information regarding its influence on self-efficacy and, as a result, influence modifications in teacher education programs. Although student teaching requirements are regulated by each state, most college and university programs require only a 10-week course. The accessibility to increased time within the classroom and applying learned pedagogy could prove advantageous.

Continuing to follow preservice teachers as they begin their teaching experience could determine if this sense of self-efficacy continues throughout their first year. With formal and informal observations providing verbal persuasion and everyday teaching adding to their mastery experiences, the effect on one's self-efficacy can either be positive or negative. This, in turn, may affect teacher attrition which has increased from 5.1% to 8.4% from 1992 to 2005 respectively (Carver-Thomas & Darling-Hammond, 2017).

A replication of the current study during post-COVID-19, could foster more insight into the current educational programs at the university. As classes are expected to return in-person in the Fall of 2021, content and presentations within the mathematical methodology courses can cultivate and encourage more personal interactions and discussions, providing timely feedback, and opportunities for lesson demonstrations. All have the capability of increasing self-efficacy in mathematics. If students are presented with the opportunity to attend mathematics methodology courses in either a hybrid or synchronous format, surveying the students in all three classroom designs can provide the university with the optimum experience for their students in the future.

Conclusion

An individual's self-efficacy is influenced by numerous factors that can begin early on in a person's life. Preservice teachers' encounters with mathematics have its foundations when they are students themselves in the classroom. These initial experiences can initiate positive, promoting their self-efficacy, or negative feelings towards the subject matter, often causing anxiety. As they enter their college years, teacher education programs need to not only cultivate a sense of preparedness in teaching mathematics but encourage those who may have self-doubt.

This study showed that preservice teachers can be limited to the types of experiences in their college coursework which can ultimately affect their self-efficacy. Increased instances for preservice teachers to have exposure to the sources of self-efficacy - mastery experience, vicarious experience, verbal persuasion, and emotional arousal- within the college teacher preparation programs can be beneficial to the preservice teachers, the universities, and the students they will be serving.

APPENDIX A

Re: Requesting Permission

DeAnn M Huinker <huinker@uwm.edu>
Thu 4/2/2020 7:51 PM
To: Christina Miller <millerc2@stjohns.edu>

* External Email *

Hi Christina,

Yes, you have my permission to use the MTEBI in your research.

Best to you in your research and professional work,
Dr. DeAnn Huinker

> On Apr 2, 2020, at 1:45 PM, Christina Miller <millerc2@stjohns.edu> wrote:
>
> Good afternoon Dr. Huinker.
>
> I hope this email finds both you and your family well during this pandemic.
> My name is Christina Miller and I am a candidate in the EdD program at St. John's university in Queens, New York. I would like to ask permission to use the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) in my dissertation proposal that I am in the process of completing.
>
> Please let me know if there is any other information you would need.
>
> Sincerely,
>
> Christina Miller
> Jumpstart St. John's University
> Senior Site Manager
> 8000 Utopia Parkway
> Marillac Hall, Room 34
> Jamaica, NY 11439
> (718) 990 - 3241
> This email may contain proprietary, confidential and/or privileged material for the sole use of the intended recipient(s). Any review, use, distribution or disclosure by others is strictly prohibited. If you are not the intended recipient (or authorized to receive for the recipient), please contact the sender by reply email and delete all copies of this message.

Dr. DeAnn Huinker, Mathematics Education
University of Wisconsin-Milwaukee
- Professor, Department of Teaching and Learning
Director, Center for Mathematics and Science Education Research (CMSER)
Board of Directors, National Council of Teachers of Mathematics (NCTM)
huinker@uwm.edu ~ 414-229-6646 ~ Twitter: @dh11235

APPENDIX B

Dear St. John's Student:
I am writing to invite you to participate in my study. As a doctoral student for the School of Education here at St. John's University, I am conducting research for my Ed.D. in Educational Leadership. My research looks to determine if there is relationship between the self-efficacy in teaching mathematics and the year within the program (sophomore, junior, or senior), subject concentration (mathematics, other), and the program (childhood/elementary, adolescent). Self-efficacy is defined as one's belief in completing a task or achieving a goal.

Participants must be currently enrolled as a full-time student within the teacher education programs at St. John's University. If you are willing to participate, you will be asked to complete an online survey through Qualtrics. The survey should take approximately 15 minutes and will be completely anonymous.

Voluntary Participation:
Participation in the study is completely voluntary and you can end your participation at any time.

Benefits:
The benefit of your participation will be in providing information on the current education program at St. John's University and in assisting the researcher with potential recommendations for future.

Risks:
We do not foresee any risks in your participation of this study.

Cost:
There will be no costs to you for participation in this study nor compensation for your participation.

Confidentiality:
We will protect your confidentiality and the information that we collect about you during the course of this study. We will keep the data for the duration of the study, approximately one year.

Questions:
Please email the researcher, Christina Miller, at millerc2@stjohns.edu if you have any questions.
If you have questions or concerns about your rights as a research participant, please contact the St. John's University Institutional Review Board (IRB) at irbstjohns@stjohns.edu.

Study Procedures:
Please click on the survey link to indicate that you have read the consent information and that you are 18 years of age or older. Completion of the survey will imply that you consent to participate in the research study.

Thank you for your time and consideration.

Sincerely,

Christina Miller
St. John's University Doctoral Student

APPENDIX C

The Mathematics Teaching Efficacy Belief Instrument

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate response.

1) When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.

Strongly Agree Agree Uncertain Disagree Strong Disagree

2) I will continually find better ways to teach mathematics.

Strongly Agree Agree Uncertain Disagree Strong Disagree

3) Even if I try very hard, I will not teach mathematics as well as most subjects.

Strongly Agree Agree Uncertain Disagree Strong Disagree

4) When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.

Strongly Agree Agree Uncertain Disagree Strong Disagree

5) I know how to teach mathematics concepts effectively.

Strongly Agree Agree Uncertain Disagree Strong Disagree

6) I will not be very effective in monitoring mathematics effectively.

Strongly Agree Agree Uncertain Disagree Strong Disagree

7) If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.

Strongly Agree Agree Uncertain Disagree Strong Disagree

8) I will generally teach mathematics ineffectively.

Strongly Agree Agree Uncertain Disagree Strong Disagree

9) The inadequacy of a student's mathematics background can be overcome by good teaching.

Strongly Agree Agree Uncertain Disagree Strong Disagree

10) When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.

Strongly Agree Agree Uncertain Disagree Strong Disagree

11) I understand mathematics concepts well enough to be effective in teaching elementary mathematics.

Strongly Agree Agree Uncertain Disagree Strong Disagree

12) The teacher is generally responsible for the achievement of students in mathematics.

Strongly Agree Agree Uncertain Disagree Strong Disagree

13) Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.

Strongly Agree Agree Uncertain Disagree Strong Disagree

14) If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.

Strongly Agree Agree Uncertain Disagree Strong Disagree

15) I will find it difficult to use manipulatives to explain to students why mathematics works.

Strongly Agree Agree Uncertain Disagree Strong Disagree

16) I will typically be able to answer students' questions.

Strongly Agree Agree Uncertain Disagree Strong Disagree

17) I wonder if I have the necessary skills to teach mathematics.

Strongly Agree Agree Uncertain Disagree Strong Disagree

18) Given a choice, I will not invite the principal to evaluate my mathematics teaching.

Strongly Agree Agree Uncertain Disagree Strong Disagree

19) When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.

Strongly Agree Agree Uncertain Disagree Strong Disagree

20) When teaching mathematics, I will usually welcome student questions.

Strongly Agree Agree Uncertain Disagree Strong Disagree

21) I do not know what to do to turn students on to mathematics.

Strongly Agree Agree Uncertain Disagree Strong Disagree

APPENDIX D

Hello Christina,
Good afternoon! I fondly remember being in your position asking researchers to use his/her instrument for my dissertation research too. I would be happy to have you use the interview protocol for your study. Please just cite me as your mentioned in your email.
Best wishes!
Jodie Brinkmann

On Tue, Jan 26, 2021 at 3:41 PM Christina Miller <millerc2@stjohns.edu> wrote:
Good afternoon Dr. Brinkmann.

My name is Christina Miller and I am a doctoral candidate at St. John's University. I am currently working on my study dealing with the effect of teacher education programs on pre-service mathematics teachers. I read your paper "Making A Difference: Increasing Elementary Pre-Service Teachers' Self-Efficacy in Mathematics" and I found your semi-structured interview questions to be what I would need for the qualitative portion of my study.

I am requesting permission to use them in my interviews, acknowledging you within my paper for their creation. I, too, had utilized the MTEBI survey in the fall.

Thank you for taking the time to read and consider my email.

Sincerely,

Christina Miller
Jumpstart St. John's University
Senior Site Manager
8000 Utopia Parkway
Marillac Hall, Room 34
Jamaica, NY 11439
(718) 990 - 3241
This email may contain proprietary, confidential and/or privileged material for the sole use of the intended recipient(s). Any review, use, distribution, or disclosure by others is strictly prohibited. If you are not the intended recipient (or authorized to receive for the recipient), please contact the sender by reply email and delete all copies of this message.
Dr. Jodie L. Brinkmann
Clinical Assistant Professor of Practice, Educational Leadership
Virginia Polytechnic Institute and State University
Phone: 804-662-7288
Email: jlbrinkmann@vt.edu
VIRGINIA TECH

APPENDIX E

Semi-Structured Interview Protocol

1) How prepared do you feel to implement best practices in mathematics? Explain your answer using experiences if possible.
2) How prepared do you feel to differentiate mathematics instruction for your future students? Why?
3) What was the most beneficial part of your mathematics coursework? The least beneficial?
4) Could the mathematics methodology courses be improved? If yes, how? Please provide specific examples.
5) Based upon your answers to the survey, what did you discover about yourself as a future teacher of mathematics?
6) Finish the sentence: Teaching math to children can be _____.

APPENDIX F

Purpose: This study looks to examine the impact of the education program and its mathematics courses have on the self-efficacy of the preservice teachers (individuals not out in the field) at two campuses of a private, northeastern university towards teaching elementary mathematics topics.

Principal Investigator: Miller, Christina

Introduction
You are being invited to take part in this research study if you are at least 18 years of age. This study is being conducted by Christina Miller, a doctoral student, at St. John's University, Queens, New York.

Study Procedures
In this part of the study, you are being asked to participate in an interview which will be conducted via TEAMS. The questions will revolve around your mathematics self-efficacy. The interview will be semi-structured and should take 30 minutes. Only the Principal Investigator will have access to your responses and all recordings will be destroyed once the study is concluded.

Benefits
As a participant in this research study, there may not be any direct benefit for you; however, information from this study may benefit St. John's University School of Education students now or in the future.

Risks
We do not foresee any risks from your participation in this research study.

Costs
There will be no costs to you for participation in this research study.

Confidentiality
We will protect your confidentiality and the information that we collect. information collected about you during the course of this study will be stored with a code name or number so that we are able to match you to your answers. The code name will be kept separately, which is only available to the researcher. We will keep the data for the duration of the study, approximately one year. Only researchers with approved St. John's University research ethics training will have access to data.

Voluntary Participation
Participation in this study is completely voluntary. There are no consequences to the participants regardless of their volunteered participation within the study and you have the right to end your participation at any time.

Questions
If you have any questions about this study, please feel free to contact Christina Miller at millerc2@stjohns.edu. If you have questions or concerns about your rights as a research participant, please contact the St. John's University Institutional Review Board (IRB) at irbstjohns@stjohns.edu.

Study Procedures:
Please click on the survey link to indicate that you have read the consent information and that you are 18 years of age or older and will bring you to an interview set-up form. Completion of the form will imply that you consent to participate in the interview portion of the research study.

Thank you for your time and consideration.

Sincerely,

Christina Miller
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