Illuminating Changes in Preservice Teachers’ Perceptions about Teaching Elementary Mathematics in an Introductory Methods Course

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Illuminating Changes in Preservice Teachers’ Perceptions about Teaching Elementary Mathematics in an Introductory Methods Course

by

Elaine Cerrato

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Curriculum and Instruction
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Keywords: mathematics education, teacher preparation, teacher beliefs, elementary preservice teachers

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Dedication

This dissertation is dedicated to my grandparents, Michael and Irene, whose support and encouragement allowed me to persevere and reach beyond my wildest dreams. Although you were called home before I was ready to let you leave, I feel your presence with me every day and can still hear you telling me I can do anything. All I’ve ever wanted to do was make you proud! I love and miss you both beyond words!
Acknowledgments

Throughout this dissertation, my faith has been tested and renewed; I believe with God all things are possible.

I want to begin by thanking Dr. Andy Reeves for his belief in my ability to flourish in the Ph.D. program and nudging me in the right direction. With his encouraging words, I was able to believe I was meant to succeed. I am grateful for his kind words and bringing out the confidence in me during my master’s program to embrace and excel in teaching mathematics at all levels.

I also want to thank my committee co-chairs, Dr. Eugenia Vomvoridi-Ivanovic and Dr. Janet Richards for their unwavering support, encouragement, and honesty – even when it was difficult to hear. You both have stood by me through this journey, and I cannot thank you enough. Also, I thank my committee members, Dr. Jennifer Jacobs and Dr. Edward Fletcher for stepping in when I needed you, your kind words, and insight.

Furthermore, I must thank my family and friends who have supported me in so many ways and have heard more about mathematics preservice teachers than you ever imagined you could handle. Thank you to my sweet little Chewie who has been my fur-baby, cheerleader of unconditional love, and who has forgiven me for all my long days and nights I’ve had to write and not play – I’ll make it up to you.

Finally, I must acknowledge Dr. Denisse Thompson and Dr. Sabrina Lewis for your constant encouragement, for keeping me moving forward, and for reminding me not to let anything or anyone stand in the way of pursuing my dreams – I am grateful beyond words.
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Abstract

Producing highly skilled elementary mathematics teachers capable of facilitating mathematics learning in ways aligned with The Principles and Standards for School Mathematics (NCTM, 2000) and the Common Core State Standards for Mathematics (CCSSM), is a common objective of teacher preparation programs (National Governors Association & Chief Council of State School Officers, 2010). After decades of effort, Brown (2003) argues, teachers continue to teach in the way they were taught; thus, they disregard mathematics standards. As Abell, Appleton, and Hanuscin (2010) note, students’ preexisting ideas relevant to the nature of learning and teaching stem from experiences in their schooling, life, and formal classes. Specifically, related to mathematics, these experiences often reflect the difficulty in learning mathematics, fear of mathematics, and consequently, a dislike for the subject (Abell et al., 2010; Wilson, 2014). These preconceived beliefs influence how preservice teachers (PSTs) perceive subject matter. Beliefs also impact the decisions they make about teaching and learning mathematics. In this exploratory descriptive case-study I investigated in what ways three PSTs describe their experiences as K-12 mathematics learners, how the PSTs perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course, how the PSTs perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course, and what catalysts, relative to their experiences, do the PSTs consider noteworthy in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students. I utilized constant comparative methods (Strauss
and Corbin, 1998; Denzin and Lincoln, 1994; Strauss, 1987; Miles and Huberman, 1984) to analyze the data and identify overarching themes related to the goals of the study.
Chapter One: Overview of the Study

My Reasons for Conducting the Study

John Dewey believed in progressive education; a view of education that emphasizes the need to learn by *doing*. He held that human beings learn through a “hands-on approach” and “We do not learn from experience... we learn from reflecting on experience” (Dewey, 1933). As an active participant in my education, I feel drawn to this quote and begin this chapter by reflecting on my prior knowledge about teaching and learning mathematics and my reasons for conducting this study.

My Pedagogical Orientation

I am dedicated to continuing exploring the most recent innovations in the field of teaching, especially as a mathematics’ teacher educator. I learn *with* my students as we explore new strategies and methods of teaching mathematics, which are distinctly dissimilar from how we were taught to complete mathematics problems. I consider myself a partner and stakeholder in my students’ learning. I believe in fostering education through inquiry-based experiences, mathematical discourse, and critical reflection. I purposefully create a non-threatening environment in my classroom where my students can wrestle with new methods of teaching mathematics and can feel comfortable sharing their victories as well as their uncertainties. I afford my students opportunities to experience the new mathematical methods of teaching and encourage them to explore the struggles and resistance they will most likely encounter when teaching their students. I strive to produce highly skilled elementary mathematics teachers.
capable of, and comfortable with, facilitating mathematics learning in ways aligned with our current mathematics standards while they maintain a critically reflective practice.

I have been a teacher in many ways with my younger siblings and a lover of learning since I was a young child. I have always been drawn to mathematics. Mathematics is everywhere, and we all use mathematics every day. I have always accepted the challenge of discovering solutions and solving problems, although the content has not always come easily to me. In mathematics, I learned to follow the rules, the method, and the strategy the teacher offered. This process would always provide the correct answer, and you did not question the teacher. I could memorize how to solve problems, but always wondered why the solutions were right, which left me feeling as though I was missing a critical part of ‘the bigger picture.’ My personal experiences and struggles learning mathematics have inspired me to impart determination and promote opportunities to teachers and students in making meaningful connections with mathematics.

“Great teachers are not born; they are made. Just as the most talented musicians or artists become great by reflecting on their art, beginning teachers become accomplished teachers, and skilled teachers become great teachers, by thinking hard about their teaching, and finding ways to improve it” (Artzt, Armour-Thomas, & Curcio, 2008, p. xvii). I love teaching, and I love learning. If the goal of teaching and learning, lies beyond mere content coverage, then reflection is not optional. Critically examining my teaching has become an integral part of my daily practice and one I hope to instill in my students. I am a white, female adjunct professor and mathematics education teacher at a local University in the Southeastern region of the United States. I have taught for 15 years, in grades three-six as well as college level courses. For the past eight years, I have taught education courses at the college-level. I have worked with both
undergraduate and master’s level students teaching both mathematics and science methods courses and supervised undergraduate interns at the elementary and secondary level. I have worked as a mathematics content coach and as a residency field supervisor in the University’s Elementary Teacher Residency Program. Within these roles, I worked collaboratively to prepare future teachers utilizing research-based, signature pedagogy, and intensive supervised clinical experiences. I am familiar with the Standards for Mathematical Practice, which describe variations of knowledge that preservice teachers (PSTs) at all levels might seek to cultivate in their students. These practices rest on important “process and proficiencies” with longstanding importance in mathematics education (CCSSM, 2018). As well as the various measures by which the PSTs will be assessed in our surrounding school districts.

My research interests have focused on adult learning, specifically in the elementary mathematics methods courses. Learning to teach in a content area is an area in which researchers have studied for many years (Ball, Hill, & Bass, 2005; Ball, Lubienski, & Mewborn, 2001; Brown & Smith, 1997; Charalambous, 2010)

**My Educational History**

Motivation is key. I was always a high achiever in school. I have always loved being the first one to find the correct answer, so it is fair to say I did not have any negative memories or self-perceptions. Although I struggled at times with the mathematics content in middle school, I did everything in my power to understand, or rather, memorize the steps of what we were ‘taught’ In high school, I took as many math classes possible to challenge myself. This, however did not mean I understood everything I was ‘learning,’ but I maintained my 4.0 average and this grade point exempted me from exams. I always knew I wanted to teach so after graduation it
was my mission to learn the processes within mathematics problems and how specific methods led me to the correct answer – I needed to know the “why” and unlock my mystery.

Education has always been my passion on many levels. I have an undergraduate degree in Elementary (K-6) Education; am a National Board-Certified Teacher as a Middle-Childhood Generalist; and have earned an MA degree in Mathematics and Science (K-8) Education as well. I also have an additional certification in Mathematics Education (6-12) and pursued this Ph.D. in Mathematics Education.

**Why I Chose This Study**

I have always been a lover of learning. Through my 15 years of teaching, I have encountered students, on varying ability and developmental levels who hold my passion for mathematics and those who loathe the sound of the word “mathematics.” I developed my teaching methods to nurture, encourage and embrace my students’ strengths and difficulties, whether they are children or adults. I overcame my challenges with mathematics both in and out of school and decided to take every opportunity to empower my students in their journeys.

I was determined to follow my mission and desire to make meaningful connections with my students and pursue my educational journey. Along the way, I encountered one professor who saw something in me, tested my limits and instilled a confidence I did not realize I possessed. I will never forget the words he used when talking to a colleague:

“Ms. T has that spark that we’re looking for in the education field. She has a positive outlook, works well with others, and does not hesitate to ask questions to further clarify her own understanding. Ms. T exhibits excellent teaching strategies and techniques and works extremely hard to assist students and teachers in their
efforts to achieve at the highest level. Over the years, she has developed an excellent rapport with students, teachers, administrators, and colleagues. She shows a sincere interest in them as individuals and to the teaching profession.”

He later told me I was his success story and those words provided me the courage to pursue my passion for helping students at all levels.

Progressing from teaching children to teaching adults, I recognized similar struggles and apprehensions regarding mathematics. Both children and adults struggle with foundational gaps in mathematical knowledge; however, adults such as - PSTs, are faced with having to teach mathematics while still learning.

Another concern PSTs face is a misalignment between how they experienced mathematics as learners, and the contemporary view of mathematics teaching practices (Brown, Friedrichsen, & Abell, 2013; Wilson, 2014). An area where teachers struggle is learning new methods of teaching that is considerably different than the ways they were taught mathematics in grades K-12 (Adams and Krockover 1997; Davis et al., 2006; Wilson, 2014). They may not only struggle with mastery of the content itself, but also with the new methods and strategies in which they are expected to teach today. These novices are just beginning to craft their own identity before recognizing the notion that they can be successful with mathematics (Feiman-Nemser & Remilard, 1995). There is nothing more disheartening than hearing a PST (or student) shut down and limit themselves. Comments such as: “there is no way I’m teaching math,” “I will have to teach kindergarten because I can’t do that math,” or worst of all, “maybe I should find another major.”

Knowing the huge concerns of my PSTs’, I find it critical to discover creative ways in which I can better support and promote confidence in my students. For this study, I chose to
focus on how three PSTs describe their experiences as K-12 mathematics learners, how the PSTs perceive their abilities to teach mathematics prior to participating in an elementary mathematics methods one course, how the PSTs perceive their abilities to teach mathematics after participating in an elementary mathematics methods one course (with some field-based components), and what catalysts, relative to their experiences, the PSTs consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students.

Summary

In chapter one I provide context for the study by introducing the educational value of a “hands-on approach” to learning, I recognize that learning occurs not only through our experiences but also by reflecting on those experiences. I then present my reasons for conducting the study and reflect on my personal knowledge and involvements teaching and learning mathematics. At the same time, I communicate my struggles learning mathematics and explain how they guide my pedagogical orientation. I continue the chapter by sharing my educational history from my early childhood years and include my journey leading up to the study. I conclude with a description of why I chose this study and my specific focus to illuminate changes in PSTs perceptions about teaching elementary mathematics.
Chapter Two: Introduction

Introduction

General Statement of the Problem

There is a high demand for highly qualified, well-prepared mathematics teachers (Bailey, 2017; Gilewski, 2016; Wilson, 2014). The “expectations of teachers in the 21st century are different from what they were as little as a generation ago” (Artzt et al., 2008, p.3). Although it is true that a competent teacher must engage in classroom behaviors that are likely to promote student learning of mathematics, this is not the full story of professional competence. There is a growing recognition that teaching involves more than what teachers do in the classroom and extends to the driving forces behind the teachers’ actions: their beliefs (Artzt et al., 2008; Wilson, 2014).

For almost two decades, researchers have built frameworks and models that seek to understand the mind and related actions of the teacher (e.g., Artzt & Armour-Thomas, 1998; Fennema & Franke, 1992; Schoenfield, 1998; Simon, 1997; Swars, 2004; Wilson, 2014). Artzt, Armour-Thomas, and Curcio (2008) share their conceptualization on this issue is that teacher knowledge, beliefs, perceptions, and goals directly influence decision making. Further, research has indicated the use of effective mathematics instructional practices is strongly related to teachers’ beliefs and perceptions in their capabilities to have positive influences upon student learning (Enon, 1995; Swars, 2004). Enon (1995) found highly efficacious teachers are more successful mathematics teachers (Swarz, 2004).
Mathematics educators might consider the importance of examining beliefs and belief change based on the substantial role beliefs play in the teaching and learning of mathematics (Ambrose, Phillip, & Chauvot, 2004; Leder, Pebkonen & Tomer, 2022; Pajares, 1992; Thompson, 1992; Swars, 2004). Although there are many reviews concerning teacher ability and teacher beliefs, there is limited research on mathematics teacher efficacy and beliefs (Swarz, 2004). Some of the studies have focused on in-service teachers, yet few have examined PSTs. Furthermore, several studies and models describe the relationship between teacher beliefs and practices (see Raymond 1997; Swars, 2004).

There is a gap in the research on the consistency between teachers’ beliefs and practices, their experiences as mathematics learners, and their connection related to PSTs’ teacher education programs. In this exploratory descriptive case study, I investigated any changes in three PSTs’ perceptions about teaching elementary mathematics. The following A Priori questions will guide the study:

1. How do three preservice teachers describe their experiences as K-12 mathematics learners?

2. In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?

3. In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?
(4) What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?

**Purpose of the Study**

When many PSTs learn theories, methods, and strategies in their [mathematics] education courses, they may not see the relevance of what is being taught (Gilewski, 2016; McMillian, 1985). Consequently, some PSTs were not encouraged to examine their own beliefs about mathematics teaching and learning (Holt-Reynolds, 1992; Kagan, 1992; Wilson, 2014) and may simply refer to their prior K-12 mathematics experiences rather than making informed decisions about reform-based methods of teaching in the classroom (Darling-Hammond, 2006; Lortie, 1975; Richardson, 1996). Furthermore, the PSTs may believe that the way they learned mathematics is suitable for their students. This type of thinking can contribute to a cycle of poor teaching (Gilewski, 2016). As a result, it is imperative that teacher educators begin to explore new methods of teaching as well as their own beliefs about teaching and learning. Accordingly, teacher educators need to find ways to assist them with their self-awareness to enable future teacher’s decision making. I believe it is vital for me to learn more about the nature of the PSTs’ prior mathematics experiences to gain an understanding of what might have shaped their beliefs about teaching and learning mathematics. I also want to discover in what ways the PSTs perceive their abilities to teach mathematics before, and after participating in an introductory mathematics methods course, including the catalysts they considered most significant to their professional development.
Type of Study

To address my research questions, I utilized an exploratory descriptive case study design (Barkley, 2007; Merriam, 2009; Neuman, 2004). A case study is “…the study of an issue explored through one or more cases within a bounded system…” (Cresswell, 2007, p.73) Over time through a systematic collection and analysis (Berg, 2009). Case study “allows an investigation to retain the holistic and meaningful characteristics of real-life events” (Yin, 1994, p. 3). A case study was an appropriate method for this research because it allowed me to examine the beliefs and perceptions of three PSTs in an introductory mathematics method course. Berg (2009) also states that the information collected in a case study must be rich, detailed, and in-depth. Case study research…” examines many features of a few cases” (Neuman, 2004, p. 42). The cases can be individuals and the data collected are useful when the researcher wishes to become familiar with a new research setting, and the features of this setting, during the process of pulling together various forms of data from a “comparatively small community” (Neuman, 2004, p. 15). Descriptive research also begins with a clear question, and the study’s objective is a detailed picture of the research questions (Neuman, 2004). I also utilized exploratory design because there is scarce research on changes in PSTs’ perceptions about teaching mathematics to elementary students that compares their experiences as mathematics learners and the development of their beliefs and pedagogy (Barkley, 2007; Neuman, 2004). “We use exploratory research when a subject is very new, we know little or nothing about it, and no one has yet explored it” (Neuman, 2004, p.38).

Definition of Terms

Many variations exist in the terminology used throughout teacher education literature. The following are definitions used throughout this study.
Preservice Teacher (PST). An individual enrolled in a teacher preparation program who satisfied all program requirements and does not yet hold a Professional Educator’s Certificate (CAEP, 2013). PSTs selected for this study have completed their introductory mathematics methods course, MAE 4310: Teaching Elementary (K-6) Mathematics Methods I; and their Level II Internship.

Beliefs. Beliefs are defined as both conscious and unconscious ideas and thoughts about oneself, the world, and one’s position in it; these ideas are considered by the individual to be true (Cross, 2009; Pajares, 1992; Thompson, 1992). Beliefs are personal, stable, and often exist at a level beyond the individual’s immediate knowledge. They are very influential, reliable indicators of human behavior, and tend to be highly resistant to change (Cross, 2009; Thompson, 1992).

Perceptions. Perceptions are defined as the process of becoming aware of something through the senses. Everyone holds a range of beliefs that influence his/her impressions of the experiences they have with others and the world in general (Bailey, 2017; Cross, 2009).

Theoretical Frameworks

The frameworks I gravitated toward are theories that demonstrate how adults construct knowledge as they work conjointly in social environments. The approaches offer insights into the situated nature of cognition (Brown, Collins, & Daguid, 1989; Lave & Wenger, 1991; Richards, 2015; Steele, 2001) and clarify how significant learning occurs when individuals participate in authentic or simulated real-world tasks (Curwood, 2014). Each model considers the emotional learning environment essential to adults’ development of knowledge in which participants is valued and social interaction, questioning, and inquiry are encouraged (Curwood, 2014; Lave & Wenger, 2002).
I am philosophically disposed toward constructivist, sociocultural and adult learning theories. Just as I felt the urgency to learn more about the meaning behind the mathematics to better support and prepare my elementary students for this upcoming era, I equally see and can relate to the struggles PSTs experience in the mathematics methods courses I have taught. I believe it is my responsibility as a teacher educator to better understand not only my students’ backgrounds, but their strengths and needs, to prepare them to teach their future students successfully.

**Constructivist and Sociocultural Perspectives**

Vygotsky’s (1930’s) sociocultural theory paved the way for the constructivist movement (Jaramillo, 1996)). His theoretical framework greatly influenced the development of this approach (Cobb, 1994; Jaramillo, 1996; Thorne, 2005). In this theory, he posits social experience shapes individuals’ ways of thinking and interpreting the world and individual cognition occurs in a social situation (Jaramillo, 1996). Constructivism has a gamut of contributors with differing theoretical positionings, which afford this theory an assortment of teaching styles. For this study, I focused on Vygotsky’s view of a nonlinear learning sequence and that learning is social and situated within its occurring context and situation (Abell et al., 2010; Steele, 2001).

**Constructivist and Sociocultural Theory in Mathematics**

In this study I draw on both constructivist and sociocultural perspectives because learning mathematics is both socially (interactively) and individually constructed (Baurersfeld, 1988; Cobb, 1994; Confrey, 1987; Steele, 2001; Yackel et al., 1990). In the introductory mathematics methods course in which the PSTs participate, the instructor and students continuously engage in dialogue. This dialogue is unique for everyone based on their interpretations of new methods of
mathematics teaching, classroom activities. Discussion also is partially based on their previous experiences (Confrey, 1987; Gilewski, 2016; Steele 2001). The foundation to a sociocultural approach to teaching is constructed on the notion that communication is fundamental to learning. Within the sociocultural framework, individuals’ learning is shaped by participation in edifying practices, and PSTs create mathematical meaning as they share their reasoning (Batista, 1999; Cobb & Yackel, 1995; Steele, 2001).

Researchers acknowledge experience is socially constructed and can be analyzed and manipulated. Our experiences furnish the catalyst for critical reflection. Tennant (1991) offers a description of using a learner’s experience that seems most congruent with adult learning theory. [Shared] learning experiences establish a common base from which each learner constructs meaning through personal reflection and group discussion…The meanings that learners attach to their experiences may be subjected to critical scrutiny. The teacher may consciously try to disrupt the learner’s worldview and stimulate uncertainty, ambiguity, and doubt in learners about previously taken-for-granted interpretations of experience (p.197).

It can be argued that there are successive levels of intricacy in development (Tennant, 1990; Hobson et al., 1998) and it would be overly simplistic to claim that change is regulated merely by normative stages of development.

**Adult Learning Theory**

While we have known for centuries that adults learn as part of their daily lives, it was not until the early decades of the twentieth century that researchers systematically studied learning (Merriam, 2001; Merriam & Bierema, 2014; Merriam, Cafferella, & Baumgartner, 2012). It was then by behavioral and cognitive scientists who were most interested in memory, intelligence,
and information processing, and how age impacted these processes (Merriam, 2017). These early studies generated different theoretical approaches to learning and adult learning, approaches which still frame research about adult learning today (Jarvis, 1992; Merriam, 2017). Research supports the idea that adults, as they move through life are affected by physical, psychosocial and social patterns that are related to their changing needs, interests and responses (Erickson, 1978; Hobson et al., 1998; Levinson, 1978; Merriam et al., 2014). There are five assertions in the andragogic model: (1) learners need to be aware of why something is important to learn; (2) learners must be informed how to guide themselves through information; (3) learners must be able to connect the matter to their experiences. Also; (4) adults will not learn until they are prepared and interested; (5) learners might need support in trying to overcome inhibitions, behaviors, and beliefs about learning (Conner, 1997, 2004, p12). How one moves through the andragogic model considers not only the learner but also the context of the learning and the nature of the learning itself; therefore, the learning that occurs within the context of the introductory mathematics methods course is unique to everyone (Merriam 2001; Steele, 2001).

**Significance of the Study**

This proposed study is significant because it will add new and necessary information to the literature about PSTs’ experiences within the context of a prospective elementary mathematics teacher preparation program. The inquiry will contribute to the sparse details on how PSTs beliefs might change during their experiences learning how to teach elementary mathematics. The study has the potential to contribute to theory and practice regarding the advantages and disadvantages to mathematics educators in course planning for preservice mathematics teacher programs. Furthermore, the discoveries of the study might assist teachers of different mathematics courses the importance of other mathematics teacher beliefs.
One of the difficulties teachers face in learning how to teach in reform-oriented ways is that this new practice is different from what teachers experienced as mathematics learners (Adams & Krockover, 1997; Bailey, 2017; Davis et al., 2006; Brown, Friedrichson, & Abell, 2013). Researchers have identified learning to teach mathematics is a complex process where prior knowledge and experiences shape the development of new knowledge (Brown, Friedrichson & Abell, 2013; Casey, 2016; Russell & Martin, 2007). Lortie (1975) argued the experiences in K-6 mathematics courses ground prospective teachers’ beliefs about teaching and learning at the onset of a teacher preparation program, while Schon (1983) proposed that prospective teachers build valuable knowledge by focusing on their work in the classroom to improve student learning. To understand how teachers develop knowledge during teacher preparation, researchers must identify the types of knowledge integral to effective mathematics teaching (Adams & Krockover, 1997; Davis et al., 2006; Brown, Friedrichson, & Abell, 2013).

Through this research, I hope to provide insights about changes in PSTs’ beliefs and how their experiences helped shape their perceptions about their ability to teach mathematics. I am optimistic readers of my study will be able to relate to, reflect on, and coincidently learn from the characteristics of this phenomenon. I expect this study will provoke readers, to think critically about their own educational experiences, their assumptions about the teaching and learning of mathematics that originate from those experiences, and how those assumptions might support or incumber progress in the education of PSTs at their institutions. In giving equal voice to PSTs as learners in this study, my goal is to make it possible for members of the educational community to relate to and empathize with both the teacher and learner.
Summary

In this second chapter, I provided a general statement of the problem, identified my *a priori* questions for the study, outlined the purpose of the study and the type of research that I conducted. I then specified the theoretical frameworks that undergird this study: constructivist theory, sociocultural theory, and adult learning theory. I elaborate further on the theoretical frameworks as they pertain to mathematics learning in the following chapter.
Chapter Three: Review of the Literature

Introduction

Individuals enter teacher education programs with preexisting knowledge, beliefs, and perceptions about teaching, which are well grounded in their experiences as participants in our society (Hart, 2004; Wilson, 2014). Anderson and Smith (2007) assert that throughout their school careers, preservice teachers (PSTs) have witnessed a didactic orientation to mathematics instruction where mathematics is presented as a body of static knowledge (Anderson & Smith, 2007; Borko & Putnam, 1996; Kagan, 1992). Thus, PSTs have served as passive listeners of learning rather than active participants of the process. This experience is misaligned with the current contemporary methods of teaching and learning.

Framing the Literature Review

This review of literature contains information about teacher beliefs and perceptions, how experiences shape those beliefs, and challenges related to changing beliefs and perceptions. It also includes research on how constructivist, sociocultural and adult learning theories guide teacher experiences, beliefs, and perceptions. I selected scholarly journal articles and the research relative to PSTs and mathematics teaching and learning whenever possible. This section will focus on my A Priori questions, assumptions upon which experiences, beliefs, and perceptions play concerning PSTs’ practice and pedagogy. Finally, I end with a discussion, implications for practice, research, and a summary.
A Priori Questions

The following four A Priori questions will guide my inquiry:

(1) How do three preservice teachers describe their experiences as K-12 mathematics learners?

(2) In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?

(3) In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?

(4) What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?

Teacher Beliefs and Perceptions

In response to a call for research on teaching and learning, the National Council of Teachers of Mathematics (NCTM) has developed reform recommendations that form the basis for most teacher education programs in mathematics (NCTM, 1989, 1991, 1995, 2000). The transformative methods represented in the NCTM documents is vastly different from how most PSTs were taught as K-12 mathematics learners and in mathematic foundation courses when then entered college. The change required to teach mathematics from a reform perspective is more than learning new techniques; it requires reconceptualizing one’s notion of teaching, learning, and mathematics. The new methods require considerable restructuring of mathematics practice; and needs a paradigm shift and most likely, a change in beliefs (Hart, 2004; Goldsmith & Schifter, 1997).
Beliefs may be considered characteristics toward action, having a motivational influence (Ambrose, 2004; Cooney, Shealy, & Arvold, 1998; Rokeach, 1968). Teachers are frequently faced with challenging situations and are forced to make spur-of-the-moment decisions. Their beliefs unknowingly compel them to demonstrate specific behaviors. Beliefs are not all-or-nothing entities; they are, instead, held with varying strengths (Rokeach, 1968, as cited in Pajares, 1992). Beliefs are often content specific and surface in situations with specific characteristics (Cooney et al., 1998), and therefore a respondent’s belief is contingent on his or her interpretation of the context.

For this study, I utilize the definition of beliefs as both conscious and unconscious ideas and thoughts about oneself, the world, and one’s position it is; these ideas are considered by the [PST] to be true (Cross, 2009; Pajares, 1992; Thompson, 1992). Such beliefs are personal, constant, and the PSTs are often unaware of their existence. Beliefs are very influential and are thought to be highly resistant to change (Cross, 2009; Thompson, 1992). Additionally, each holds a range of beliefs that influence his/her perceptions of the experiences they have with others and the world in general. These beliefs have been investigated across different areas of educational research and form a broad literature base that includes studies on personal epistemology (Cross, 2009; Fives and Beuhl, 2008; Muis, 2004).

Bryan and Atwater (2002) contend that the process of learning to teach starts by making clear one’s beliefs about teaching and learning. Over a decade of studies in teacher education have illustrated the influence of teachers’ beliefs and perceptions about teaching and learning on classroom practice (Artilles, 1996; Bowers & Flinders, 1990; Brickhouse, 1990; Bryan & Abell, 1999; Pajares, 1992). Hence, in learning to provide high-quality and
varied opportunities to learn mathematics, it is essential for teacher educators to take into consideration the beliefs and perceptions PSTs embrace.

It has become customary to say one is not good at mathematics, yet this claim may be unacceptable if applied to other subjects like reading (Robertson, 2016; Wilson, 2014). As students' early perceptions regarding the enjoyment of mathematics and their self-efficacy of mathematical abilities strongly influence their career and educational choices, guidance from early mathematics teachers and mathematics teacher educators is critical in students' formation of positive and engaging experiences during their teacher preparation (Robertson, 2016; Rowan-Kenyon, Swan, & Creager, 2012).

**How Experiences Shape Beliefs**

As PSTs enter a teacher preparation program, most have the goal of positively affecting the lives of students, to become “agents of change” (Manuel & Hughes, 2006, p. 16), or to give students what they may not have received as students themselves (Richardson & Watt, 2005; Richardson & Watt, 2006; Watt & Richardson, 2007; Watt & Richardson, 2008; Wright & Tuska, 1968). However, PSTs are often unaware of how their educational experiences have shaped their beliefs about teaching and learning, and this lack of awareness can be counterproductive to their goals (Collins, Selinger, & Pratt, 2003; Gileski, 2016; Gore & Zeichner, 1991; Holt-Reynolds, 1992; Kagan, 1992).

When determining how PSTs’ educational experiences have shaped their beliefs about teaching and learning, two features are most relevant: “[the teacher] is cognizant of and questions the assumptions and values he or she brings to teaching” and “is attentive to the institutional and cultural contexts in which he or she teaches” (Zeichner & Liston, 1996/2013, p. 6). These two key features are essential to address when working with PSTs as they become
aware of their beliefs about teaching and learning. Without aiding them in discovering these beliefs and how these beliefs were developed, some PSTs will have difficulty becoming reflective practitioners and efficient teachers because they will not understand why they are doing what they are doing and how their beliefs are impacting their classroom environment and culture (Zeichner & Liston, 2013).

Reflecting on and changing ones’ beliefs is not something that is easily done (Gileski, 2016; Tabachnick & Zeichner, 1984). Therefore, it is essential for teacher preparation faculty to find methods to help PSTs become aware and reflective of how their experiences have shaped their beliefs about teaching and how these beliefs will affect what they will do in their future classrooms and how they will interact with students (Collins et al., 2003).

**Connecting Beliefs with Practice**

In 1984, Thompson determined there was a subtle connection between teachers’ beliefs about mathematics and their practices when teaching mathematics. Kupari also found a link between teachers’ practices and beliefs, albeit a weak one (Kupari, 2003). Yet other researchers take a different stance than these, finding either strong evidence for a coherent system of beliefs and practices (Cooney & Shealy, 1997; Ernest, 1989b; Fennema & Nelson, 1997; Nespor, 1987; Stipek et al., 2011) or a full or partial mismatch between beliefs and practices (Barkatsas & Malone, 2005; Beswick, 2012; Devine, Fahie, & MacGillicuddy, 2013; Kupari, 2003). Although this dichotomy exists, there is a body of research that identifies intersections between teacher beliefs, teacher knowledge, the use of resources in the classroom, and ultimately teaching practices (Speer, 2008). For example, Cross (2009) examined 9th grade Algebra teachers at different career stages and hypothesized that ultimately beliefs about how students learn mathematics rests upon a belief of what mathematics is. That is, based on their beliefs of what
mathematics is, teachers’ reason what evidence would constitute expertise in mathematics and then determine what evidence of student learning in mathematics looks like based upon their beliefs of knowledge. Teachers ultimately make instructional decisions to move students to the desired learning outcomes based on their feelings about mathematics and mathematical expertise.

In an exploration of ways in which a combination of beliefs and previous experiences in practice can affect teachers’ current practice, Nespor (1985) demonstrated that some teachers model their practice on episodic memories, recalling earlier experiences to model their current pedagogy. Raymond’s (1997) model of the relationship between beliefs and practices offers a view that both previous beliefs and practices PSTs experienced as students strongly influence their current practices. Ideas may be more influential than knowledge when determining how individual teacher behavior is predicted (Ernest, 1989; Nespor, 1985; Stipek et al., 2001). Furthermore, teachers themselves trust their beliefs and perceptions inform their practice (Raymond, 1997). If PSTs approach their teacher education programs already holding traditional, transmissive beliefs about how students learn mathematics due to their previous experiences (Conner, Edenfield, Gleason, & Ersoz, 2011; Decker, Kunter, & Voss, 2015; Hart, 2004; Klein, 2012; Swars et al., 2009), teacher educators may wish to shift their beliefs to a more constructivist view. This shift is essential in mathematics education as researchers have found higher achievement gains in students with teachers holding beliefs about mathematics, namely constructivist beliefs rather than beliefs centering indirect transmission (Staub & Stern, 2012). In the following section, I discuss ways in which teachers have successfully changed their beliefs.

**Changing Beliefs and Perceptions**

Block and Hazelip (2005) explained that beliefs are not static and fluctuate in intensity and nature, and gradually improve over time. Individuals can change his or her beliefs
based on the strength of the convictions and with varying levels of effort. The stronger the belief, the more resistant it becomes to change (Block & Hazelip, 2005). Several researchers (e.g., Kagan, 1992a; Pajares, 1992) correlate Block and Hazelip's assertion that "teacher beliefs and belief systems are grounded in their personal experiences and, hence, are highly resistant to change" (Block & Hazelip, 2005, p. 27).

The is considerable research that supports the role of beliefs in teacher change in mathematics education (Cooney & Shealy, 1997; Hart, 2004; Pajares, 1992; Richardson, 1996). Pajares (1992) proposed [PSTs] have formulated their beliefs about teaching by the time they enter college (Hart, 2004). The PST’s beliefs were developed during “the apprenticeship of observation” that occurs over their years as K-12 mathematics students (Lortie, 1995). Beliefs are challenging to transform and include perceptions about what it takes to be an effective teacher (Hart, 2004; Pajares, 1992); they are also carried to their teacher preparation programs where beliefs are seldom confronted (Zeichner & Gore, 1990).

Even in the aspect of conflicting evidence, beliefs are often resilient (Hart, 2004). Challenging and shifting beliefs is a formidable task that takes time; the reality is teacher education programs typically have a short amount of time with PSTs. In elementary programs, mathematics education and mathematics content courses are typically only a small aspect of the overall program requirements (Hart, 2004; Wilson, 2014). Change is restricted further when the PSTs are taught mathematics content from a behaviorist perspective during their K-12 schooling and then taught mathematics from a constructivist perspective in mathematics methods courses (Hart, 2004).

In Jao’s (2017) study, he asserts it is the intention of the methods courses to move the PSTs forward from their inhibited perceptions of teaching established through their time spent as
students observing and evaluating their K-12 teacher’s perspective on classroom events (Lortie, 1975). Mathematics methods courses offer an avenue to support PSTs’ development in their teaching and provide a rich opportunity for PSTs to experience mathematics in a situated way where they may engage with mathematics as both learners and teachers that reflect reform-based ideals (Jao, 2017).

**Theoretical Frameworks**

The frameworks I gravitated toward are theories that demonstrate how adults construct knowledge as they work conjointly in social environments. The theories offer insights into the situated nature of cognition (Brown, Collins, & Daguid, 1989; Lave & Wenger, 1991; Richards, 2015; Steele, 2001) and clarify how significant learning occurs when individuals participate in authentic or simulated real-world tasks (Curwood, 2014). Each model considers the emotional learning environment essential to adults’ development of knowledge in which participants are valued and social interaction, questioning, and inquiry is encouraged (Curwood, 2014; Lave & Wenger, 2002).

**Constructivist and Sociocultural Theory in Mathematics**

In a sociocultural approach to teaching, communication is the foundation to learning. Within this framework, individual learning is overwhelmingly influenced by participation in social situations, and PSTs construct their meaning as they explore their thoughts and varying perspectives (Batista, 1999; Cobb & Yackel, 1995).

Researchers acknowledge experience is socially constructed; therefore, it can be analyzed, critiqued, and implemented. It is experience that provides the initiative for critical reflection. Tennant (1991) theorizes, adult learners share common experiences where each construct meaning through their own personal reflection. Dialogue and challenging viewpoints
may lead to questioning of one’s beliefs. It can be argued that there are successive levels of complexity or maturity in development (Tennant, 1990; Hobson et al., 1998) and it would be overly simplistic to claim that change is regulated merely by normative stages of development.

Additionally, Vygotsky (1994) suggests individuals acquire the meanings of social environments by internalizing the meanings and being changed by them as they begin to discuss differing perspectives (Steele, 2001). Thus, PSTs manufacture their knowledge and develop mathematical meanings and perspectives as they learn to express their thoughts and justify their thinking to others. As they learn to speak the mathematical language, they convert their thinking of mathematical concepts (Steele, 2001).

**Adult Learning Theory**

Andragogy is also identified as adult learning theory and was proposed by Malcolm Knowles in 1968. Prior to Knowles, considerable research and attention had been based on the concept of pedagogy – teaching children. Knowles recognized children and adults learn differently and with a different purpose. He intended to acknowledge the depths and unique qualities adult learners possess (Merriam, 2001; Merriam & Bierema, 2014; Merriam, Cafferella, & Baumgartner, 2007). Knowles is also documented for identifying five assumptions teachers should make about adult learners: self-concept; past learning experiences; readiness to learn; practical reasons to learn; and they are driven by internal motivation.

While we have known for centuries that adults learn as part of their daily lives, it was not until the early decades of the twentieth century that researchers systematically studied learning (Merriam, 2001; Merriam & Bierema, 2014; Merriam, Cafferella, & Baumgartner, 2007). It was then by behavioral and cognitive scientists who were most interested in memory, intelligence, and information processing, and how age impacted these processes (Merriam, 2017). These
early studies generated different theoretical approaches to learning and adult learning, approaches which still frame research about adult learning today (Jarvis, 1992; Merriam, 2017). Research supports the idea that adults, as they move through life are affected by physical, psychosocial and social patterns that are related to their changing needs, interests and responses (Erickson, 1978; Hobson et al., 1998; Levinson, 1978; Merriam et al., 2014). In the andragogic model, there are five assertions: (1) adult learners need to understand the relevance of what they are learning; (2) adult learners are self-directed; and (3) adult learners hold a depth of experiences with which they can connect to content topics. In addition; (4) adults have internal motivation and a readiness to learn; and (5) may require assistance to overcome inhibitions, behaviors, and beliefs about learning (Conner, 1997, 2004, p12). The manner in which adults work through the andragogic model is dependent upon the learner and the nature of the learning itself (Merriam 2001; Steele, 2001).

Moreover, Habermas (1971, 1984) assisted in recognition of two chief areas of learning with different purposes, logics of inquiry, principles of rationality, and approaches of authenticating beliefs (Mezirow, 2000). Habermas (1981) also contributed to adult learning theory by asserting that problem solving, and learning may be contributory to [PST] efficacy, ability to improve implementation; understanding of what is being communicated. Communicative learning involves at least two persons inspired to reach an understanding of the sense of a diverse view or the validation for a belief. Ideally, this nature of learning involves reaching a compromise (Taylor, 1998; Wilson, 2014).

**Critical Reflection**

Critical reflection is based on Habermas’ view of rationality and analysis and is considered a distinctive attribute of adult learning (Merriam & Bierema, 2014). Only in
adulthood does one become aware of the “uncritically assimilated half-truths of conventional wisdom and power relations…. p.16 (Taylor, 1998). Habermas did not see the reflection in adult learning as a suppletory educational method, but instead as the core element of adult education. Taylor (1998) posits that the goal of adult education is “to help the individual become a more independent thinker by learning to negotiate his or her values, meanings, and purpose rather than simply acting on those of others” (Taylor, 1998, p.19).

According to Habermas, merely having an experience is not enough to prompt a change in adult learning, the discrepant event must invoke critical reflection on the involvement. As Criticos (2003) observed, what is valuable is not the experience itself but "the intellectual growth that follows the process of reflecting on experience. Effective learning does not follow from a positive experience but effective reflection" (Merriam & Beriama, 2014, p.162).

**Rational Discourse**

Another critical aspect of adult learning is rational discourse. This manner of conversation is the essential avenue through which transformation is elevated and thus developed. However, dissimilar to everyday dialogue, it is used “when we have reason to question the comprehensibility, truth, appropriateness, (about norms), or authenticity (in relation to feelings) of what is being asserted or to question the credibility of the person making the statement.” (Taylor, 1998, p.90). Rational discourse is a catalyst for change, as it induces participants to articulate the ideas to others (Merriam & Bierema, 2014). Thus, adult learning theory involves rational discourse, which permits individuals to make self-discoveries. As individuals make self-discoveries, their feelings, images, and thoughts are unified with their actions (Wade, 1997, p.713). Knowles (1999) looked at biographical factors and experiences of preservice and beginning teachers and created a framework for action that is useful in
Experiential Learning

David Kolb’s experiential learning philosophy (1984) describes learning as the process where knowledge is created through the catalyst of experience. This, in turn, suggests instant or tangible experiences are the foundation for reflections. These reflections are integrated and refined into theoretical concepts from which new suggestions for action can be obtained. These implications can be actively tested and serve as guides in creating new experiences (Kolb, 2000). Experiential learning further builds upon the ideas that are elaborated in the transactional curricular position that knowledge is constructed. Learning is the process whereby knowledge is shaped by experience (Kolb, 1984).

Experiential education differs from traditional education in that a student learns material by practicing it instead of merely talking or reading about it (Bacon, 1983). “Exclusively independent of aspiration or objective, every experience resides in further experiences. Therefore, the central problem of an education based upon experience is to select the kinds of existing experiences that live productively and creatively in subsequent experiences (Dewey, 1938 p. 27).” Therein is the nature of experiential learning in the context of a professional development school.

The amount of time allocated by many teacher preparation programs as enough field experience to acquaint candidates with the duties and orientations of becoming a teacher is usually one school semester (Hart, 2004; Wilson, 2014). Considering this, we must contemplate the nature and value of experience and the long-term effects of preservice preparation and their traditional professional development programs. A multitude of personal and institutional,
organization, social, formal and informal experiences play a part in the development of capable, enthusiastic, well rounded professional educators (Howie & Bagnall, 2015).

Within the context of preparing and supporting the transition from student to teacher, there must be an exploration of prior experiences that are critical incidents (Howie & Bagnall, 2015), which in turn are construed as persuasive in the educator’s practical and professional development. Kolb (1984), assembled a comprehensive theory based on Dewey and Lewin’s earlier work, which suggested the foundation for an approach to education and learning as a lifelong process, soundly based in traditions of cognitive and social psychology (Healey & Jenkins, 2000; Zuber-Skerrett, 1992).

Based on the work of Dewey, experiential learning accentuates a working knowledge composition involving connections between a person and the situation (Healey & Jenkins, 2000; Kolb, 2012). It is through this process where prior experiences guide a person’s way of thinking and knowledge acquisition. This connects appropriately with recent educational reform efforts that support self-reflection, problem-solving, and abstract thinking, while concurrently developing complex communication skills (Kolb, 2012).

Experiential learning is regularly misconstrued as a set of tools and techniques to afford learners with experiences from which they can learn. Others have used the term to describe knowledge that is a mechanical documenting of experiences. Experimental learning is above all a philosophy of education based on what Dewey (1938) called a “theory of experiences.” He argued that unlike traditional education, that had little need for theory because the practice was guided by tradition, the new reform approach to education needs thorough research of experience as a guide (Kolb & Kolb, 2005).
Dewey (1904) emphasized the importance of learning from authentic classroom cases rather than allowing peripheral situations to apprise education. He maintained that the only reality of the educational condition lies in the dealings among the teacher and student, and the specific requirements within the classroom context, and thus “the real course of study” (p.268). The teacher, whom he regarded as “the only real educator in the school system” (p.272), must not serve to enact externally required routing habits, but rather subsist as a learner of pedagogical literature, as well as “a student of the most fundamental educational problems in their most urgent reality” (p.273).

According to Dewey (1933), learning requires “reflective experience” (p.150) to gain understanding from past or present condition and action. Dewey considered thinking to be the joining between action and consequence. He believed that to learn, one must find a perplexing situation, anticipate the effects of varying approaches, collect data, clarify the challenge, revise the plan of action, and finally, act upon and learn from it (p.150). In this way, educators would create personally meaningful knowledge from within their own classroom experience to enlighten their work with real students.

**Discussion**

Research has shown adult learning requires real experiences and reflection. These essential components can empower PSTs involved in learning how to teach mathematics (De Leon, 2015). Interests in Knowles adult learning theory has resulted in international conferences, journals, books, and presentations, each dedicated to a different aspect of adult learning theory. Over time, adult learning theory has undergone modifications and incorporated new constructs as researchers have and undoubtedly will continue to influence adult learning theory.
Summary

In this paper, I synthesized the literature on constructivist, sociocultural and adult learning theories. Beginning with a discussion about teacher beliefs and perceptions, I then connected each with mathematics in its relationship to adult learning and teacher learning, I discussed various theoretical frameworks and models that promote adult learning, which might serve as a basis for supporting PSTs’ beliefs and perceptions about their personal abilities in the development of a mathematics methods course.
Chapter Four: Methods

Introduction

When many preservice teachers (PSTs) learn theories, methods, and strategies in their [mathematics] education courses, they may not see the relevance of what is being taught if they are unable to implement what they learn within their practice (Gilewski, 2016; McMillian, 1985). Consequently, some PSTs have not been encouraged to examine their own beliefs about mathematics teaching and learning (Holt-Reynolds, 1992; Kagan, 1992; Wilson, 2014) and thus, may rely on their prior mathematics learning to make decisions about what to teach and how to teach (Darling-Hammond, 2006; Lortie, 1975; Richardson, 1996). Furthermore, the PSTs may think whatever worked for them as students will work for their students. This type of thinking can contribute to a cycle of poor teaching (Gilewski, 2016). With awareness of new teaching methods and strategies, PSTs have opportunities to evaluate their beliefs and develop an understanding of what and why they are teaching (Darling-Hammond, 2006; Gilewski, 2016). I believe it is essential for me to learn more about the nature of the PSTs’ prior mathematics experiences to understand what might have shaped their beliefs about teaching and learning mathematics, so that I can ascertain changes in beliefs over time. I also want to discover in what ways the PSTs perceive their abilities to teach mathematics before and after participating in an introductory mathematics methods course, including they catalysts they considered most significant to their professional development as mathematics teachers.
Methodological Perspective

Exploratory Descriptive Case Study

To address my research questions, I utilized an exploratory descriptive case study design (Barkley, 2007; Merriam, 2009; Neuman, 2004). Case study “allows an investigation to retain the holistic and meaningful characteristics of real-life events” (Yin, 1994, p. 3). Case study is an appropriate method for this research because it will allow me to examine the beliefs and perceptions of three PSTs in an introductory mathematics method course. Berg (2009) also states the information collected in a case study must be rich, detailed, and in-depth. Case study research…” examines many features of a few cases” (Neuman, 2004, p. 42). The cases can be individuals and the data collected are useful when the researcher wishes to become familiar with a new research setting, and the features of this setting, during the process of pulling together various forms of data from a “comparatively small community” (Neuman, 2004, p. 15). I also utilized exploratory design because there is scarce research on changes in PSTs’ perceptions about teaching mathematics to elementary students, specifically little research that considers PSTs’ experiences as mathematics learners and the development of their new beliefs and pedagogy (Barkley, 2007; Neuman, 2004).

Yin (2003) asserts these types of case studies often provide incentives to try something “different.” The exploratory descriptive case serves as an example of the potential benefits of change, and as a result, they are a popular research methodology. Additionally, researchers employ a descriptive case study to provide a rich description of events and to reveal patterns and connections about theoretical constructs to advance theory development in the real-life context, in which they occur (Baxter & Jack, 2008; Merriam, 2009).
Research Questions:

The following *A Priori* questions guided my study:

1. How do three preservice teachers describe their experiences as K-12 mathematics learners?

2. In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?

3. In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?

4. What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?

Context for the Inquiry

I conducted this study at a university in the Southeastern region of the United States. The course in which the three PSTs participated was entitled MAE 4310, which was the first of two courses required by the College of Education for undergraduates who are working towards a bachelor’s degree in Elementary (K-6) Education. MAE 4310 Teaching Elementary School (K-6) Mathematics Methods I course was a three-semester-hour course offered in the spring semester annually (see Appendix A for the course syllabus). The students enrolled in the course also participated in a Level II internship, in which the interns were placed at local elementary schools and each student in the cohort worked with a different collaborating teacher one day a week for approximately 6 hours. The PSTs may potentially be placed in an English/Language
Arts (ELA) class and may not regularly observe mathematics being taught. However, the PSTs do have opportunities to visit classroom where mathematics is taught daily (see Appendix B for a description of the structure of the field experiences). A Graduate Assistant (GA) from the College of Education in the Secondary Mathematics Education Department teaches the course. Following my initial face-to-face introduction to the class, my communication with the study participants took place via email messages and semi-structured interviews. See Table 1 below for a description of participants.

Table 1. Description of Participants

<table>
<thead>
<tr>
<th></th>
<th>K-12 School Design</th>
<th>Prior Experience Working with Children</th>
</tr>
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| Amanda   | • K-2: General education, public school  
• 3-8: Enrolled in Ballet Academy  
• 3-4: Very small class size  
• 5: 5th/6th-grade combo class  
• 6-8: All middle school together; math taught online with a teacher available for support  
• 9: Public high school  
• 10-12: Virtual school  
• Self-guided, good student, good grades, the favorite subject  
• Limited exposure to English Language Learners (ELLs) or Exception Student Education (ESE)                                                                                                    | • 10th grade worked at a local YMCA and helped with homework  
• 11th and 12th grade taught a ballet class                                                                                                                                                                         |
| Becka    | • K-4: General education, public school  
• 5-7: Intermediate school  
• 8-9: Public high school  
• 10-12: Moved to Florida, public high school  
• 12th grade received tutoring after school  
• Good student, good grades  
• No exposure to English Language Learners (ELLs) or Exception Student Education (ESE)                                                                                                                     | • Beginning of college worked as an in-home tutor for 6th-grade girl                                                                                                                                                                  |
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<tr>
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<th>K-12 School Design</th>
<th>Prior Experience Working with Children</th>
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<tbody>
<tr>
<td>Carly</td>
<td>• K-12: General education, public school</td>
<td>• No prior experience working with children</td>
</tr>
<tr>
<td></td>
<td>• Mother worked at her middle school</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Average student, average grades</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Received GKT math tutoring before/during data collection</td>
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**Research Design**

In this study I explored how three PSTs describe their experiences as K-12 mathematics learners; in what ways the PSTs perceive their abilities to teach mathematics prior to participating in an introductory mathematics methods course; in what ways the PSTs perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course; and what catalysts, relative to their experiences do three PSTs consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students. To answer these questions, I visited the MAE 4310 course to which I had been invited. I introduced myself and verbally informed each potential participant of the purpose and nature of the study as well as in writing through an informed consent form prepared in accordance with the expectations and regulation of the university-based Institutional Review Board (IRB). Participation in the study was based exclusively on voluntary participation and did not include anyone who did not volunteer or provide consent via the IRB. I verbally highlighted the option to cease participation at any time during the study with no penalty as a result, during the informed consent process. The informed consent form listed the following features: (1) the purpose of the study, (2) study procedures, (3) the total number of participants, (4) alternatives, (5) benefits, (6) risks or discomforts, (7) compensations, (8) cost, and (9) confidentiality. All participants received a printed copy of the informed consent form during my
face-to-face meeting in the MAE 4310 class. After I explained the informed consent process, I asked the participants to sign the form if they agreed to participate in the study. I then collected the signed informed consent forms and randomly selected three participants for the study (Merriam, 2009). I contacted the three selected participants via an email message to initiate the data collection process and I collected all data through one ninety-minute audio-recorded interview per participant and additional email communication.

**Benefits and Compensation**

During the informed consent process, I notified the participants that a possible benefit of participating in the study was an increased perception of the theory and practice of teaching mathematics to elementary students. Additionally, I explained upon completion, I provided compensation for the study in the form of a $40.00 gift card. In the case of participant withdrawal before the conclusion of the study, I provided compensation in the way of a $20.00 gift card. I paid for the gift cards for payment.

**Triangulation and Data Sources**

**Triangulation**

Using a combination of approaches to encourage greater accuracy of results and findings, increase credibility, and search for consistency are benefits of triangulation of data (Merriam, 2009; Patton, 2002). The balance does not necessarily focus on any one of the various methodologies or new data used to support the study, but the user provides a more in-depth understanding into the relationship between the inquiry approach and the studied phenomenon (Patton, 2002). I used semi-structured interviews, asynchronous email communication, a researcher reflective journal, and member checks as a way of examining my personal feelings and thoughts, and to bracket these ideas to minimize their influence on the research in this study,
to best explore the phenomenon of teaching mathematics to elementary students, since I am also a proponent of teaching mathematics using contemporary methods.

Credibility measures to ensure the research is trustworthy are necessary for all qualitative studies (Brantlinger et al., 2005). In case study research, using at least two data sources is recommended to check for data consistency (Yin, 1994). I collected data from multiple sources: a.) 90-minute audio-recorded semi-structured interviews, b) multiple email correspondence, c.) reflective researcher journal, and d.) member checks, where I emailed the PSTs if I had any questions regarding their responses or if I have further wonderings. These multiple sources of data collection also served to triangulate data, as I was able to compare data from all sources to recognize patterns and any contradictions (Creswell, 2002; Merriam, 2009). I explored each data set for each participant and compared for consistency. I constantly referred to my reflective journal notes to help me continue to be aware of my biases. I also conducted member checks where I asked all study participants to review a copy of the interview transcripts and my analyses and interpretations of data to confirm that I had not misrepresented their statements, thoughts, perceptions or feelings. Finally, I presented thick, detailed descriptions to provide explanations and I was transparent in my explanations regarding how I drew conclusions and determined the implications of the study and for whom these implications applied (Creswell, 2002; Merriam, 2009; Patton, 2002).

**Data Collection Methods**

In this exploratory descriptive study, I used several data collection instruments to explore elementary PSTs experiences as K-12 mathematics learners, their perceptions about their abilities to teach mathematics prior to and after participating in an introductory elementary mathematics methods course, and what catalysts they consider significant in the development of
their beliefs and concurrent pedagogy about teaching mathematics to elementary students. I collected qualitative data: (1) during one 90-minute audio-recorded interview, (2) numerous email messages that included question prompts directly correlated to my research question as well as clarifying questions I had following our meeting, (3) through a researcher reflective journal where I used journaling as a way of including my own reflexivity on PSTs’ email communication, and (4) I asked the PSTs additional or probing questions if I needed clarifications about their responses as a form of member checking.

**Interviews**

Every word people use to tell their stories is a microcosm of their consciousness (Vygotsky, 1987, p. 236). As Siedman (2013) states, “Individuals’ awareness gives access to the most complicated educational issues because they are abstractions based on the concrete experience of people” (p. 7). Qualitative methods employ an inquiry design and data collection method that inspires in-depth responses and examination and offers “rich and substantive data” (Patton, 2002). When I reflected on how to design this study, I believed qualitative interviewing was one research style suited for this study, as it “attends to particulars,” relied “on the use of expressive language and the presence of voice in the text,” and was “interpretive in character” (Ladson-Billings, 1994; Siedman, 2013).

Interviewing affords the researcher an opportunity to collect data on the perspectives of the participants, and highlights the participants’ perspectives, which can further assist in rich data collection that can be significant to others (Patton, 2002). As stated by Rubin and Rubin (2005), “Qualitative interviews are conversations in which a researcher gently guides a conversational partner in an extended discussion” (p. 4), and it is within this discussion where valuable exploration of the phenomena and lived experiences take place.
Semi-structured interviews are designed with open-ended questions that encourage participants to provide detailed, multifaceted responses. The semi-structured interview protocol offers the researcher the organization and reassurance of preplanned questions but does not presume an answer (Richards & Morse, 2012; Seidman, 2013). Semi-structured interviews allow participants to take any direction they want while they reflect upon and make meaning of their learning experiences (Seidman, 2013).

I audio-recorded each of the semi-structured interviews with the participants’ permission. Each of the audio files was uploaded to Landmark Associates, Inc., a transcription service. The website provides transcription services using multi-level encryption protection. This website is password-protected and I the transcripts was stored on my laptop, which is also password-protected.

**Asynchronous Email Communication**

There are numerous approaches to encourage extensive dialogue with participants, when thinking about which best fit the research questions for this study, the open-ended communication (Merriam, 2009; Patton, 2002) seemed most appropriate. This style of communication is open-ended. Accordingly, I asked carefully-worded questions aligned with my research questions, while allowing room for me, as the researcher, to further probe and for the study participants to respond. I asked a series of questions correlated to each research question in the emails I sent to the participants (see Appendix B). I asked previous PSTs similar questions to determine if their responses would be useful to my research. Due to the asynchronous nature of a place, email communication provides extended access to the participants (Opdennamakker, 2006). This email process enabled me to contact the PSTs at times they find most appropriate to their schedules (Lewis, 2015; Opdennamakker, 2006).
Email communication also allows the PSTs to choose to respond or not to respond and provides them liberty to express themselves more freely than in face-to-face communication (Lewis, 2015; Opdennamakker, 2006).

I asked all participants to respond to questions in connection with my research questions concerning their experiences as K-12 mathematics learners prior to entering their degree program, their perceptions regarding their ability to teach mathematics in an elementary classroom, their experiences throughout the semester enrolled in an introductory mathematics methods course, and what catalysts, related to their experiences they consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students. I encouraged the participants to discuss their personal experiences, beliefs, and perceptions, as they relate to teaching mathematics. I provided the participants with the questions in an email message and requested they respond within three days to allow time for the PSTs to comprehend the questions, recollect experiences, and provide enough detail to answer my guiding questions thoroughly. Throughout the email communication process, I asked the PSTs additional or probing questions if I needed further clarification about their responses.

**Reflective Journal**

Along with email communication between the PSTs and myself, I used a researcher’s reflective journal to “refine the researcher as a research instrument” (Seidman, 2006) by further supporting the triangulation process. Since the researcher is the primary research instrument in qualitative research (Hatch, 2002; Seidman, 2006), I used journaling as a way of including my reflexivity on the PSTs’ email communication during the data collection process. Also, I used my reflective journal as a tool to clarify my ideas and perspectives and to acknowledge ownership of my perspective and clarify how I drew conclusions (Patton, 2002). This tool can
be utilized for several reasons such as: (1) to polish the understanding of the role of the researcher in the form of reflection and writing, (2) to improve the knowledge of participant responses in the study, (3) use of a journal as an collaborative tool of communication between the participant and researcher within the study, and (4) individuals become authorities of their wondering, reflection patterns, and their own comprehension of their work as qualitative researchers (Patton, 2002; Stake, 1995). Seidman (2006) stated, the qualitative researcher is always dealing with lived experience and must be awake to that experience and for that experience. The researcher reflective journal is a strategy to further awaken myself, as the researcher, to what I have observed, though, reflected on, and questioned.

I recorded my thoughts and experiences in a reflective researcher journal and utilized a website titled Penzu™. The primary purpose of this website is for online journal writing. This website is password-protected, and I wrote my journal notes on my laptop, which is also password-protected.

**Member Checking**

I also used member checking to help edit and extend the accuracy and credibility of the qualitative findings as recommended by Cresswell and Clark (2007). I immediately sent an email with a copy of the interview transcripts attached to each participant to verify for accuracy once I received them from Landmark Associates. I intended to understand the PSTs’ general beliefs and perceptions of their mathematics experiences. Merriam (2009) references Maxwell (2005) when documenting the magnitude of “ruling out the possibility of misinterpreting the meaning of what participants say and do and the perspective of identifying your own biases and misunderstanding of what you observed” (p.217).
I found themes that emerged across the participants’ experiences and highlighted a description of their experiences by utilizing direct quotations, but only those that are meaningful and relevant, “substantively significant and providing enough detail and evidence to illuminate and make that case” (Patton, 2002, p. 503). To understand the themes I discovered, I afforded voice to my participants (Richards, 2017). For instance, I provided examples of their authentic statements. I also sent an email with a draft of my findings and interpretations of the information the participants communicated with me for their review of accuracy, and asked they contact me with any changes or comments they might have. This process also offers credibility to the research.

Qualitative research depends upon the participants’ perspectives for credibility (Lichtman, 2012; Merriam, 2015). Verisimilitude is also linked with the credibility and trustworthiness of the study. The credibility is involved in establishing that the results of the research are believable. Lincoln and Guba (1985) use these terms to replace ‘reliability’ and ‘validity,’ which are usually linked to quantitative research. Dependability is the degree to which results are consistent with data and emphasizes the critical role of the researcher to account for the ever-evolving context of the study (Lichtman, 2012; Merriam, 2015).

Data Analysis

During the semi-structured interviews and email communication process, it was critical for me, as the researcher, to learn to pay attention to detail, to see what there was to see, to hear what there was to hear, to know how to distinguish detail from inconsequential comments, to accomplish the former without being overwhelmed by the later, to use careful methods to validate and triangulate these data, and to report the depths and limitations of my own perspectives that will necessitate both self-knowledge and self-disclosure (Patton, 2002). While
reading the interview transcripts and email communication, common terms or phrases emerged or even gestures or feelings of excitement about teaching mathematics to elementary students that I placed within my field notes and reflective journal. However, to collect data from all sources and extrapolate thematic interpretations, I employ the steps of constant comparative analysis (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008)

**Constant Comparative Analysis**

For this study, I utilized constant comparative methods (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008) to analyze the data and identify overarching themes. I carefully reviewed the interview transcripts and email responses to my questions as well as any follow-up responses I received if I thought I needed to delve deeper or need a more detailed description from the PSTs using thematic analysis. I added and dated my thoughts in my reflective journal immediately after receiving and reading the email responses to my guiding questions. Next, I used constant comparative analysis, which required me to begin to look at what makes this piece of data different or like other pieces of data (Corbin & Strauss, 2007; Creswell & Clark, 2007).

I utilized Strauss and Corbin’s (2008) coding process as the method of analyzing data. Coding involves three levels of analyses: (a) open coding, (b) axial coding, and (c) selective coding, to assemble a comprehensive depiction of the information obtained during the data collection process (Merriam, 2009; Strauss & Corbin, 2008). During the first level of the coding process, I compared these data and continually asked myself questions about what I did and did not understand. The identification of different categories, properties, and dimensions within and among the data can be accomplished (Merriam, 2009; Strauss & Corbin, 2008).

My next step in the process was axial coding; where I pieced together these data in new modes after open coding and recognized connections between categories. During this phase of
coding, I wrote memos in the right margin of the interview transcripts and reformatted the transcripts to include line numbers for more efficient access to specific quotes later in the coding process. I then connected subcategories by continuing to ask questions and make comparisons to the data (Merriam, 2009; Strauss & Corbin, 2008). In the final stage of coding or selective coding, I identified and choose the core categories and systematically connected them to subcategories, to validate those similarities and relationships and then completed categories that needed further refinement and development (Merriam, 2009; Strauss & Corbin, 2008). Once all themes were established, I created tables for the themes, which emerged for each research question. In this final phase, I also color-coded similar descriptors to assist with elaborating the findings for chapter five.

**Ethical Considerations**

I, the researcher, served as the primary research instrument in qualitative methods used to design, collect, and interpret data. With that chief responsibility, I took ethical considerations seriously. Primarily, I was attentive to the participants in this study and upheld a duty to them as well. I carefully designed and implemented ethical considerations from the communication of informed consent between the participants and me, throughout the study, during the interpretation of the data, and through the reporting of the findings. It was necessary to approach every aspect of the study with honesty, integrity, and a commitment to quality. As highlighted by Merriam (2009) ethical issues that should be maintained while engaging a qualitative research are: (1) explaining purpose of the inquiry and methods to be used, (2) promises and reciprocity, (3) risk assessment, (4) confidentiality, (5) informed consent, (6) data access and ownership, (7) interviewer mental health, (8) advice [who will be your counselor on ethical matters], (9) data collection boundaries, and (10) moral versus legal conduct. Commitment to these features not
only helped to ensure ethical considerations and a level of quality throughout the research but 

enhanced trustworthiness on my part as the researcher, as well.

I explained informed consent clearly with all potential participants, and each participant 
had to sign the informed consent form before starting the data collection process, reflected on 
actual steps that were taken regarding ethical considerations, as mentioned previously. I was 
sure to outline that participation was voluntary and participants could elect to withdraw from the 
research at any time. Additionally, I used pseudonyms, rather than participants’ names, in the 
manuscripts and identifying information such as the names of schools, school districts, 
colleagues, or students were removed. I secured the names of the participants on a password-
protected computer and any additional features in accordance with IRB expectations.

Limitations of the Study

As holds true with all research, there will be limitations to the study. First, my role as the 
researcher is a limitation because I have taught this course for eight years. Therefore, I hold 
assumptions about the course and the PSTs in the course that I may not recognize. A second 
limitation focuses on hermeneutic considerations (Merriam, 2005; Patton, 2002) that posit others 
may interpret these data different than I because of differences in personal and professional 
experiences and epistemologies (Richards, 2017).

In addition, the PSTs in this study may not share all their perceptions and beliefs about 
their experiences as K-12 mathematics learners or learners in this introductory mathematics 
methods course because they may not wish to reveal all their experiences. Another consideration 
is memory distortion and lapses in memory (Haynes, 2000; Searle, 1999). Searle (1999) 
identifies the heavy reliance on memory when reconstructing information about past experiences 
and events may be subject to distortion (Haynes, 2000). For example, as the PSTs look back on
their K-12 experiences as mathematics learners probably they have forgotten some of these experiences (Ellis, 2013).

Finally, in relation to email communications, an email “may have the same verbal content as one conducted in person, but lacks inflection, body language, and many other nuances that often communicate more vividly than words” (Merriam, 2005, p. 158). Another issue pertains to the PSTs’ willingness and abilities to disclose their “truths” through email conversations (Fontana & Frey, 2000; Parris, 2008; also see Richards, 2016). A possibility also exists that the PSTs might have difficulty communicating their thoughts through email discussions because they lack written communication skills appropriate to express their experiences about their beliefs. There, they may not have fully expressed their experiences or beliefs (Parris, 2008).

Furthermore, when questioning participants about past events, the responses might capture the PSTs’ views and precede self-presentation at one point in time. Both can change. The present frames any view of the past (Holstein & Gubrium, 2003; Mead, 1932). As the present changes, so also may the participant’s view of past events and of self (Ellis, 2013; Sutton, 2015). For example, a participant might disclose that he glossed over earlier events in a preceding correspondence because he could not face the personal implication; however, by downplaying the seriousness, he might also have diminished the significance of the event. Multiple communications chart a person’s path through a process (Holstein & Gubrium, 2003). Thus, conducting multiple communications fostered trust between the participants and me. This also allowed independent checks over time. Through multiple correspondences, the participant’s story gained depth, detail, and resonance (Holstein & Gubrium, 2003). Sometimes the experiences being explored were clear in the participant’s mind, whereas on other occasions reliving past experiences were challenging (Sutton, 2015).
Summary

There was scant literature related to teaching mathematics to elementary students, a need to further clarify this concept—both theoretically and practically, and a demand to further define its meaning and clarify its purpose. Although the findings from the study cannot be generalized outside the context of the participants, the study can be used as a means of encouraging discourse on preparing PSTs who are learning to teach mathematics to elementary students and to inform the body of research and provide reflective experience for elementary mathematics educators. Even though there has been a push for teachers to utilize reform-oriented mathematics pedagogy, this new practice is very different from what most teachers experienced as mathematics learners (Adams & Krockover, 1997; Davis et al., 2006; Brown, Friedrichson, & Abell, 2013). Therefore, it is critical that discourse is encouraged to explore ways in which teachers develop knowledge during teacher preparation and identify the types of knowledge integral to effective mathematics teaching (Adams & Krockover, 1997; Davis et al., 2006; Brown, Friedrichson, & Abell, 2013).

In review, chapter four began by highlighting the theoretical perspectives of used to frame the study, along with the qualitative research design and methods of interviewing, and the researcher’s reflective journal. I also outlined the specific information related to the participant selection and recruitment process, as well as how I analyzed the data and report it in the manuscript. The chapter concluded by highlighting ethical considerations and limitations of the research.
Chapter Five: Research Findings

Introduction

My purpose in this exploratory descriptive case study was to identify any changes in three preservice teachers’ (PSTs’) perceptions about their ability to teach mathematics and discover how their experiences helped shape their beliefs and concurrent pedagogy about teaching mathematics to elementary students. I employed semi-structured interviews and asynchronous email communication to explore my purpose described above. I devised the following A Priori research questions to guide the study:

1. How do three preservice teachers describe their experiences as K-12 mathematics learners?
2. In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?
3. In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?
4. What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?

In this chapter, I present findings related to the four research questions using data from one 90-minute semi-structured interview per participant, several emails from all three participants, and notes and memos recorded in my researcher reflective journal during and after the interview sessions. I utilized Strauss and Corbin’s (2008) process for analyzing data to
prepare and analyze interview data and email responses to the guiding and follow-up questions. I analyzed data related to each of the *A priori* questions. I employed constant comparative methods of analysis (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008), I present my discoveries by themes, which emerged, and I support my findings with the voices of the participants. I used the themes to provide a lens for me to interpret the participants’ direct quotes and then summarized the themes in accordance with each research question.

**Participant Selection**

After receiving Institutional Review Board (IRB) approval, I emailed the students who expressed interest in participating in the study with a copy of the approved IRB Informed Consent Form to ascertain if they still intended on participating in the research. I asked those who were interested in participating to sign the consent form and return the form to me via email within one week. Once I received the signed consent forms, I randomly selected three participants for the study by placing the forms in a manila envelope and drawing three forms and then contacted each participant via email to notify them they were chosen and to schedule our initial interview. Selected participants had completed the Teaching Elementary (K-6) Mathematics I (MAE 4310) course in the spring of 2018. The selected participants were female, and in their early 20’s, two were Caucasian, and one was Puerto Rican.

**Research Interview Protocols**

During the 90-minute recorded semi-structured interview, I asked the three participants to respond to research questions concerning their perceptions regarding their ability to teach mathematics in an elementary classroom; their experiences as K-12 mathematics learners prior to entering their degree program. I also asked about their experiences throughout the semester enrolled in an introductory mathematics methods course, which was aimed at both new methods
of teaching mathematics and content review; and what catalysts, related to their experiences they consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students. I encouraged the participants to discuss their personal experiences, beliefs, and attitudes, as they relate to teaching mathematics. I also utilized asynchronous email correspondence to explore the participants’ responses further and to ascertain if I needed further clarification to their responses. I provided the participants with questions in an email message and asked that they respond within three days to allow time for the PSTs to comprehend the questions, recollect experiences, and provide enough detail to answer my guiding questions thoroughly. I immediately asked the participants additional or probing questions throughout the email communication process, if I needed clarification of their responses.

**Constant Comparative Analysis**

For this study, I utilized constant comparative methods (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008) to analyze the data and identify overarching themes. I carefully reviewed the interview transcripts and email responses to my questions as well as any follow-up responses I received if I thought I needed to delve deeper or need a more detailed description from the PSTs using thematic analysis. I added and dated my thoughts in my reflective journal immediately after receiving and reading the email responses to my guiding questions. Next, I used constant comparative analysis, which required me to begin to look at what makes this piece of data different or like other pieces of data (Corbin & Strauss, 2008; Creswell & Clark, 2007).

**Constant Comparative Analysis to Answer Question One**

Research question one (RQ 1): *How do three preservice teachers describe their experiences as K-12 mathematics learners?* I asked the participants questions related to their K-
12 memories as mathematics learners; the type of schools they attended, what they liked/disliked and why; specific positive or negative experiences; and recollections of a typical day in math class. I read and reviewed the data I collected from the semi-structured interviews, email messages, and my researcher reflective journal and memos. I used constant comparative analysis to group similar and different data pieces from the written responses and transcripts (Corbin & Strauss, 2008; Creswell & Clark, 2007; Miles, Huberman & Sladania, 2014). I used open coding to create 18 preliminary categories after two holistic readings of the data. I used axial coding after the third review to combine and create four themes: (1) Class design, (2) Relationships, (3) Self-concept (related to mathematics), and (4) Disconnect. See Table 2 for a description of the themes that emerged.

Table 2: Participant’s K-12 Memories Themes

<table>
<thead>
<tr>
<th>Class Design</th>
<th>Relationships</th>
<th>Self-Concept (related to mathematics)</th>
<th>Disconnect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of classroom</td>
<td>Positive/negative experiences with teachers</td>
<td>Good/bad a math</td>
<td>Conceptual vs. procedural learning</td>
</tr>
<tr>
<td>Teaching styles</td>
<td>Best/favorite teacher</td>
<td>Ease/difficulty understanding mathematics content</td>
<td>Memorization</td>
</tr>
<tr>
<td>Use of manipulatives</td>
<td>Tutoring Opportunities</td>
<td>Placement with students (high/low ability)</td>
<td>Unfamiliar with new strategies and methods of teaching mathematics</td>
</tr>
<tr>
<td>Class procedures</td>
<td>Feeling supported</td>
<td></td>
<td>Textbook/teacher centered</td>
</tr>
<tr>
<td>Classroom environment</td>
<td>Trust</td>
<td></td>
<td>Unfamiliar with manipulatives</td>
</tr>
</tbody>
</table>

I reviewed the data at least three times and used direct quotations from the participants
throughout this chapter to support the themes and answer each research question while attempting to capture the essence of the participant’s responses each below.

**Class Design.** *Class design* is the theme that emerged most often among participants concerning their K-12 memories and experiences as mathematics learners. This encompasses the type of classroom, teaching styles, use of manipulatives, class procedures, and classroom environment.

All three participants attended a public K-12 school. Amanda had a portion of her middle school online in conjunction with some teacher support and then attended virtual school through high school. Another theme all participants had in common was having few if any memories of elementary school. Becka responded, “elementary school is a blur.” Beyond elementary school, most of the memories of learning mathematics were: memorization; not “really learning” math; no strategies; doing book work, worksheets, and teacher lecture; following the “math rules” to solve problems; and having to go to the teacher’s desk for help. Each of the participants expressed a desire to have had more hands-on and interactive experiences in math class. Finally, two of the participants had a vague recollection of seeing containers of manipulatives in class or “maybe” using counters in elementary school. The only manipulative they remembered using in middle or high school was a calculator. Becka believed she might have understood the math concepts better if her teachers used manipulatives in conjunction with instruction.

**Relationships.** *Relationships* are the theme with the second highest frequency as it related to participants K-12 memories and experiences. All three participants shared recollections of, and value in positive relationships during the interviews and email communication. They imparted details to illustrate their experiences with positive relationships during the interviews, such as Amanda remembered “the best teacher,” Becka discussed “a
favorite teacher,” “tutoring opportunities after school,” “feel supported,” “helped me learn,” and Carly shared one teacher “made me feel comfortable.”

Amanda deemed her sixth-grade teacher as her favorite “because even though the class was online, the teacher was in the classroom and would take the time to check on us and help make things more interactive instead of just leaving us on the computer to just figure things out.” Becka depicted her relationship with her sixth-grade teacher as positive. Becka “remembered her a lot” “she made a point of creating a good learning environment where we felt comfortable asking questions if we needed help.” Although this is beyond K-12, Carly shared,

Tutoring with you (at USF for GKT math help) helped me enjoy math more. You took the time to explain the problems even if it took a couple of times. I felt like you really cared about what I was doing.

Carly was coming to me for tutoring to help prepare her to pass the mathematics portion of the Florida Teacher Certification Exam’s (FTCE) General Knowledge Test (GKT). I created a risk-free environment where students were able to speak freely with me – I assured them I would keep our conversations in confidence. She expressed a dislike and apprehension with mathematics, so I was sensitive in my responses and tried to make the work as enjoyable as possible. I provided practice problems for Carly to work on at home and when she came to tutoring, we explored the problems in-depth to offer support and clarification when needed until she felt she was prepared to take the test.

Several of Becka’s experiences were negative and she believed those relationships made a long-term impression. Becka revealed teachers ridiculed her in four different grade levels. She described the incidents further as, “being mocked for a response,” “for asking for help,” “not
getting support,” and “being ignored.” Becka also shared she believes so many negative experiences with teachers caused her to have a general dislike for the subject.

**Self-concept (related to mathematics).** Self-concept (related to mathematics) is the theme that also had the second highest frequency. The participants described themselves in relation to their understanding or feelings about mathematics. Amanda had a very positive self-concept. She expressed, “math is my favorite subject; it was usually very easy for me because everything made sense,” but felt frustration when “I did not understand the mathematics.” She was self-motivated to learn and interested in learning more difficult math concepts. Becka felt like she was “a good student and got good grades in math” and had reasonable confidence in her mathematics ability to teach conceptually even though she only learned through memorization.

Carly had a different self-concept - she always struggled with math. She did not like “all the rules, multi-step problems, the amount of patience solving problems requires, and the memorization.” Carly disclosed she was always an average, below-average math student and remembered math always being hard to understand. She explained, “When they paired us with another student in math class, I knew they paired us with one high ability student with one low ability student – and I was the low student.” Carly also described a middle school experience where she was placed in an advanced math class. She thought it was because her mom worked at the school. She felt good about the placement but admitted she really struggled and later moved to a lower level class. Although this was discouraging, she said she felt better because she could understand the math better. After that experience, Carly began to like some parts of math class; when she persevered through a problem and finally got an answer, she felt satisfaction.
**Disconnect.** A *disconnect* refers to a misalignment in the way in which PSTs learned mathematics and how they are expected to teach is the last theme. Both Becka and Carly indicated a disconnect in their mathematics experiences through their interview responses. They both identified a misalignment in the way they learned mathematics (procedurally and through memorization) and the current teaching methods (more conceptually). Amanda identified her encounters learning mathematics as “unique” based on the number of schools she attended, varying states of attendance, and numerous online curricular initiatives. She believed that because “mathematics came very easy” to her and “because I spent so much time learning math myself online” that she didn’t feel “as prepared to teach math more conceptually.”

None of the participants remembered learning a variety of strategies or methods when they were in school; they remembered “teacher lectures,” “worksheets,” and “some partner work.” Becka did express some resistance to current teaching methods when she stated she did not agree with having to teach conceptually, she “valued memorizing how to solve math problems.”

Becka revealed one final point of interest during her interview the others failed to address, which is the impact high-stakes testing had in the classroom. She was concerned with and disagreed “with the amount of testing the students had to endure.” “They had a whole process for testing” and “it seemed like that was all they were talking about.” Becka communicated the “amount of testing really influenced my decision in the grade level I want to teach because I want to be able to *teach*, not teach a test.”

**Conclusions from RQ1**

As I reflected on the themes I have identified, participants’ direct quotes, and my notes and memos from my data analysis I included my understandings to answer the first research
question further. When I asked the participants how they would describe their experiences as K-12 mathematics learners all three participants initially had difficulty remembering specific experiences. They had vague if any memories of mathematics learning in the classroom. Some of their recollections included teacher lecture, completing problems from their textbook, and pulling out workbook pages for homework. They did not remember any form of social interaction. Their memories stemmed primarily from the relationships they formed with former mathematics teachers, both positive and negative. I found interesting all participants equated their self-concept in relation to how they felt about mathematics in connection with those teacher relationships. Finally, all participants were able to recognize a difference in the way they did learn mathematics in comparison to the methods in which they are expected to teach. See Table 3 below for a comprehensive table with each participants’ direct quotes related to each theme.

Table 3. RQ 1: Themes and Descriptors Derived from Data Analysis

<table>
<thead>
<tr>
<th>Class Design</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“no memories using manipulatives”</td>
<td>“testing huge in 3rd grade”</td>
<td>“Kinda remember plastic containers with manipulatives”</td>
</tr>
<tr>
<td></td>
<td>“middle school online”</td>
<td>“focus was memorization”</td>
<td>“Never used manipulatives in middle or high school”</td>
</tr>
<tr>
<td></td>
<td>“small class size 3rd/4th grade”</td>
<td>“memorization is not teaching”</td>
<td>“all I can remember are worksheets, bookwork, and lectures”</td>
</tr>
<tr>
<td></td>
<td>“virtual school 10th-12th grade”</td>
<td>“don’t agree with so much testing”</td>
<td>“I needed more hands-on activities in math”</td>
</tr>
<tr>
<td></td>
<td>“only remember workbook pages”</td>
<td>“didn’t learn strategies”</td>
<td>“individual work in middle school”</td>
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<tr>
<td></td>
<td></td>
<td>“only remember facts and steps”</td>
<td>“it was so awkward to go to the teacher’s desk for help”</td>
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<tr>
<td></td>
<td></td>
<td>“used worksheets and maybe some plastic counters”</td>
<td></td>
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<tr>
<td></td>
<td>Amanda</td>
<td>Becka</td>
<td>Carly</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Relationships</strong></td>
<td>“best math teacher”</td>
<td>“fifth-grade teacher made fun of me”</td>
<td>“I know my teachers influenced my feelings about math”</td>
</tr>
<tr>
<td></td>
<td>“personal relationships are key”</td>
<td>“really liked my 6th grade teacher”</td>
<td></td>
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<td></td>
<td>“need interaction”</td>
<td>“bad experience with my 7th-grade teacher”</td>
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<td></td>
<td></td>
<td>“don’t remember learning math, but I do remember people”</td>
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<td></td>
<td></td>
<td>“didn’t get teacher support in 9th-grade”</td>
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<td></td>
<td></td>
<td>“my 10th-grade teacher was funny and engaged the class”</td>
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<tr>
<td></td>
<td></td>
<td>“my 12th-grade teacher had tutoring after class, that helped me a lot”</td>
<td></td>
</tr>
<tr>
<td><strong>Self-concept</strong></td>
<td>“favorite subject, easy for me”</td>
<td>“pretty confident I can teach math conceptually”</td>
<td></td>
</tr>
<tr>
<td>(related to</td>
<td>“get frustrated when I don’t understand”</td>
<td>“I was a good math student, and I got good grades”</td>
<td></td>
</tr>
<tr>
<td>mathematics)</td>
<td>“interested in learning more kinds of math”</td>
<td>“Algebra was my favorite because it made sense to me”</td>
<td></td>
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<tr>
<td></td>
<td>“had to be self-motivated”</td>
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<td></td>
<td></td>
<td>“I know I’m just average”</td>
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<td></td>
<td></td>
<td>“math was always hard to understand”</td>
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<td></td>
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<td>“when we were paired up, I knew I was the low student”</td>
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<td></td>
<td></td>
<td>“I don’t like being put on the spot”</td>
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<tr>
<td></td>
<td></td>
<td>“I like when I work through a problem and finally get the answer”</td>
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</tbody>
</table>
Constant Comparative Analysis to Answer Question Two

Research question two (RQ 2): *In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?* I asked the participants questions about how they perceived their ability to teach mathematics before they entered the MAE 4310: Teaching Elementary (K-6) Mathematics I course during the interviews and email communication. I requested the participants consider their expectations from the course, what they were excited and afraid of, experience they had working with students, and if they thought their experiences influenced their responses. I used open coding to create sixteen preliminary categories and axial coding after the third review to combine and create four themes: (1) Concern with teaching mathematics, (2) Interests, (3) Confidence, and (4) Misconceptions. See Table 4 for a description of the themes.

Table 4: PST’s Perceptions about Ability to Teach Mathematics Prior to Methods Course Themes
**Concern with teaching mathematics.** *Concern with teaching mathematics* is the theme that emerged most often among participants related to their perception about their ability to teach mathematics. This theme was identified at least two to three times more than the other three. All three of the participants expressed hesitation and some concern with being able to teach math to students when they first entered the mathematics methods course, and each with unique reasons. Amanda was concerned “because math always came very easy to do, it just clicked and that was not going to be the case for most students.” Becka was “afraid of doing something wrong, messing up the lesson, and screwing kids up for life.” Carly had some experience helping students with their homework, but “didn’t know what they were doing a lot of the time and didn’t know the methods they were learning.”

Amanda was also concerned with her ability to explain the new methods of “doing math” because they were unfamiliar. She was also concerned because she had some experience working with kids, it was not in an academic mode and she was afraid she “would not be able to communicate well enough or explain how to solve math problems because it came so easy” to her. Amanda also admitted she “had limited knowledge and exposure to current teaching
methods.” She was also worried about “working with students with disabilities or second language learners” because she “was never around ESE or ELL students growing up.”

Becka expressed apprehension about “teaching number sense concepts” because she “had no recollection of learning early math concepts.” She was also “not comfortable teaching math using manipulatives” because she “didn’t have any experience.” Another area of worry for Becka was “it is very different when you’re the student and have to transition yourself into the teacher; it is a different role – teaching someone how to learn.” She also mentioned,

If I’m thrown into kindergarten, I will struggle because I’m unfamiliar with that grade level environment. I personally struggle with the basic-basic because math comes so naturally to me.

Becka was in a fifth-grade classroom for her internship and really enjoyed working with the older students. She felt comfortable helping students learn math concepts she had experience teaching, such as fractions. She shared she “had no idea how to introduce numbers and basic math concepts” and she “wouldn’t even know what to do if they didn’t get” what she was trying to teach them.

Carly voiced trepidation in her ability to teach math because there “is such a great misalignment from how I learned math and how I have to teach” and “thinking of myself as a teacher, I’m not good at math.” She also disclosed, “I’m nervous to present in front of a whole class, I’m a little worried about how to answer kids’ questions.”

**Interest.** *Interest* is the theme with the second highest frequency as it related to participants’ perceptions about their ability to teach mathematics. All three participants expressed the greatest interest or desire was to learn more about “working with manipulatives, incorporating manipulatives in lessons, and how using manipulatives support math concepts.”
Each of the participants also expressed an interest in learning more about a specific grade level and “what I need to know before I have to teach math in my next internship.” Amanda and Becka both had a craving to “feel more comfortable in the teacher role” and “have good classroom management.” Becka conveyed “the priority has to be on classroom management and behavior first before I can even think about teaching content.”

**Confidence.** *Confidence* is the theme with the third highest frequency. Both Amanda and Becka articulated confidence in their math skills and feeling about teaching. Amanda stated, “I really enjoy math,” and “feel pretty decent teaching it.” Becka’s “general feeling about teaching math is a 3.75 out of 4” because “I understood most of the math.” Becka and Carly both expressed confidence in teaching Algebra because “of the step-by-step process.” The other areas of confidence were “showing and helping others,” and “feeling like I can do this. I know how to write a lesson.”

**Misconceptions.** *Misconceptions* are the last theme that emerged. The participants shared several misconceptions during the interviews that specifically related to misunderstandings of grade level knowledge and mathematics content. All three participants believed algebra is not visible in all grade levels. Becka felt “best about teaching 3rd or 4th grade because they barely touch on algebra.” She also assumed “4th and 5th graders would know number sense and stuff like that by the time they are in that grade.” The remainder of the misconceptions were associated with determining if one grade level is more difficult to teach than another grade level, based on the “importance” of the grade level. Becka believed “primary grade teaching is harder because you have to teach all of the foundation stuff.” I was uncertain whether this statement was a misconception related to knowledge of the grade level or mathematics content, so I had to ask Becka what she meant by “all of the foundation stuff.”
Becka’s memory of learning mathematics in elementary school “was a blur.” She admitted, “I did not even think about the fact that I would have to be teaching the foundations of all new math topics and teaching the stuff the kids didn’t learn already.” “I was thinking about how to get kids to understand why $1 + 1 = 2$…I just know it, and I wouldn’t even know where to start if they didn’t get it.” Carly, on the other hand, thought intermediate grades are harder to teach, “Because I don’t really know all that math.” Becka ultimately had a misconception about having to provide the groundwork for mathematics at all grade levels, where Carly determined the difficulty of teaching based on her knowledge of mathematics content.

**Conclusions from RQ2**

As I reflected on the themes, participants’ quotes, and my notes and memos, I included my understandings to answer the second research question further. When I asked the participants in what ways they perceived their abilities to teach mathematics prior to entering the introductory mathematics methods course, I had to word my questions vigilantly to obtain authentic responses. At the time of the interviews, the course was ending so the participants had to separate their views from the beginning of the semester from their holistic perceptions. All three participants focus on the question was based on concern. They recognized their lack of knowledge related to teaching strategies and methods, inexperience with using manipulatives and working with students in a classroom setting. The participants began the semester with average teaching confidence based on their prior encounters. They all also indicated initial interests in expanding their knowledge of teaching mathematics and ways in which they could improve. See Table 4 below for a comprehensive table with each participants’ direct quotes related to each theme.
Table 5. RQ 2: Themes and Descriptors Derived from Data Analysis

<table>
<thead>
<tr>
<th>Concern with teaching mathematics</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I’m hesitant to teach cause math just clicked with me”</td>
<td>“I’m afraid of doing something wrong, messing up the lesson, or screwing kids up for life”</td>
<td>“I helped kids with their homework, but I didn’t know what they were doing a lot of the time”</td>
<td>“I helped kids with their homework, but I didn’t know what they were doing a lot of the time”</td>
</tr>
<tr>
<td>“a little concerned with explaining new methods of doing math”</td>
<td>“I struggled with math myself when I was in school”</td>
<td>“for the kids, the new math methods and strategies are easier than they are for me”</td>
<td>“for the kids, the new math methods and strategies are easier than they are for me”</td>
</tr>
<tr>
<td>“what if I’m not able to communicate so the students understand?”</td>
<td>“don’t remember learning anything about early number concepts in school”</td>
<td>“There is a great misalignment in the way I learned math and how I have to teach”</td>
<td>“There is a great misalignment in the way I learned math and how I have to teach”</td>
</tr>
<tr>
<td>“I only have a little knowledge of current teaching methods”</td>
<td>“don’t feel comfortable using manipulatives because I have no experience using them.”</td>
<td>“when thinking about myself as the teacher, I’m not good at math”</td>
<td>“when thinking about myself as the teacher, I’m not good at math”</td>
</tr>
<tr>
<td>“I need more than just simple math for stimulation”</td>
<td>“it’s really difficult to transition yourself into the teacher, it is a different role, teaching someone how to learn”</td>
<td>“I’m a little worried because I never knew you had to scaffold lessons”</td>
<td>“I’m a little worried because I never knew you had to scaffold lessons”</td>
</tr>
<tr>
<td>“not familiar with ESE/ELL students”</td>
<td>“I’ll have trouble with basic-basic math because math comes so naturally to me”</td>
<td>“I don’t personally feel smart in math”</td>
<td>“I don’t personally feel smart in math”</td>
</tr>
<tr>
<td>“this is all very overwhelming”</td>
<td>“If I’m thrown in kindergarten, I’ll struggle because I’m unfamiliar with that level”</td>
<td>“I’m really nervous about presenting in the classroom”</td>
<td>“I’m really nervous about presenting in the classroom”</td>
</tr>
<tr>
<td>“never worked with kids in an academic way”</td>
<td>“I had struggles in reading that might affect my teaching”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>Amanda</td>
<td>Becka</td>
<td>Carly</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
</tr>
</tbody>
</table>
|          | “I want to learn more about new methods of teaching math”  
            “I think it will be good to learn more about teaching kids’ math” | “I need to learn more about the teacher role before I could even think about teaching”  
            “I want to learn more about good classroom management”  
            “I’m interested in learning more about my students, I’m a people person”  
            “would need help incorporating manipulatives in math lessons” | “My main goal from the course was to learn more than I knew before”  
            “I want to learn how to use manipulatives and the way math is expected to be taught”  
            “I’m interested in teaching 2nd grade, it’s not baby stuff, and it is before the major testing” |

<table>
<thead>
<tr>
<th>Confidence</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
</table>
|           | “I enjoy math and feel decent teaching it” | “I understood most math; I’d say I’m a 3.75 or 4 out of 5”  
            “I feel confident teaching algebra”  
            “I’m pretty confident in my teaching ability” | “I have some experience working with kids from my tutoring job”  
            “I may not be that good at math, but I am good at showing and helping others”  
            “I felt like ’I can do it’ at the beginning of the course before I knew I needed to know how to scaffold lessons” |

<table>
<thead>
<tr>
<th>Misconceptions</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
</table>
|                | “I need more than basic math, like when they start learning algebra” | “I feel best about teaching 3rd or 4th grade because they don’t learn algebra”  
            “primary grades are the hardest grades because you have to teach all that foundation stuff”  
            “I didn’t know I’d have to teach foundation stuff at all levels”  
            “you have to be patient with the little ones if they don’t get it right away” | “algebra isn’t taught in the early grades” |
Constant Comparative Analysis to Answer Question Three

Research question three (RQ 3): *In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?* I asked the participants questions about how they perceived their ability to teach mathematics after they completed the MAE 4310: Teaching Elementary (K-6) Mathematics I course, their Level II internship, and internship seminar throughout the interviews and email communication. I requested the participants consider their experiences from the course, how they felt participating in course activities, their experience utilizing course content in their internship, and their comfort level teaching during their internship. I provided the participant with a copy of their course syllabus from MAE 4310 and their seminar, through the interview process, as well as a copy of their textbook as a reference since the questions covered such vast information. I used open coding to create 30 preliminary categories and axial coding after the third review to combine and create five themes: (1) Comfort level teaching mathematics, (2) Role of the teacher, (3) Values, (4) Concerns, and (5) Theory to practice. See Table 6 for a description of the themes that emerged.

Table 6: PST’s Perceptions about Ability to Teach Mathematics After Methods Course Themes

<table>
<thead>
<tr>
<th>Comfort level teaching mathematics</th>
<th>Role of the teacher</th>
<th>Values</th>
<th>Concerns</th>
<th>Theory to practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased comfort level after experiences</td>
<td>Identifying learning styles</td>
<td>Instructor’s organization, preparation, and high expectations</td>
<td>More time in internship</td>
<td>Misalignment in course content and internship</td>
</tr>
<tr>
<td>Class discussions helped</td>
<td>Positive outlook</td>
<td>Variety of scenarios and activities</td>
<td>Unfamiliar with math content</td>
<td>Internship content more difficult</td>
</tr>
<tr>
<td>Comfort level teaching mathematics</td>
<td>Role of the teacher</td>
<td>Values</td>
<td>Concerns</td>
<td>Theory to practice</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------</td>
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<td>----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Using manipulatives in class was helpful</td>
<td>Decision making</td>
<td>Resources</td>
<td>Failing students</td>
<td>Not seeing what was taught in the course</td>
</tr>
<tr>
<td>Learning new strategies provided confidence</td>
<td>Best practices</td>
<td>Real world connections</td>
<td>Conflicting teaching methods</td>
<td>Course content and district content not aligned</td>
</tr>
<tr>
<td>Learned how to interact with students</td>
<td>Differentiating Instruction</td>
<td>Social interaction</td>
<td>Grade level knowledge</td>
<td></td>
</tr>
<tr>
<td>New methods and strategies provided strength</td>
<td>Organization, preparation</td>
<td>Group assignments</td>
<td>Lack of teaching opportunities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interaction with students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationships with students</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Comfort level teaching mathematics.** *Comfort level teaching mathematics* is the theme that emerged most often related to the participants’ perception about their ability to teach mathematics after completing the course and Level II internship. Each of the participants expressed an increased comfort level in their ability to teach mathematics at the end of the semester. The three participants discussed several descriptors to explain what they believed led to their new confidence in their ability to teach mathematics.

All participants consistently believed the social and interactive aspect of the course was an influencing factor in the mathematics methods course. Some of the responses included, “the class discussions helped me feel more comfortable,” “we were given a lot of different types of
scenarios to discuss with our groups,” “talking to my group for partner work really helped me,” “you learn things from talking and sharing experiences with people, things that you just can’t read about in a book to learn and understand,” “the people interaction made more sense, seeing the chapter come to life,” and “the group talk was beneficial, the social learning, I learn better from talking to people and doing.” The participants valued the level and variety of classroom discourse throughout the semester. The social and interactive aspect of the course provided them with knowledge unique to each participant.

**Course Assignments.** Another aspect all three of the participants steadily spoke to that they all believed promoted their comfort level were the hands-on activities and assignments they had to complete in the course. Through the semester, all students had to present two different lessons to their peers in partnerships. The first was a technology assignment:

**Technology Presentation**

You will work in a small group to present a technology tool for a specific grade level (K-6) and topic covered within this course. Your small group will present (10-15 minutes) your technology tool to the entire class. Your presentation should include the following components:

1) Topic, grade level, objective and standards
2) Brief description of technology tool
3) Provide written directions for accessing and using technology tool
4) Demonstration of technology tool
5) Provide opportunity to explore technology tool
6) Benefits and drawbacks of technology tool

There will be a section on Canvas for someone in your group to upload the
supplemental materials that your group used (more details will be provided in-class).

All the participants had positive experiences with their technology presentations and attributed those experiences to an increased comfort level in teaching. Their responses included, “being able to pick my partner for the activity really helped,” “I thought the collaboration with my friends helped me feel more comfortable,” “the technology assignment helped me learn new software and new ideas during the group presentation,” “this helped me to see a bunch of different types of software that I didn’t even know existed and don’t think I’d have time to find on my own,” and “I really thought the technology assignment was great because I got to see so many different technologies and how they could be implemented in the class, even if some of them are expensive.” The participants appreciated and found worth in the extensive technological innovations uncovered with this assignment. The variety of topics provided them with a foundation they may further explore in their own classrooms.

The second presentation the participants had to complete was a Micro-Teaching Lesson:

**Micro-Teaching Lesson**

You will work in a small group to plan and present a portion of a hands-on (with manipulatives) lesson for a specific grade level (K-6) and topic covered within this course. Your small group will present a 15-20-minute portion of your lesson to the entire class. Your presentation should include the following components:

1) Topic, grade level, objective and standards

2) Do Now or Warm-up activity

3) Demonstrate mini-lesson

4) Introduce group activity & provide written directions
5) Conduct group activity

6) Provide Accommodations (e.g., ELL or ESE student)

There will be a section on Canvas for someone in your group to upload the supplemental materials that your group used (more details will be provided in-class).

All participants admitted, being able to select their partners was “definitely a bonus” and “helped me feel more comfortable since I am a little afraid to present to a whole class.” They also all agreed, “being able to pick who you are going to work with isn’t really realistic” and “if we were just given someone to work with this would have changed the experience.”

There were varied responses when I asked why they supposed this assignment helped them gain confidence and improve their comfort level in teaching. Collectively, the participants claimed, “getting to see a lot of different strategies in different grade levels was eye-opening,” “each group did something a little different,” “seeing the primary lessons were helpful because I am very unfamiliar what kids at that grade level,” “I felt really comfortable with this lesson and even tried it out in my internship,” “I liked teaching a primary lesson, even though I didn’t pick it. It was helpful because I am not familiar at all with how little kids learn.” “I thought the chance to see how others would present problems was really helpful,” and “I liked seeing examples of lessons taught in the varying grade levels because you never know what grade you are going to have to teach.”

At this point in their program, the participants had only partaken in two internship experiences, which were both only one day a week in the same school environment. The participants found the micro-teaching assignment to be an opportunity to gain exposure to a variety of teaching styles and mathematics content with which they were unaccustomed.
Overall, the participants shared other aspects of the course, in general, to they felt promoted their increased ability to teach. Some of these were, “I feel more prepared to teach, this was the first class that actually taught us how to teach,” “I learned a lot of new methods where math problems were broken down for us, I had never seen that before,” “I really liked learning about manipulative because I didn’t have those experiences before,” “I felt more aware of questions I had,” “learning the different strategies helped me gain confidence,” “I saw new methods of doing problems that I never saw growing up,” “I felt very comfortable in the course activities,” “I felt like I was doing good teaching,” “I liked learning using real-world experiences,” and “I feel like I have a much stronger ability to teach now.”

**Role of the teacher.** The role of the teacher is the theme with the second highest frequency related to the participants’ perception about their ability to teach mathematics after completing the course and Level II internship. I derived this theme based on the participants’ responses aligned with making teacher decisions, noticing best practices, and comments related to critical reflection. When I asked about having to teach something they were unfamiliar with, Amanda shared, “I just have to figure it out,” “everyone learns different and I have to find ways to help my students.” She also stated, “At the end of the course I felt positive because I am more aware now of questions I will have as a teacher.” Amanda also expressed,

I had suggestions for improvement in my internship class, but I didn’t think it was my place to tell my collaborating teacher. I think she could have used more formative assessments and differentiated instruction a little more.

Amanda made known her collaborating teacher appeared to have a stronger connection with the higher-level students in the internship class. She recognized the importance of having a relationship with students and considered the lower-level students might perform better with
instruction, which targeted their individual needs. Amanda did acknowledge the pressure of time in the classroom and elected to retain her informed suggestions.

A few other examples of Amanda in the role of the teacher were being self-driven and “recognizing the roles and responsibilities of teaching as a profession, even though all of my classmates didn’t do the same.” Amanda also expressed the guiding questions they discussed in their seminar “brought out personal awareness and forced me to critically reflect on what I was doing and seeing every day.”

The focus of Becka’s responses related to the role of the teacher stemmed from her internship experience. She was able to recognize, “classroom management is definitely a learning process for me,” “I noticed student engagement when the teaching was relating the math to real-life,” “I thought the teacher needed more small groups and one-on-one support,” “I was doing what I had to, it was part of the job expectation and of the internship expectation. A lot of the other interns didn’t do their part,” “I don’t think the kids should have been put on the computers for so long, they already do that at home.” Becka was cognizant of what she considered areas of weakness and sought opportunities to further her teaching repertoire.

During her experience, Becka also developed an “area of personal growth. I have to not get frustrated when something doesn’t work right, a lesson or the technology, I have to roll with the punches and keep moving forward.” This notion is described below.

I have a new appreciation for lesson planning and goals and objectives. I must have an end goal in mind, you can’t just teach to teach. You have to focus on the outcome and learning goals.

Finally, even though Becka did not have many opportunities to teach in her internship, she was still positive and “was happy that I still got experience.”
Carly let me know she did not have any opportunities to teach during her internship, she walked around helping students and graded their homework using the teacher’s guide. What she did gain from her collaborating teacher was support in lesson planning. She expressed, “I learned a lot about the components of writing a math lesson. I never realized how important the flow of a lesson was.” She admitted she was very “shy and awkward at first” during her internship, “but getting to know my CT better really helped me feel comfortable in asking her questions.” Carly also had a couple self-discoveries in the role of a teacher. She “made connections between teaching beliefs and self-reflection,” “know that trust and building relationships with students is so important,” and “learning math and teaching math is very different.” Even without independent teaching experiences, Carly maintained she learned indispensable lessons.

**Value from the course/internship.** *Value from the course/internship* is the theme with the third highest frequency. One area all the participants emphasized was the value they placed on the course instructor’s preparation, organization and expectations. This provided them consistency during the semester and “even though we were guinea pigs sometimes, I always felt like I learned something.” All participants agreed they did not find value in the textbook assigned for the course. They all admitted they “quit doing the readings” and “didn’t feel like the text was helpful at all” to use as a reference in their internship classes. I did explain to the participants that it was not unusual that they might not have been able to apply the course content to what they were observing in their internship classes. This is because this was the first of two methods courses required for their degree program, and the course outline was not aligned with the districts public school scope and sequence. I also let them know they were likely to observe
more of the content from the text in their next internship since they will examine the remaining mathematics topics in their second methods course.

I included examples the participants shared during their internship in this section. Each of the participants had a unique internship classroom, which provided them with unique experiences. Amanda found value in the resources her collaborating teacher (CT) shared with her during the internship. She also valued the humor her CT displayed and the relationships she had with her students, as well as the care her CT exhibited to the students. In turn, Amanda “truly valued the relationships I had with the students and getting to know them made me feel like a teacher.”

Becka’s comments mirrored some of Amanda’s in relation to valuing the formed relationships. Her experiences included valuing the “real-world scenarios my CT used” and “the student engagement when the teacher used examples the kids could relate to.” She also valued “teacher interaction with the students” and had a “personal commitment to the internship” even though this was “very different from a lot of the other interns, they just complained,” “the care for student outcomes really became internalized, even though I was only with them one day a week, I wanted them to pass.” Becka acknowledged her attentiveness to relationships throughout the interview.

Concern. Concern is the next theme that emerged related the participants’ perception about their ability to teach mathematics after completing the course and Level II internship. One of the concerns consistent among the three participants related to the time in their internship. Some of the parallel responses were, “not having enough teaching time,” “my CT had a lot of personal things going on and I feel like that took away from my internship experience,” “we didn’t have much if any time to debrief the lesson or how the day went because we were running
around trying to get things done—teacher life,” “I have to learn classroom management first before I can even think about teaching anything,” “I tried to teach lessons, but there wasn’t time,” “I felt rushed and didn’t have enough time with my CT,” and “I wish we were in the classroom more so I could see more math being taught.” All three participants declared their desire to have more time in their internship classrooms and deemed time to debrief with their collaborating teacher is critical.

The participants had additional concerns, which were unique to their experiences. Some of Amanda’s additional apprehensions were, “if I’m not able to figure out a problem, how will a 2nd grader be able to,” “I feel a little nervous about remembering all that we did and learned in class—so many new strategies and new methods,” and “I would definitely need more resources if I had to teach harder concepts.”

Becka still had a lingering fear of “messing kids up” and “what if I’m placed in kindergarten next semester, it is going to be a problem; I just don’t want to fail my students.” In addition, “if students don’t get number sense, it can throw everything off— that’s a lot of pressure.” Aside from additional anxieties with “incorporating manipulatives into math lessons,” Becka was considerably concerned with “needing more understanding and exposure to working with ESE/ELL students. This is a new concept from where I’m from and I want to be able to meet the needs of my students.”

Carly’s worries resonated with her self-perception. She “has a fear of competition and being put on the spot,” and “felt like I was learning with my students because the math was so different from the way I learned—I’m used to relying on a calculator.” Carly did believe many of her concerns would subside after the second math methods course.
**Theory to practice.** The implementation of *theory to practice* is the last theme that emerged. All participants expressed a greater difficulty with the mathematics content in their internship compared to their methods course. Amanda “feel like there was a misalignment with what I observed in internship and what we learned in class.” She was in a fifth-grade class for her internship and they were working on fractions and ratios while they were learning about number sense, meaning of operations, and place value in their methods course. Carly “didn’t see anything we learned in our class in my internship.” She was also in a fifth-grade class for her internship. Becka was the only one who was able to bridge the connection from theory into practice when she was “very excited to use what I learned in the course about fraction in my internship, the students were really able to see what was happening.” All participants discussed a hope that they were able to apply more from the course in their internship. Amanda thought “most of what we did in class seemed like common sense” but in my internship “the math seemed much harder” “I think I just got stuck in the wrong class at the wrong time.” Becka “wish I could have used more in my internship besides just a little of the fraction stuff.” Carly thought “not much aligned or connected with the theories and strategies we learned from the course to my internship.” I reminded the participants that they were likely to observe more of the content from the text and hopefully will be able to apply more of the theory they learned in their course during their next internship.

**Conclusions from RQ3**

As I reflected on the themes, participants’ quotes, and my notes and memos, I included my understandings to answer the third research question further. When I asked the participants in what ways they perceived their abilities to teach mathematics after completing the introductory mathematics methods course, I noticed a shift in their conviction. Their initial
concerns had transformed from a lack of knowledge and experience to formulate thoughts with the role of the teacher in mind. They were able to recognize best practices, areas of improvement within the classroom, and what they valued from the methods course and their internship. One last area all participants noticed was a pronounced misalignment in the mathematical theories and content they learned in the course and what they observed during their internships. See Table 7 below for a comprehensive table with each participants’ direct quotes related to each theme.

Table 7. RQ 3: Themes and Descriptors Derived from Data Analysis

<table>
<thead>
<tr>
<th>Comfort Level</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
<tbody>
<tr>
<td>“feel better about teaching math after working with more students”</td>
<td>“I was excited to learn content in the course and see it in practice in my internship”</td>
<td>“I know more, but I’m still not 100%”</td>
<td>“I learned many strategies and methods”</td>
</tr>
<tr>
<td>“I’m open to new ideas”</td>
<td>“I liked the people interaction, it made more sense, seeing the chapter come to life”</td>
<td>“feel better about teaching math”</td>
<td>“I’m used to relying on a calculator, and I felt like I was learning the content with the students”</td>
</tr>
<tr>
<td>“I feel more prepared to teach, the course taught us how to teach”</td>
<td>“using manipulatives in class helped me understand how to teach math concept in new ways”</td>
<td>“real-world experience helped a lot”</td>
<td>“the group talk was beneficial, the social learning, I learn better from talking to people and doing”</td>
</tr>
<tr>
<td>“class discussions helped me feel more comfortable”</td>
<td>“felt like I was doing good teaching”</td>
<td>“the process of going through lessons taught me the order of the lesson is critical”</td>
<td>“knowing my CT and building a relationship with her increased my comfort level and confidence”</td>
</tr>
<tr>
<td>“learned many methods where math problems were broken down”</td>
<td>“I learned how to interact with students better from my CT”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“not as concerned with teaching the new strategies”</td>
<td>“learned I have to roll with the punches and move forward”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“feel better learning how to use some manipulatives now”</td>
<td>“feel I have a much stronger ability to teach math now”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“learning new strategies helped me gain confidence”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role of Teacher</td>
<td>Amanda</td>
<td>Becka</td>
<td>Carly</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| “I just have to figure it out and have a positive attitude”  
“everyone learns different”  
“I became more aware of questions I have as a teacher”  
“I know how to make suggestions for improvement based on best practices, like using formative assessments”  
“differentiating instruction is so important”  
“I understand the responsibilities of teaching even if some of my classmates didn’t” | “appreciated course instructor’s organization and preparedness”  
“classroom management has been a learning process for me”  
“noticed students were more engaged when connected to real-life”  
“can see correlation to my own teaching beliefs”  
“I think my CT should have used more small groups and one-on-one support”  
“don’t think kids should be on computers for that long”  
“I was happy that I still got the experience” | “I learned a lot about the components of writing a math lesson”  
“I never realized how important the flow of a lesson was”  
“I was very shy and awkward at first, but getting to know my CT better really helped me feel comfortable in asking questions”  
“I know that trust and building relationships with students is so important”  
“learning math and teaching math is very different” |                                                                                                                                                                                                                                                                  |
| Value from the course/internship | “having a lot of scenarios helped”  
“our teacher’s preparation, organization, and high expectations helped me”  
“learning primary content helped because I was really unfamiliar”  
“I personally don’t think the text helped me to be prepared”  
“the resources my CT shared with me helped a lot” | “the real-world scenarios my CT used were so important”  
“The students were very engaged when my CT used examples the kids could related to”  
“my CT had such a good relationship with the students”  
“I made a personal commitment to the internship even though a lot of my peers just complained”  
“even though I was there only one day a week, I really wanted the kids to pass” | “the activities we did in the course helped me, I’m a visual and hands-on learner”  
“I formed some good relationships with my kids in internship, they really responded to me”  
“I learn better from talking to people”  
“The chance to see how others solved the problems in class helped me learn from them”  
“The technology assignment was really good, there are so many things we don’t have time to try ourselves” |
<table>
<thead>
<tr>
<th>Concern</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I still think I need to teach intermediate kids for the stimulation”</td>
<td>“I still have some fear of messing kids up if I teach something wrong”</td>
<td>“I have a fear of competition, so I don’t like math games and being put on the spot”</td>
<td>“I didn’t get to teach any math lessons during internship, I felt more like a teacher assistant than an intern”</td>
</tr>
<tr>
<td>“If I’m not able to figure out a problem, how will 2nd graders be able to?”</td>
<td>“if I’m placed in kindergarten, it is going to be a problem, I don’t want to fail my students”</td>
<td>“I don’t understand why we have to teach so many different strategies when they get tested on doing things one way”</td>
<td>“the internship felt rushed, I really wish we would have had more time”</td>
</tr>
<tr>
<td>“I’m a little nervous about remembering all of the strategies we learned in class”</td>
<td>“number sense is the hardest because everything builds on that”</td>
<td>“I don’t understand why we have to teach so many different strategies when they get tested on doing things one way”</td>
<td>“the internship felt rushed, I really wish we would have had more time”</td>
</tr>
<tr>
<td>“I could probably teach harder concepts, but I will need a lot of resources”</td>
<td>“if students don’t get number sense, it can throw everything off and that’s a lot of pressure”</td>
<td>“I didn’t see anything we learned in our class in our internship”</td>
<td>“I didn’t see anything we learned in our class in our internship”</td>
</tr>
<tr>
<td>Theory to Practice</td>
<td>“content in the internship was a lot harder than our coursework”</td>
<td>“I was very excited to use what I learned in the course about fractions in my internship, the students were really able to see what was happening”</td>
<td>“not much aligned or connected with the theories and strategies we learned from the course to my internship”</td>
</tr>
<tr>
<td>“I feel like there was a misalignment with what I observed in internship and what we learned in class”</td>
<td>“I wish I could have used more in my internship besides just a little of the fraction stuff”</td>
<td>“most of what we did in class seemed like common sense but in my internship the math seemed much harder”</td>
<td>“most of what we did in class seemed like common sense but in my internship the math seemed much harder”</td>
</tr>
<tr>
<td>“most of what we did in class seemed like common sense but in my internship the math seemed much harder”</td>
<td>“I think I just got stuck in the wrong class at the wrong time”</td>
<td>“I think I just got stuck in the wrong class at the wrong time”</td>
<td>“I think I just got stuck in the wrong class at the wrong time”</td>
</tr>
</tbody>
</table>

Constant Comparative Analysis to Answer Question Four

Research Question four (RQ4): What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent
I asked the participants questions about their overall experience during the semester, and what they believed assisted them in developing their beliefs as a teacher and their pedagogy, during both the interviews and follow-up email communication. I requested the participants consider their K-12 experiences, the completion of the first math methods course, their internship and seminar concurrently before they responded. I used open coding to create 30 preliminary categories and axial coding after the third review to combine and create five themes: (1) Exposure, (2) Aspirations, (3) Critical reflection, (4) Relationships, and (5) Needs. See Table 8 for a description of the themes.

Table 8: Catalysts PSTs Considered Significant in Development of Beliefs Themes

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Aspirations</th>
<th>Critical reflection</th>
<th>Relationships</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning styles</td>
<td>Establishing positive relationships</td>
<td>Handling sensitive situations</td>
<td>Establish lasting relationships with students</td>
<td>More time to understand learning styles</td>
</tr>
<tr>
<td>Variety of strategies and methods of teaching</td>
<td>Make learning fun</td>
<td>Unaware of beliefs</td>
<td>Responsive students</td>
<td>Exposure to ESE/ELL students</td>
</tr>
<tr>
<td>LGBTQ lessons</td>
<td>Student engagement</td>
<td>Future classroom standards</td>
<td>Genuine concern for students</td>
<td>Handling behavior issues</td>
</tr>
<tr>
<td>Inappropriate behavior</td>
<td>Care</td>
<td>Providing fair opportunities</td>
<td>Humor</td>
<td>More knowledge of manipulatives</td>
</tr>
<tr>
<td>Versatility</td>
<td>Integration of manipulatives</td>
<td>Learning from students</td>
<td></td>
<td>More time in internship</td>
</tr>
<tr>
<td>Foundation of concepts</td>
<td>Trust</td>
<td></td>
<td></td>
<td>Debrief time with CT</td>
</tr>
<tr>
<td>Impairments</td>
<td></td>
<td></td>
<td></td>
<td>Connect course content with internship</td>
</tr>
<tr>
<td>Teaching styles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Exposure.** Exposure is the theme that emerged most often as it related to the participants’ perception of the formation of their beliefs and pedagogy. Since each of the participants had unique experiences it seemed natural their responses in this section were more individualized. One area Amanda felt influence her beliefs was her exposure to learning styles. She “knows everybody learns different and has different learning styles” and “I know this is something I want to make sure I know more about.” After her exposure to so many new teaching methods and strategies, Amanda “was nervous about remembering all of the methods we learned” but “learning different strategies helped me gain confidence.” Another aspect of Amanda’s experience that shifted her thought process was,

- exposure to a LGBTQ lesson in seminar. This “really forced me to think about how I would handle situations and what I would do. The guiding questions from the seminar lesson really brought out an awareness for me.

Amanda explained further that she read short stories in her internship seminar, with LGBTQ themes. One of the stories discussed a student who constantly came late to class and the teacher in the story was very upset. Each time the student arrived late, he was extremely apologetic. The student did not have behavior issues, yet the teacher remained upset. As the story concluded, the parents were contacted, and the teacher learned of issues the child was having because of his parents’ gender identity. Amanda gained an “appreciation of really learning about the students, and what is going on in their lives so you’re not quick to judge.” This was a pivotal moment in her education program.

Amanda also shifted her thinking and realized “it is really important for students to develop a good foundation of concepts of math,” “especially not memorizing facts – although memorization is important at times.”
Becka felt her exposure to the “inappropriate behavior as college students” in the methods course and internship helped define her beliefs as a teacher and a learner. She shared, some of the girls mocked Professor T a little bit because of her personality and stuff. She’s here to teach you. That’s not the purpose of coming to class. We’re here to learn. That upset me a little bit. I enjoy my classmates, but some of them can be a little mean. She later explained several of the PSTs complained about assignments, and not having enough time to “get anything done” in their internship. She also observed some teachers at her internship school and identified them as “non-examples of the teacher I will be.” These were pivotal experiences for Becka. She said, “my heart is strong, I’ve always had that and seeing how some of those girls acted, and the teachers, that is just not right!”

Becka also mentioned a shift in her thinking about pedagogy that connected to the way she learned mathematics – by memorization, and how she now believes she will teach. She believed, “if I’m teaching my way [rote memorization] it is forcing it in hopes kids get it,” “it’s not enough and will hurt them in the long run.” She also learned, “you have to make yourself versatile,” “and get into every single type of mode of teaching.” She expressed further, You have to learn how to diversify yourself in a way that you can approach all the students to make sure all their needs are being met so by the end of the day you can go home and feel good that a student “got it.” You can then think about if the method that worked for one student might work for another. She also acquired the knowledge “that it is important to see a variety of teaching styles to allow me to develop my own teaching ways,” and “you have to be able to pull out the best from bad examples and experiences and make them work for you.”
Carly on the other hand did not believe her beliefs had changed “because through these experiences that I have had in the College of Education, they have helped me start to build my teaching beliefs.”

**Aspirations.** Aspirations is the theme with the second highest frequency. Each of the participants discussed the importance of forming positive relationships with students. Amanda said she “aspires to form bonds with my students to establish a mutual trust and respect in the classroom.” Becka believes “kids need to know you care about them.” Carly “wants to be the kind of teacher that the kids trust” and “if they don’t think they can trust you, they’re never going to listen to you.” Another consistent belief all participants aspire to is to make math fun for the students. Amanda hopes to “find ways to make math fun,” I want students to have a positive experience and love learning.” Carly wants “them to know math isn’t terrible” I want to be the happy teacher,” “students respond well to that.”

Becka revealed an experience she “wouldn’t ever forget that showed me the type of teacher I wish to be.”

This was a very unique experience teaching students how to learn math when they’re visually impaired. I was working with a couple of visually impaired students and they had these white-board things, but they were not as much whiteboards. They were just magnetic holders. They would have--the things that I taught them were division problems and then multiplication. For instance, if they’re trying to set up their problem ‘cause you can’t type it working it out. It’s hard. They would feel with their hands certain bumps that represent lines to separate what we were working on. They did it very differently than I did. Instead of starting with the big number and have the dividing number on the outside, they would work in so they didn’t have the subtraction sign. They
would just have the final answer and they would work down into a triangle shape which was really different. They would fight with me because this is what I do. They were like, no, no, no. That’s how we do it. That was learning how to do something really different. The kids taught me how to use the boards and to do the math their way. They even taught me how to spell my name in braille.

Becka was excited to share her collaborating teacher was impressed she was able to understand the braille-boards and method of using them to solve division problems so easily. This encouragement inspired Becka, ignited her inner teacher, and is the experience that stood out for her as the type of teacher to which she aspires.

**Critical reflection.** Critical reflection is the theme with the third highest frequency through the interviews and email communication. Amanda directed her personal critical reflection toward community. “I can learn from students’ own community and how to use that information to support an inclusive learning environment.” She also indicated, “The discussions about LGBTQ really forced me to think about how I would handle situations with my own class and what I would do, how would I handle those sensitive and important discussions.” Finally, Amanda did not feel “my beliefs necessarily changed, they were just refined more as I learned more. I didn’t realize I had some beliefs until you started to pull them out of me during this experience.”

Becka’s critical reflections stemmed from her personal growth and the type of lessons she will bring into her classroom. She believed, “work from textbooks and worksheets isn’t very engaging and I would not do that for my own teaching standards,” “you have to teach with purpose,” “you have to make yourself versatile and diversify yourself in a way that you can approach all the students to make sure all their needs are met,” and “I think attitude is a major
point.” Becka concluded with, “I knew I had to take the bad examples I saw and make them work for me, you know pull out the best from it and know the kind of teacher I want to be.”

Carly’s critical reflection was centered around self-reflection. She described her experience,

Through seminar I learned that every student deserves a fair chance at learning and teachers do not always provide that opportunity unfortunately. That has shaped my teaching beliefs because I want to make sure that in my future classroom, everyone is treated fairly keeping in mind that fair is not always equal. I believe that my beliefs have not changed from what I learned so far, but the experiences in the next course might potentially shift my teaching beliefs.

Although Carly embraced the notion that she did not initially embody “teaching beliefs,” she encountered what she considered “significant learning experiences.”

**Relationships with students.** Relationships with students is the next theme that emerged as it related the participants’ perception about the formation of their beliefs and pedagogy. All three participants believed it was critical to form positive relationships with students as a foundation for their classrooms. Amanda believed, “it is important to establish lasting relationships with students, so they know you care,” and “students really respond well to you when you are happy around them,” Becka shared “having good relationships is what I want to have for my own classroom.” Carly expressed “being open and having a good relationship and joking with them will help my students feel more comfortable with me,” “I want my students to know I want them to shine.” “having a relationship with your students is key, if they don’t trust you, they’re not going to listen to you,” and “I want my future students to have a trusting
relationship with me because I believe that is the foundation to everything else in the classroom.” They all equated personal relationships with learning and success in the classroom.

**Needs.** *Needs* is the last theme that emerged through the data analysis. This theme is comprised of participants’ comments related to what they believed they still needed as they formed their beliefs and pedagogy. The necessities included, “a variety of learning styles to reach all students,” “solid understanding of all the methods and strategies we learned,” “more experience and strategies working with ESL/ELL students,” “strategies to handle behavior issues and improve my classroom management is a must,” “more time to learn methods of teaching conceptually since I learned by memorization and procedures,” “more instruction incorporating manipulatives in my math lessons,” and “more time for internship so I can see a variety of teaching styles and form my own.” As I discussed early in the chapter, all three participants requested more time in their internship in addition to an opportunity to have more elaborate discourse with their collaborating teachers prior to moving forward in their program.

**Conclusions from RQ4**

As I reflected on the themes, participants’ quotes, and my notes and memos, I included my understandings to answer the final research question further. When I asked the participants what specific catalysts related to their experiences they considered significant in developing their beliefs and pedagogy about teaching mathematics to elementary students, I was delighted at the level of consideration they provided. This last question encompassed all their encounters as K-12 learners, the semester in an introductory mathematics methods course, and their Level II internship. The participants referred to their exposure to situations that occurred during the semester the most. The responses ranged from sensitive conversations within the classroom, meeting the needs of all students, new strategies and methods of teaching, to learning how to find
balance and time to perform all the responsibilities incorporated in the teaching profession. The other stimuli they remarked on was incorporated and driven by critical reflection. The participants acknowledged contributing to this study forced them to consider their beliefs about teaching and together we were able to connect those beliefs and their perceptions about their abilities to their experiences and relationships they formed. The participants’ final responses focused on what they believed they needed or lacked during the semester, which I discuss further in the implications for practice. See Table 9 below for a comprehensive table with each participants’ direct quotes related to each theme.

Table 9. RQ 4: Themes and Descriptors Derived from Data Analysis

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I know everybody learns different and has different learning styles”</td>
<td>“my exposure to the inappropriate behavior as college students helped me define my beliefs as a teacher and learner”</td>
<td>“I don’t really feel like my beliefs changed because through these experiences I have had in College of Education, have helped me start to build my teaching beliefs”</td>
<td></td>
</tr>
<tr>
<td>“I was nervous about remembering all of the methods we learned, but learning different strategies helped me gain confidence”</td>
<td>“if I’m teaching my way [rote memorization] it is forcing it in hopes that the kids get it, it’s not enough and will hurt them in the long run”</td>
<td>“real-life connections are very important to help with student understanding”</td>
<td></td>
</tr>
<tr>
<td>“my exposure to a LGBTQ lesson really forced me to think about how I would handle situations in my own classroom”</td>
<td>“you have to make yourself versatile and learn how to diversify yourself in a way that you can make sure all of students’ needs are being met”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“it is really important for students to develop a good foundation of concepts of math, especially not memorizing facts – although memorization is important at times”</td>
<td>“it is important to see a variety of teaching styles to develop my own teaching ways and pull out the best from bad examples and experiences and make them work for you”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirations</td>
<td>Amanda</td>
<td>Becca</td>
<td>Carly</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>&quot;I aspire to form bonds with my students to establish a mutual trust and respect in the classroom&quot;</td>
<td>&quot;kids need to know you care about them&quot;</td>
<td>&quot;I want to be the teacher that has a relationship built on trust&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;I want to find ways to make math fun, I want my students to have a positive experience and love learning&quot;</td>
<td>&quot;I want math to be fun for my students&quot;</td>
<td>&quot;I want to be the kind of teacher that the kids can trust&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;teaching my students who were visually impaired taught me the kind of teacher I want to be&quot;</td>
<td>&quot;having interactive classroom activities is so important&quot;</td>
<td>&quot;I want them to know math isn’t terrible, I want to be the happy teacher, students respond well to that&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;STEM is so important, I want to find ways for kids to enjoy learning so they are so much more set for the future&quot;</td>
<td>&quot;I want to learn as many different ways as I can to use manipulatives and which are best to teach with&quot;</td>
<td>&quot;my tutoring experiences have helped show me the kind of teacher I want to be&quot;</td>
<td></td>
</tr>
<tr>
<td>Critical Reflection</td>
<td>&quot;I can learn from students’ own community and how to use that information to support an inclusive learning environment&quot;</td>
<td>&quot;work from textbooks and worksheets isn’t very engaging and I would not do that for my own teaching standards&quot;</td>
<td>&quot;I’m open to new ideas now&quot;</td>
</tr>
<tr>
<td>&quot;the discussions about LGBTQ forced me to question how I would handle those sensitive and important discussions&quot;</td>
<td>&quot;you have to teach with purpose&quot;</td>
<td>&quot;realizing that every student deserves a fair opportunity to learn has shaped my teaching beliefs because I want to make sure that happens in my future classroom, that everyone is treated fairly keeping in mind that fair is not always equal&quot;</td>
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<td>&quot;I don’t realize I had some beliefs until you started to pull them out of me during this study experience&quot;</td>
<td>&quot;you have to diversify yourself in a way that you can approach all the students to make sure all their needs are met&quot;</td>
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<td></td>
<td>&quot;I think attitude is a major point&quot;</td>
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<td></td>
<td>&quot;I knew I had to take the bad examples I saw and make them work for me, you know pull out the best from a situation&quot;</td>
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<tr>
<td>Amanda</td>
<td>Becka</td>
<td>Carly</td>
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| **Relationships with students**                                       | **“Having good relationships is what I want to have for my own classroom”**  
|                                                                      | **“I was so concerned with the students not passing the FSA”**  
|                                                                      | **“you have concern for the students, you have feelings for them, you care about them”**  
|                                                                      | **“the relationships I established with the students in my internship helped me feel more comfortable. Even if you mess up a lesson, it won’t scar them for life”**  
|                                                                      | **“students just respond well to a happy teacher”**  
| **“it is important to establish lasting relationships with students, so they know you care”**  
|                                                                      | **“students really respond well to you when you are happy around them”**  
|                                                                      | **“I want my future students to have a trusting relationship with me because I believe that relationships are the foundation to everything else in the classroom”**  
|                                                                      | **“being open and having a good relationship and joking with them will help my students feel more comfortable with me”**  
|                                                                      | **“I want my students to know that I want them to shine”**  
| **“students deserve a fair chance at learning and teachers do not always provide that opportunity”**  
| | **“I was so concerned with the students not passing the FSA”**  
| | **“you have concern for the students, you have feelings for them, you care about them”**  
| | **“the relationships I established with the students in my internship helped me feel more comfortable. Even if you mess up a lesson, it won’t scar them for life”**  
| | **“students just respond well to a happy teacher”**  
| | **“I want my future students to have a trusting relationship with me because I believe that relationships are the foundation to everything else in the classroom”**  
| | **“being open and having a good relationship and joking with them will help my students feel more comfortable with me”**  
| | **“I want my students to know that I want them to shine”**  
| **“I want my future students to have a trusting relationship with me because I believe that relationships are the foundation to everything else in the classroom”**  
| | **“being open and having a good relationship and joking with them will help my students feel more comfortable with me”**  
| | **“I want my students to know that I want them to shine”**  

Amanda

Needs

“I really think we should have had more time to understand all of the different learning styles”
“my background didn’t give me an experience with ESE and ELL students, so I was hoping to have that in my internship”
“my internship school didn’t provide me with experience dealing with students with behavior issues, we should have that to be better prepared to teach in our own classroom”

Becka

“even though I learned math procedurally, I need to be more comfortable teaching it conceptually, so they really understand”
“manipulatives are extremely important to teach math concepts, we need more exposure in using them correctly”
“I think we needed more time without CTs during our internship to talk about and debrief the things that happened through the day, plans for upcoming classes, and if we have any questions”

Carly

“There were not enough opportunities in internship to teach or have discourse with CT”

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<th>Needs</th>
<th>Amanda</th>
<th>Becka</th>
<th>Carly</th>
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<tr>
<td>Amanda’s Needs</td>
<td>“I really think we should have had more time to understand all of the different learning styles”</td>
<td>“even though I learned math procedurally, I need to be more comfortable teaching it conceptually, so they really understand”</td>
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<tr>
<td>Becka’s Needs</td>
<td>“manipulatives are extremely important to teach math concepts, we need more exposure in using them correctly”</td>
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<tr>
<td>Carly’s Needs</td>
<td>“there were not enough opportunities in internship to teach or have discourse with CT”</td>
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Summary

As I reflect on the themes identified and discussed in this chapter, I ask myself how these themes relate to the significance of my study? Did the data allow me to answer my research questions? Where will I go from here?

I created a table to model the categories and themes I derived from the data analysis and coding process for all four research questions. These tables display the original descriptive categories I established and their combined themes. I created an additional table for each research question that includes direct quotes from all participants and interpreted them whenever possible throughout the chapter.

For RQ (1): “How do three preservice teachers describe their experiences as K-12 mathematics learners?” four themes emerged from the data analysis: class design, relationships, self-concept (related to mathematics), and disconnect. My condensed
interpretation of the data analysis and themes is PSTs had vague K-12 mathematics memories but were able to provide detail about personal relationships with their teachers. They also formed their self-concept based on their feelings about mathematics and their performance in their K-12 mathematics classroom.

For RQ (2): “In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?” four themes emerged from the data analysis: concern with teaching mathematics, interest, confidence, and misconceptions. My condensed interpretation of the data analysis and themes is the PSTs entered the introductory methods course consumed with concerns about teaching mathematics and misconceptions about grade level knowledge and mathematical content.

For RQ (3): “In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?” five themes emerged from the data analysis: comfort level, the role of the teacher, values, concerns, and theory to practice. My condensed interpretation of the data analysis and themes is PSTs concluded the course with increased confidence in teaching mathematics and were able to identify various roles of the teacher.

Finally, for RQ (4): “What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?” five themes emerged from the data analysis: exposure, aspirations, critical reflection, relationships, and needs. My condensed interpretation of the data analysis and themes is PSTs concluded the introductory methods course, internship, and my data collection process able to critically reflect and formulate their pedagogical aspirations.
In the next chapter, I elaborate further on how my findings relate to the significance of my study, are consistent with the extant literature, connect to the theoretical frameworks, and provide opportunities for future research.
Chapter Six: Discussion

Introduction

As I write this chapter I reflect on my familiarities as a mathematics teacher educator and I consider the ways in which preservice teachers (PSTs) grapple with the misalignment in contemporary views of mathematics teaching practices and how they experienced mathematics as K-12 learners (Brown, Friedrichsen, & Abell, 2013; Wilson, 2014). While I did not teach the course in which the participants were enrolled, they were in the same class on the same day, received the same instruction, yet left with significantly unique experiences. Each of the participants entrusted me with their thoughts and experiences, teaching beliefs, and perceptions about their abilities to teach mathematics as upcoming teachers. In this final chapter, I give due diligence in giving voice to the participants’ accounts.

When I think of drawing conclusions about the participants’ interview responses, I recognize the telling of their beliefs and perceptions are a trace of their overall experience that comprises the entirety of their educational career, and I also recognize the limitations of participants’ memory over time (Cartwright-Finch, 2016; Pillemer & White, 2009). As a researcher, I am capturing a small period in my participants’ lives that include the complex nature of their pasts, present, and futures.

In chapter three, I discussed three theoretical frameworks constructivism (Dewey, 1916, 1933; Richardson, 1997; Vygotsky, 1978), sociocultural theory (Bruner, 1990; Vygotsky, 1978), and adult learning theory (Merriam, 2001; Merriam & Bieremma, 2014; Meriam, Cafferella, & Baungartner, 2012). I discuss how these theories provided a lens for me to understand the
participants’ experiences within a social context of the introductory mathematics methods course. I briefly touched on the existing literature in chapter five in the analysis and summary of the themes which emerged across this study and the significance of the analysis. In this chapter, I revisit the participants’ responses from interview transcripts and email messages. I also identify themes and provide my interpretation of participants’ direct quotes with the theoretical framework and existing literature in mind. I then answer each research question, provide my interpretation for suggestions of future research, and conclude the chapter with my final reflections.

**Overview of the Problem**

Research has indicated the use of effective mathematics instructional practices strongly correlates to teachers’ beliefs and perceptions in their capabilities to have positive influences on student learning (Enon, 1995; Swars, 2004). Enon (1995) attained teacher efficacy is a substantial predictor of mathematical instructional strategies and that highly efficacious teachers are more successful mathematics teachers.

Because of the important role beliefs play in the teaching and learning of mathematics (Ambrose, Phillip, & Chauvot, 2004; Leder, Pekkonen & Tomer, 2002; Pajares, 1992; Thompson, 1992; Swars, 2004), mathematics educators might consider ways to explore beliefs and belief change. Although there are many studies concerning teacher ability and teacher beliefs, research on mathematics teacher efficacy and beliefs is scant (Ambrose, 2004; Smith, 2001; Steele, 1997, 2001; Swars, 2004). Some of the studies have focused on in-service teachers, yet few have examined PSTs. Further, there are numerous reports and models that designate the relationship between teacher beliefs and practices (see Raymond 1997; Swars, 2004), yet there is a gap in the research on the consistency between teachers’ beliefs and
practices, their experiences as mathematics learners, and their connection related to PSTs’
teacher education programs.

**Purpose of the Study**

My goal in this exploratory descriptive case study (Barkley, 2007; Merriam, 2009;
Neuman, 2004) was to identify any changes in three preservice teachers’ perceptions about their
ability to teach mathematics before and after having participated in an introductory mathematics
methods course and discover how their experiences helped shape their beliefs and concurrent
pedagogy about teaching mathematics to elementary students.

*A Priori research questions*

The following research questions guided my study:

1. How do three preservice teachers describe their experiences as K-12 mathematics
   learners?
2. In what ways do three preservice teachers perceive their abilities to teach mathematics
   prior to participating in an introductory elementary mathematics methods course?
3. In what ways do three preservice teachers perceive their abilities to teach mathematics
   after participating in an introductory elementary mathematics methods course?
4. What specific catalysts, relative to their experiences, do three preservice teachers
   consider significant in the development of their beliefs and concurrent pedagogy about
   teaching mathematics to elementary students?

As I reflect on each of the *A Priori* research questions above, I speculate whether my conclusions
in chapter five answered my research questions. I contemplate if they were the answers I
expected and how these answers might influence teacher educators in the future.
The Study

I conducted my study at a large public university during the Summer 2018 semester after the introductory mathematics course (MAE 4310) had concluded. I randomly selected three participants who expressed interest in the study and elected to volunteer. I employed Strauss & Corbin’s (2008) method of constant comparative analysis (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008) in my exploratory descriptive case study (Barkley, 2007; Merriam, 2009; Neuman, 2004). I analyzed the findings to answer each research question and capture the lived experiences of how elementary PSTs described their encounters as K-12 mathematics learners prior to entering their degree program. I also examined their perceptions regarding their ability to teach mathematics in an elementary classroom, their experiences throughout the semester enrolled in an introductory mathematics methods course; and what catalysts, related to their experiences they consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students.

Interpretation of Findings

I began my analysis by organizing and coding the semi-structured interview transcripts, email messages, and notes and memos in my researcher reflective journal. I used Strauss & Corbin’s (2008) process for analyzing data to prepare and analyze interview transcripts and email responses to my guiding and follow-up questions.

I completed several readings of the qualitative data. I used thematic analysis, an iterative coding process, memos, and constant comparative analysis (Patton, 2002; Saldana, 2013; Strauss & Corbin, 2008) to identify and group conceptual similarities and differences from the semi-structured interview transcripts, email messages, and my reflective journal notes and memos. I extracted four to five themes for each of the research questions.
I triangulated the data from each source to strengthen findings using direct quotes from the participants and overcome potential gaps associated with only one method of data collection (Lincoln & Guba, 2016). Finally, I applied credibility measures (Lichtman, 2012; Merriam, 2015) by providing the participants with examples of the interview transcripts to verify their authentic statements. These measures also provided verisimilitude, credibility, and trustworthiness to my study (Lincoln and Guba, 1985).

My data analysis revealed (1) PSTs had vague K-12 mathematics memories but provided great detail about personal relationships; (2) PSTs entered the course semester sated with concerns and misconceptions; (3) PSTs ended the course with increased confidence in teaching mathematics and were able to identify with the role of the teacher; and (4) they concluded the data collection process able to critically reflect and form their pedagogical aspirations.

In the following section, I provide a discussion for each of the study findings. Within each discussion, I connect the discoveries of this study to the previous research. I used the theoretical frameworks of Constructivist Theory (Baurersfeld, 1988; Cobb, 1994; Confrey, 1987; Dewey, 1904; 1933; 1938; Steele, 2001; Vygotsky, 1930/s; Yackel et al., 1990), Sociocultural Theory (Cobb, 1994; Jaramillo, 1996; Thorne, 2005; Vygotsky, 1930’s), and Adult Learning Theory (Kitchenbaum, 2008; Kolb, 2005) to guide my interpretative analysis.

**Discussion**

As I reflect on the themes identified and discussed in chapter five, I question, how do these themes relate to the significance of my study? In chapter three, I discussed the three theoretical underpinnings of my study. These three theoretical frameworks are constructivist theory, sociocultural theory, and adult learning theory. The emergence of the patterns of teacher’s experiences, their perceptions about their ability to teach mathematics, and what they
consider significant in forming those beliefs reflect constructivist and sociocultural theory in mathematics because learning mathematics is both socially and individually constructed (Bauarersfield, 1988; Cobb, 1994; Confrey, 1987; Steele, 2001).

In the introductory mathematics methods course, the instructor and students continuously engage in interactive, hands-on group activities, explore new strategies and teaching methods, and partake in dialogue related to those encounters. These involvements are unique for everyone based on his or her interpretation of the content presented throughout the course (Confrey, 1987; Gilewski, 2016; Steele, 2001). In a sociocultural approach to teaching, communication is central to learning. The participants’ cultural practices greatly influenced their individual learning within this framework, and the PSTs constructed mathematical meaning as they imparted their reasoning (Batista, 1999; Cobb & Yackel, 1995; Steele, 2001). I provide specific examples of the derived themes and their correlation to the theoretical frameworks within each section below.

**Research question one (RQ 1): How do three preservice teachers describe their experiences as K-12 mathematics learners?**

I reviewed the data I collected from the semi-structured interview transcripts, email correspondence, and my researcher reflective journal notes and memos. I discovered the following four predominant themes: (1) ways in which K-12 classes were designed, (2) relationships the participants formed, (3) self-concept related to mathematics, and (4) disconnect in the way the participants learned and are expected to teach mathematics. These themes are consistent with how experiences shape beliefs in alignment with constructivist and sociocultural theory (Evans, Leonard, Krier, & Ryan, 2013; Steele, 2001; Vygotsky, 1987), which implies collective and individual processes are directly related (Cobb & Yackel, 1996) as evident in previous research.
All three participants attended public K-12 schools, though in different states. They all had vague if any memories correlated to learning mathematics. The participants remembered teacher-centered lessons, worksheets, and homework from their text and workbooks. They had a recollection of memorization and math rules but were not able to recognize the content they learned. I asked additional questions in an attempt to trigger some memory, but they were not able to recollect much more. The participants’ lack of ability to recollect details from their past did not surprise me based on Pillemer & White’s (2009) research identifying vast “difficulties most adults experience when trying to remember events of their childhood” (p.209).

Anne Hart (2014) asserted psychologists suggest age seven is when memories tend to fade into unconsciousness, a phenomenon known as “childhood amnesia.” Her research involved interviewing children about past events in their lives starting at age three. I found this related to my study even though I interviewed adults and asked them to recall memories from when they entered kindergarten (typically age four or five) through grade twelve.

As I thought about my interview questions and the participants’ responses, I considered their inability to recollect or respond, and I was aware of the limitation of memory during the interview process. Similarly, this reminded me of Irving Seidman’s (2006) “purpose of interviewing.” He argued, “it is a powerful way to gain insight into educational and other social issues through understanding the experience of the individuals whose lives reflect those issues” (p.14). Remembering is a constructive process and is disposed to errors therefore – including the omission, alteration or fabrication of details (Cartwright-Finch, 2016). Memories of events are also influenced by the environment in which they are recalled, including how questions are asked, as the content of my questions (Cartwright-Finch, 2016; Pillemer & White, 2009). I was
diligent in telling the participants it was understandable not to be able to answer some questions and even not having an answer could provide me with insight.

In my review of the data, I discovered all three participants were able to recollect relationships they formed with their teachers at various times as K-12 mathematics learners. As I look back at my purpose for conducting this study, I still believe it was vital for me to learn more about the nature of the PSTs’ prior mathematics experiences to gain understanding what might have shaped their beliefs about teaching and learning mathematics. Blair & Raver (2015) maintained the earliest relationships with adults [teachers] form the basis for future relationships, the development of resilience in children and school readiness and Baumrind’s (2006) study directly connects relationships within classrooms provide suggestions for benefits and cautions for intended consequences. The participants shared recollections of both positive and negative relationships they experienced with their former teachers, which all participants correlated with their initial beliefs about mathematics.

All three participants accredited their self-concept as it related to their K-12 mathematics ability. Thompson (1984) determined there was a connection between teachers’ beliefs about mathematics and their practices when teaching mathematics, and Kupari (2003) also found a link between teachers’ practices and beliefs. Likewise, Nespor (1987) explored ways in which a combination of beliefs and previous experiences in practice can affect teachers’ current practices. He contended “some teachers model their practice on episodic memories, recalling earlier experiences to model their current practice” (p.21).

When I asked the participants to describe their experiences, the final theme that emerged was a disconnect or misalignment in the way they learned mathematics and how it is expected to be taught. My questions did not provide me with a complete picture of their experiences, but
rather a snapshot of what might have influenced their beliefs about teaching mathematics or possibly have the potential to provide them with enough motive to reflect upon and perhaps change their feelings about mathematics and teaching the content to elementary students. For my study, I attempted to access as many of the participants’ encounters possible to gain an understanding of their conception of reality. Reality varies with everyone based on his/her interpretive experiences, and then they construct knowledge via his or her prior experiences, mental makeups, and beliefs (Jaramillo, 1996; Steele, 2001).

Vygotsky sought to determine how students make sense of themselves and their world via their learning experiences. To do this, he posits that teachers should obtain knowledge about how students view their world, which was my hope in learning about the participants memories of their mathematics education, the type of school they attended, what they liked/disliked, specific positive or negative experiences (Jaramillo, 1996; Steele, 2001; Vygotsky, 1933). A student’s development cannot be understood by a study of the individual, we must also examine the external social world in which the individual’s life developed in the social world – for my study, this would be the participants K-12 experiences as mathematics learners (Smitson, 2015; Steele, 2001).

**Research question two (RQ 2): In what ways do three preservice teachers perceive their abilities to teach mathematics prior to participating in an introductory elementary mathematics methods course?**

For the second research question, I reviewed the data I collected from the semi-structured interview, email correspondence, and my researcher reflective journal notes and memos. I discovered the following four predominant themes: (1) concern with teaching mathematics, (2)
personal interests, (3) confidence, and (4) misconceptions or misunderstanding grade level knowledge or mathematical content.

At the time of the second research question, the course semester had already concluded. Subsequently, I was asking the participants to reflect on the beginning of the semester retroactively. My data analysis revealed all three participants most significant concern was teaching mathematics. This theme was based on several factors: (1) all students do not learn the same way, (2) fear of misdescribing a concept, (3) learning mathematics procedurally and not understanding new methods, and (4) unfamiliarity using manipulatives in mathematics instruction. Conner et al. (2011) and Klein (2012) assert if PSTs approach their teacher education program already holding traditional beliefs about how students learn mathematics due to their experiences, teacher educators may wish to shift their beliefs to a more constructivist view.

Like Jao’s (2017) study, the participants had only experienced traditional learning contexts before this methods course. In a study conducted by Straub & Stern (2012), they claimed there were higher achievement gains in students with teachers holding constructivist beliefs about mathematics rather than traditional beliefs. Further, in Jao’s (2017) study, he ascertained many mathematics PSTs enter their teacher education with certain beliefs; and traditionally those programs have not challenged PSTs to reexamine those beliefs (Jao, 2017; Leaman & Flanagan, 2013).

All three participants discussed the remaining themes for this research question: (1) they expressed the desire to learn more about working with manipulatives and how they might support mathematical concepts, (2) they were uncertain about specific grade level knowledge
and content, so they would feel more comfortable in their next internship and their own classroom, and (3) had misconceptions and misunderstandings about the grade level knowledge.

Teachers’ background subject knowledge influences their teaching (Darling-Hammond, 2005; Hill, Rowan & Ball, 2005; National Mathematics Advisory Panel, 2008; Rosas & West, 2011). Rosas and West found that PSTs rated their perception of readiness to teach mathematics only as adequate (Rosas & West, 2011). I believe study participants’ concerns and feelings were valid and what I anticipated due to their lack of prior knowledge learning mathematical concepts in their K-12 experiences.

**Research question three (RQ 3): In what ways do three preservice teachers perceive their abilities to teach mathematics after participating in an introductory elementary mathematics methods course?**

For the third research question I reviewed the data I collected from the semi-structured interview, email correspondence, and my researcher reflective journal notes and memos. I discovered the following five predominant themes: (1) comfort level teaching mathematics, (2) identifying the role of the teacher, (3) value from the course and/or internship, (4) concerns, and (5) the implementation of theory to practice based on what they learned in their coursework and observed during their internship.

At the time of the third research question, the course semester and their internship just concluded, so the participants’ memories were much more vivid, and I noticed a shift in their deliberating. All three participants moved from a place of fear and uncertainty about teaching mathematics to now looking through the lens of a teacher. They asserted several descriptors to explain what they believed led to their new confidence and ability to teach mathematics.
All three participants believed an influencing factor in the introductory mathematics methods course was the social and interactive aspect. Examples include (1) classroom discussions with peers, (2) numerous types of mathematical scenarios to explore with their groups, (3) opportunities to collaborate with a partner or small group, (4) observing the implementation of multiple strategies to solve mathematics problems at different grade levels.

These pedagogical changes are consistent with recommendations to teach preservice mathematics teachers, in the same manner, they will be expected to teach their future students (Lloyd, 2013). Providing the PSTs opportunities to experience group work and peer-led demonstration and explanation of solutions while learning mathematics are the “authentic learning strategies that facilitate conceptual understanding of pedagogical practices” (p. 114). These experiences enhance PSTs’ development of pedagogical content knowledge, which is necessary for successful mathematics teaching (Ball et al., 2001; CBMS 2001, 2012; Shulman, 1986).

The participants concurred with the following remaining themes: (1) values they established from the course or internship, (2) concerns, and (3) the implementation of theory they learned in their coursework as it related to the practices they observed in their internship. One of the areas the participants valued through this experience were: the instructor’s preparation, organization, and high expectations. This provided them with consistency and a sense of security. All three participants also addressed concerns with not having enough time in their internship class, enough experience teaching, and not having the opportunity to observe the theories they learned in their mathematics methods coursework while engaged in their internship class. Their concerns were valid, and changing their perceptions and beliefs takes time, but teacher education programs typically have a short amount of time with PSTs. In elementary
programs, mathematics education and mathematics content courses are usually only a slight portion of the complete program requirements (Hart, 2004; Wilson, 2014).

Many teacher education programs lack the necessary amount of time to provide enough field experience to acquaint candidates with the responsibilities and orientations of becoming a teacher; usually one school semester (Hart, 2004; Wilson, 2014). Considering this, we might contemplate the nature and value of experience and the long-term effects of PST preparation programs. A multitude of personal, institutional, and social experiences are a portion of the requirements necessary for the development of capable, enthusiastic, well rounded professional educators (Howie & Bagnall, 2015).

**Research Question four (RQ4): What specific catalysts, relative to their experiences, do three preservice teachers consider significant in the development of their beliefs and concurrent pedagogy about teaching mathematics to elementary students?**

For the fourth research question, I reviewed the data I collected from the semi-structured interview, email correspondence, and my researcher reflective journal notes and memos. I discovered the following five predominant themes: (1) exposure, (2) aspirations, (3) critical reflection, (4) relationships with students, and (5) needs as the participants formed their beliefs and pedagogy.

All participants had unique and socially constructed experiences in their methods course and their internship they believed afforded them opportunities they would never have considered prior to these encounters. Some of these experiences dealt with gender issues in the classroom, working with students with varying exceptionalities, and even learning the type of teacher they did not want to become. Relatedly, according to John Dewey’s (1933) work, this type
experiential learning highlights an active knowledge construction process relating transactions between a person and the situation (Healey & Jenkins, 2000; Kolb, 2012).

Yuo and Huang (2013) found adult learners have a variety of life and work experiences and learn best when new knowledge is integrated into real-life contexts. When the PSTs identified a need, as they did throughout the data collection process, they have a strong will to learn and will seek the new knowledge necessary for their current situation (Kolb & Kolb, 2005; Knowles, 1968; Holton, & Swanson, 2015; Merriam, 2009). My analysis of the collected data revealed, new knowledge to be prevalent when the participants shared their teaching aspirations after reflecting over the duration of the course. All three participants expressed a desire to gain and use their new knowledge within their classrooms and in their final internship.

When I interviewed the participants, this final research question was a culmination of their experiences: K-12 memories learning mathematics; the coursework and assignments in which they participated during the mathematics methods course, their internship experience, and the experience participating in my study. There was an apparent transformation in their perceptions about their ability to teach mathematics and their pedagogical beliefs.

I looked to Vygotsky’s (1930’s) sociocultural theory when I further examined my research findings because he explained that social experience outlines the ways of thinking and interpreting the world as was true for all three participants during their participation in my study. Similarly, Vygotsky’s version of constructivism is a non-developmentary view of education whereby a student’s intellectual personality and socio-moral knowledge is “constructed” by internalizing concepts through self-discovery. All three participants extracted their experiences from the methods course, their distinctive internship encounters, and critical reflection from the questions I sought in my study and were able to recognize developed abilities to teach
mathematics and formulate pedagogical judgments as a basis for teaching mathematics to elementary students.

Conclusions

My study adds to the literature on changes in PSTs’ beliefs and perceptions about teaching mathematics to elementary students after participating in an introductory mathematics methods course and connects their experiences as K-12 mathematics learners. I found four essential discoveries in my exploratory descriptive case study of how three PSTs’ describe their experiences as K-12 mathematics learners, in what ways three PSTs perceive their abilities to teach mathematics prior to and after participating in an introductory mathematics methods course, and what specific catalysts they consider significant in their development of their beliefs and pedagogy about teaching mathematics to elementary students.

First, PSTs had vague K-12 mathematics memories but were able to provide detail about personal relationships they formed with their teachers. They also formed their self-concept based on their feelings about mathematics and their performance in their K-112 mathematics classroom. I drew this conclusion from my analysis and coding of the semi-structured interview transcripts and email messages with all three study participants and by reflecting on my reflective journal and memos. I identified 18 preliminary categories related to their description of their memories as mathematics learners and combined the categories into four main themes: (1) class design, (2) relationships, (3) self-concept related to mathematics, and (4) disconnect.

Second, the preservice teachers entered the introductory mathematics methods course consumed with concerns about teaching mathematics and misconceptions about grade level knowledge and mathematical content. I also based this conclusion on the analysis and coding of the interview transcripts, clarifying email messages, reflective notes, and memos. I identified
eleven preliminary categories related to their initial perceptions of their abilities to teach mathematics prior to entering the introductory mathematics methods course and I combined the categories into four main themes: (1) concern with teaching mathematics, (2) interests, (3) confidence level, and (4) misconceptions or misunderstanding of grade level knowledge of mathematics content.

Third, the PSTs concluded the course and internship with an increased level of confidence in teaching mathematics and identifying with the role of the teacher. I based this conclusion on the interview transcripts and clarifying email messages, but also from my notes in my reflective journal. The PSTs displayed more enthusiasm when responding to the interview questions and were able to answer with greater intelligibility. I identified eighteen preliminary categories based on their responses and combined the categories into five main themes: (1) comfort level teaching mathematics, (2) role of the teacher, (3) values from the course and/or internship, (4) concern, and (implementing theory to practice. There was a noticeable shift in their perceptions about their ability to teach mathematics and progressed from fear and apprehension to attention to explicit values they developed during the semester.

Finally, PSTs concluded the introductory mathematics methods course, concurrent internship, and my data collection process able to critically reflect and formulate their pedagogical aspirations. I drew this conclusion from all data collection methods and my interpretations of the personal information the participants entrusted me with. I identified twenty-one preliminary categories about the PSTs’ overall experiences and combined the categories into five main themes: (1) exposure, (2) aspirations, (3) critical reflection, (4) relationships with students, and (5) needs they identified as they formed their beliefs and pedagogy. The participants, consistent with Merriam (2001 and Steel’s (2001) andragogic model
(1) learned why the mathematics methods and strategies were important, (2) were able to direct themselves through course assignments and internship responsibilities, (3) were able to connect the course topics in some way to their experiences – past and present, (4) became motivated to learn how to teach mathematics more conceptually, and (5) learned to overcome fears, inhibitions, and prior beliefs about learning mathematics (Conner, 1997; 2004).

**Implications**

There are implications for both practice and further research based on the literature reviewed in this paper. Adult learners and teacher educator’s practice and understanding can be enhanced through the process of making meaning of their own experiences through the process of critical reflection and rational discourse about their learning experiences (Merriam & Bierema, 2014). Further research is needed on broadening the range of research designs and methodologies for institutions of higher education as well as the use of constructivist and sociocultural theory to underpin content areas and disciplines for teacher educators. This study has the potential to contribute to mathematics theory to practice, specifically for mathematics teacher educators in course planning for elementary teacher education programs.

**Implications for Practice**

Adult educators must understand that constructivist and sociocultural aspects of adult learning may take several forms involving either impartial or idiosyncratic reframing. Adult learning is rooted in the way human beings communicate and is a common learning experience not exclusively concerned with significant personal transformations (Hart, 2004; Kolb, 2012). Adult learning requires a form of education very different from that commonly associated with children. Instruction that nurtures critically insightful thought, inventive problem posing, and dialogue is learner-centered, involved, and interactive, and it encompasses group negotiation and collective problem solving (Howie & Bagnall, 2015; Merriam & Bierema, 2014).
Like Howie and Bagnall’s (2015) research on the adult learning process, much of the content the PSTs learned during the methods course was only a resource. The misalignment in the curriculum the PSTs learned and what they observed during their internship were missed opportunities for professional growth. The study participants found value in their exposure to numerous mathematical problem scenarios, working with collaborative groups, and they learned by talking and sharing their ideas with their peers. They craved more time and opportunities to implement their innovative methods and implement them in their internship. In my research study, I discovered the participants believed the most significant experiences were those that included social interaction and being required to critically reflect on their experiences in totality.

My findings also have practical implications for both course designers and teacher educators who teach mathematics methods courses. To design effective mathematics methods courses creators might want to consider the coordination of mathematics curriculum taught in the methods course with the mathematics content being taught in the district where the PSTs will be placed for their internship. In doing so, the PSTs would be more likely to implement the theories and teaching methods they learn in their methods course while participating in their internship. In doing so, they can develop differentiated learning experiences customized to the setting, needs, goals, and desired learning experiences for the internship classroom and partnership school.

**Implications for Future Research**

The findings from my study contribute to the scant amount of literature on the consistency between teachers’ beliefs and practices, their experiences as mathematics learners, and their connection related to PST education programs. My research findings and conclusions are specific to the three PST who completed an introductory mathematics methods course and
second level internship at a large public university in the Southeastern United States. Further research, using a larger population is needed to broaden and increase understanding of how PST’s prior experiences help shape their beliefs about teaching mathematics and consequently impede how they teach.

In this time, it is critical to extend our research of adult learning theory. Researchers might consider a greater examination of its intricacies, employ a broader range of research designs and methodologies, and examine adult learning theory in PST education programs throughout varying content areas. If this theory of adult learning is to remain of significance to adult educators, it must continue to inform teacher educators in ways they can improve their teaching practically and theoretically (Taylor, 2000; Wilson, 2014).

Kegan (2000) has noted students are able to critically reflect on their perspectives in late adolescence and abstractly reason about their own assumptions after two decades of living. The contemporary college experience may be so inundated with learning experiences; students have not yet fully realized the effects of these events. For this reason, recognizing and being able to articulate the experience of perception transformation may require more time than is provided in a study such as this, which examines students during one semester of a mathematics methods course (Glisczinski, 2007).

Other researchers may want to extend my study of PSTs over the duration of both mathematics methods courses and through their final internship. Researchers might consider how the mathematics methods course design affects the learning goals of the teacher preparation program. In my study, the PST’s courses were not in alignment with their internship. This means a PST could be enrolled in a mathematics methods course while placed in an English/Language Arts (ELA) classroom for their internship. This would not afford the PSTs the
opportunity to further explore the mathematics theories and content they learn while completing their coursework, which would continue a disconnected teacher education program.

In Merriam’s (2017) research, she posits “the particular learning that takes place is a function of three factors in the context where it occurs: the people in the context, the tools at hand, and the particular activity itself (p.28).” In Lave’s (1988) study, she asked adults to determine which of two products in a grocery store was the “best buy.” Those who went to the grocery store, talked with people in their group and physically handled various items to compare sizes and shapes, got 98% of the math problems correct. Those who were given the same problems in paper and pencil test got 59% correct (Lave, 1988).

Similarly, there was only one PST in my study who was able to bridge the connection from theory into practice in her internship course. She was placed in a fifth-grade classroom and was “excited to use what I learned in the course about fractions in my internship; the students were able to see what was happening.” All three participants discussed a hope that they were able to apply more from their coursework in their internship. This is one more example of how future research has the potential to improve teacher education programs.
References


Appendices
Appendix A

MAE 4310 Course Syllabus

COLLEGE OF EDUCATION

UNDERGRADUATE DEPARTMENTAL COURSE SYLLABUS

“The College of Education is dedicated to the ideals of Collaboration, Academic Excellence, Research, and Ethical Practice (CARE). These are key tenets in the Conceptual Framework of the College of Education. Competence in these ideals will provide candidates in educator preparation programs with skills, knowledge, and dispositions to be successful in the schools of today and tomorrow.”

Course Prefix and Number: MAE4310
Credit Hours: 3

Course Title: Teaching Elementary School (K-6) Mathematics I

Instructor: Doctoral Student in Mathematics Education

Course Description:

This course is required in the undergraduate programs in Elementary Education. The course continues the development of knowledge and skills necessary to prepare students to assume roles as teachers of mathematics in the elementary schools. Such a course is recommended by the National Council of Teachers of Mathematics (NCTM) in its Guidelines for Preparing Teachers. Canvas - the University of South Florida’s online learning system, is an integral component to this course. Students are responsible for staying up to date with all course information posted on Canvas.

Field-based courses statement (if applicable): This course is a field-based course. If you intend to withdraw from this course after the drop/ad date, you should inform your instructor before doing so as it may impact your ability to gain placement in a future term.

Include for field-based courses that require fingerprinting: This course requires fingerprinting. You will be informed via email by Student Academic Services regarding your need to fingerprint. Any questions/concerns regarding fingerprinting should be directed to …

Course Goals:

The purpose of this course is to provide opportunities for pre-service teachers to examine their understanding of various mathematics topics and to construct a vision of mathematics that considers the goals and assumptions of the current reform movements in mathematics education. Content, methods, and materials for teaching elementary school mathematics will be examined with a focus on Problem Solving, Whole Number concepts, and Rational Number concepts.
A. Knowledge of major goals and characteristics, including scope and sequence of elementary school mathematics programs and aspects of theories of learning as applied to the teaching of elementary mathematics.
B. Knowledge of problem-solving processes/strategies and their application in the teaching of elementary school mathematics.
C. Knowledge of current developments, including research, in education that may affect elementary school mathematics curriculum.
D. Knowledge of geometric concepts and principles and their application in the teaching of elementary school mathematics.
E. Knowledge of measurement concepts and principles and their application in the teaching of elementary school mathematics.
F. Knowledge of concepts and principles of probability and statistics and their application in the teaching of elementary school mathematics.
G. Knowledge of concepts and principles of algebraic thinking and its application in the teaching of elementary school mathematics.
H. Knowledge of Common Core and Florida Standards for elementary school mathematics—especially as applied to the elementary curriculum and as applied to the areas of geometry, measurement, and working with data.

Course Objectives (student learning outcomes):

The candidate will be able to:

1. Demonstrate pedagogical content knowledge related to knowledge of student thinking and instructional practices (Mathematics FLCS #1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7)

2. Demonstrate specialized content knowledge and pedagogical content knowledge related to knowledge of number and operations. (Mathematics FLCS #2.6, 2.7, 2.8)

3. Demonstrate specialized content knowledge and pedagogical content knowledge related to algebraic thinking (Mathematics FLCS #2.1, 2.2, 2.3, 2.4, 2.5)

4. Demonstrate specialized content knowledge and pedagogical content knowledge related to rational number concepts (Mathematics FLCS #3.1, 3.2, 3.3, 3.4, 3.5)

Course Requirements:

Professionalism. Because this course is part of an accredited program that leads to professional certification, students must demonstrate behavior consistent with a professional career. Failure to demonstrate such conduct will impact a student’s grade.

In particular, students are expected to:

a. Attend all class meetings.
b. Prepare carefully for class. Your input into the class discussion is important. Thus, you are expected to be present at the beginning and conclusion of class.
c. Complete all assignments on time. Students should maintain a file of all graded assignments until after receiving an official grade notification from the registrar. Late assignments will be handled on an individual basis and will affect your grade.
d. Collaborate responsibly with colleagues in coursework.
e. Interact professionally with classmates. Students should demonstrate respectful standards of behavior during class discussions.

**Please turn off all cell phones and pagers or place them in a non-ringing mode. Laptops will not be needed unless otherwise stated by course instructor.**

**Attendance:** Attending class is very important—it shows dedication to the teaching profession and is essential for you to master the strategies used and the content of the class. Punctuality, preparation and participation are all signs of professionalism. If an emergency arises please notify me PRIOR to the start of class. Additionally, absences will only be excused if proper documentation is provided for the emergency circumstance. If you miss more than two classes, you should consider dropping the class and re-enrolling. After two absences your course grade will be lowered 1 letter grade for poor attendance.

**Cell phones, Computers & Participation During Class:**
Please turn off your cell phones and do not use them or text message anyone during class—go outside in the hall if it’s an emergency. Please turn off tablets and laptops during class. There will be times when you may use your computer for in-class activities. Also, actively participate in activities in class, which includes giving your undivided attention to videos, etc.—do not do homework, write emails, and so forth, during such time. **I will deduct 1 point from your overall course average every time I observe such behavior.**

**Modifications to This Syllabus**
I reserve the right to make changes in the readings, schedule of readings, assignments, and evaluation (grading) criteria. Changes in assignments may be warranted because of participants’ interests, etc.; these changes will be discussed with the class ahead of time.

**Course Outline:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Class Date</th>
<th>Topic</th>
<th>Assignment Due</th>
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<tbody>
<tr>
<td>1</td>
<td>01/10</td>
<td>Course Syllabus Ch 1: Teaching with Standards</td>
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<tr>
<td>2</td>
<td>01/17</td>
<td>Ch 2: Doing mathematics Ch 3: Problem Solving</td>
<td>Quiz #1 Reading Summary #1</td>
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<td>3</td>
<td>01/24</td>
<td>Ch 4: Planning</td>
<td>Quiz #2 Reading Summary #2</td>
</tr>
<tr>
<td>4</td>
<td>01/31</td>
<td>Ch 5: Assessment</td>
<td>Quiz #3 Reading Summary #3 Technology Presentation (Groups 1, 2, &amp; 3) Checkpoint #1: Critical Task</td>
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<td>02/07</td>
<td>Ch 6: Teaching with Equity Ch 7: Teaching with Tech</td>
<td>Quiz #4 Reading Summary #4 Technology Presentation</td>
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<tr>
<td>Week</td>
<td>Date</td>
<td>Section</td>
<td>Assignments</td>
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<td>6</td>
<td>02/14</td>
<td>Ch 8: Number Sense</td>
<td>Quiz #5, Reading Summary #5, Technology Presentation (Groups 7, 8, &amp; 9)</td>
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<td>Ch 9: Operation Meaning</td>
<td>Quiz #6, Reading Summary #6, Technology Presentation (Groups 10, 11, &amp; 12), Exam #1 Review, Checkpoint #2: Critical Task</td>
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<td>02/28</td>
<td>Ch 10: Mastering Facts</td>
<td>Reading Summary #7, Exam #1 (Chapters 1-9)</td>
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<td>9</td>
<td>03/07</td>
<td>Ch 11: Place Value</td>
<td>Quiz #7, Reading Summary #8, MicroTeach Lesson (Groups 1 &amp; 2)</td>
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<td>***Critical Task Due (Submit by 11:59pm via Canvas)</td>
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<td>11</td>
<td>03/21</td>
<td>Ch 12: Computation Strategies</td>
<td>Quiz #8, Reading Summary #9, MicroTeach Lesson (Groups 3 &amp; 4)</td>
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<tr>
<td>12</td>
<td>03/28</td>
<td>Ch 13: Computation Strategies</td>
<td>Quiz #9, Reading Summary #10, MicroTeach Lesson (Groups 5 &amp; 6)</td>
</tr>
<tr>
<td>13</td>
<td>04/04</td>
<td>Ch 14: Algebraic Thinking</td>
<td>Quiz #10, Reading Summary #11, MicroTeach Lesson (Groups 7 &amp; 8)</td>
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<td>14</td>
<td>04/11</td>
<td>Ch 15: Fraction Concepts</td>
<td>Quiz #11, Reading Summary #12, MicroTeach Lesson (Groups 9 &amp; 10)</td>
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<td>15</td>
<td>04/18</td>
<td>Ch 16: Fraction Computation</td>
<td>Quiz #12, Reading Summary #13, MicroTeach Lesson (Groups 11 &amp; 12), Exam #2 Review</td>
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<td>16</td>
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**Course Points:**

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<tr>
<td>Mini-Quizzes</td>
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</tr>
<tr>
<td>Reading Summaries</td>
<td>12</td>
</tr>
<tr>
<td>MicroTeach Lesson</td>
<td>6</td>
</tr>
<tr>
<td>Exam 1</td>
<td>25</td>
</tr>
<tr>
<td>Exam 2</td>
<td>25</td>
</tr>
<tr>
<td>Mathematics Lesson Plan (Critical Task)</td>
<td>15</td>
</tr>
<tr>
<td>Technology Presentation</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

**Evaluation of Student Outcomes:**

**Note:** All assignments must be completed on time and will be submitted electronically.

**Mini-Quizzes (MQ)**
Twelve mini-quizzes will be given throughout the semester. They will always be given during the first five minutes of class. Quizzes will cover material from the course readings/discussions/activities. Each quiz will be worth 1 point. **There is no opportunity to make these points up if you are not in class on quiz days or if you come to class late.** The lowest quiz score for each student will be dropped at the end of the semester.

**Reading Summaries**
Each week reading assignments will be given. Each reading summary will be worth 1 point. You are expected to read, analyze, and reflect on each of the required reading assignments and come to class prepared to contribute to a discussion of each of the readings. As you complete assigned readings for this class, provide the essence of the readings by answering the following questions:

What did you learn? What were the major points in the text?
What did you like? Make connections in the text.

Also, please provide an activity from the text that you intend to use in your future classroom. This must be written **IN YOUR OWN WORDS.** The lowest reading summary score for each student will be dropped at the end of the semester.

**Technology Presentation**
You will work in a small group to present a technology tool for a specific grade level (K-6) and topic covered within this course. Your small group will present (10-15 minutes) your technology tool to the entire class. Your presentation should include the following components:

1) Topic, grade level, objective and standards
2) Brief description of technology tool
3) Provide written directions for accessing and using technology tool
4) Demonstration of technology tool
5) Provide opportunity to explore technology tool
6) Benefits and drawbacks of technology tool

There will be a section on Canvas for someone in your group to upload the supplemental
Micro-Teaching Lesson

You will work in a small group to plan and present a portion of a hands-on (with manipulatives) lesson for a specific grade level (K-6) and topic covered within this course. Your small group will present a 15-20 minute portion of your lesson to the entire class. Your presentation should include the following components:

1) Topic, grade level, objective and standards
2) Do Now or Warm-up activity
3) Demonstrate mini-lesson
4) Introduce group activity & provide written directions
5) Conduct group activity
6) Provide Accommodations (e.g., ELL or ESE student)

There will be a section on Canvas for someone in your group to upload the supplemental materials that your group used (more details will be provided in-class).

Critical Task Observation* FLCS #32

This critical task requires you to observe an elementary math class, take field notes, and to reflect upon the experience. Complete details will be posted on Canvas.

Exam 1 & Exam 2

These exams provide you with an opportunity to demonstrate your mastery of the specialized content knowledge and pedagogical content knowledge that we cover in our coursework.

* Indicates a critical assignment

Hillsborough County Public Schools Task Force specific class activity statement

This project has been approved through the Hillsborough County Public School Research Review process. Note that individual student information is protected under the Family Educational Right and Privacy Act (FERPA). The University of South Florida and Hillsborough County Public Schools both want to ensure that student records are protected, and that teachers and potential teachers have the most appropriate training opportunities. Student Information (K-12) collected for this task will NOT include information that identified the individual student and any student identifiable information/data collected will NOT be retained (e.g., videos with students in them, copies of student work, audio recordings of student interviews, etc.) past the completion of the course and the assignment of a grade by the instructor/professor.”
**Chalk & Wire**: All tasks designated as critical must be completed with a score of 3 or above on each criterion in order to pass the course. An assignment that receives a score of below 3 on any criterion must be resubmitted until a score of 3 or better is achieved and that score will be entered into the Assignment E-portfolio system. However, the original grade on the assignment will be the score used to compute the final grade for the course. All revisions must be completed before the last class meeting. A Chalk&Wire e-portfolio account may be purchased at the [USF Bookstore](http://www.ugs.usf.edu/policy/ChalkWire.pdf).

**Grading Criteria:**

The course uses letter grades with a plus/minus system. The College of Education requires a minimum of a C- in this course for elementary education majors.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>94-100%</td>
<td>A</td>
</tr>
<tr>
<td>87-89%</td>
<td>B+</td>
</tr>
<tr>
<td>80-83%</td>
<td>B-</td>
</tr>
<tr>
<td>77-79%</td>
<td>C+</td>
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<td>D+</td>
</tr>
<tr>
<td>60-63%</td>
<td>D-</td>
</tr>
</tbody>
</table>

This is a hands-on methods course that requires active participation. If a student has more than one unexcused absence, the final course grade will be reduced by 5% for each additional absence. At the discretion of the instructor, arriving late or leaving early may be considered absences.

**Textbook(s) and Readings:**


**UNIVERSITY POLICIES: Standard Policies**

1. **Final Examinations Policy** - all final examinations are to be scheduled in accordance with the University's final examination policy.
   - [http://www.ugs.usf.edu/policy/FinalExams.pdf](http://www.ugs.usf.edu/policy/FinalExams.pdf)
2. **General Attendance Policy**
   - [http://www.ugs.usf.edu/policy/GeneralAttendance.pdf](http://www.ugs.usf.edu/policy/GeneralAttendance.pdf)
3. **Early Notification Requirement for Observed Religious Days** - Students who anticipate the necessity of being absent from class due to the observation of a major religious observance must provide notice of the date(s) to the instructor, in writing, at the beginning of the term.
4. **Academic Integrity of Students**
   - [http://www.ugs.usf.edu/policy/AcademicIntegrityOfStudents.pdf](http://www.ugs.usf.edu/policy/AcademicIntegrityOfStudents.pdf)
5. Disruption of the Academic Process

6. Gender-Based Crimes - Educators must report incidents of gender-based crimes including sexual assault, sexual harassment, stalking, dating violence and domestic violence. If a student discloses in class, in papers, or to an instructor, the instructor is required by law to report the disclosure. The Center for Victim Advocacy and Violence Prevention (813-974-5757) is a confidential resource where you can talk about such situations and receive assistance in confidence. Additional confidential resources on campus are: the Counseling Center (813-974-2831) and Student Health Services (813-974-2331).

7. Student Academic Grievance Procedures

8. Students with Disabilities - Students with disabilities are responsible for registering with Students with Disabilities Services (SDS) in order to receive academic accommodations. SDS encourages students to notify instructors of accommodation needs at least 5 business days prior to needing the accommodation. A letter from SDS must accompany this request.
   - See student responsibilities: http://www.sds.usf.edu
   - See instructor responsibilities: http://www.asasd.usf.edu/instructorresponsibilities.asp?refer=FACULTY

9. Turnitin Privacy Policy
   In order to comply with privacy laws, students are not required to include personal identifying information, such as name, in the body of the document. Turnitin provides an originality report letting the instructor know how much of the assignment is original. Please follow your instructor's instructions carefully regarding what identifying information to include.
   - How do I submit a Turnitin Assignment?

10. University Emergency Policy
    - In the event of an emergency, it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include but are not limited to: Blackboard, Elluminate, Skype, and email messaging and/or an alternate schedule. It's the responsibility of the student to monitor Blackboard site for each class for course specific communication, and the main USF, College, and department websites, emails, and MoBull messages for important general information.
Appendix B

Structure of Level II Intern Field Experiences

During the semester PSTs are enrolled in Teaching Elementary School (K-6) Mathematics Methods I (MAE 4310), they also participate in Elementary Education Internship Level II (EDE 4942).

**COURSE PREREQUISITES:** Admission to the Elementary Education Program in the College of Education

**COURSE DESCRIPTION:** This intensive, inquiry-driven internship experience is designed to complement foundational course work expected in the Undergraduate Elementary Program. The integration of course and field experience allows the Undergraduate Teacher Candidates to make critical course to field connections. These students will spend one day per week in a supervised internship experience in classroom settings in a public elementary school in order to further their understanding of the teaching and learning process. The classroom experiences are supplemented by a weekly seminar meeting in which relevant topics are discussed.

**EXPECTATIONS:** It is expected that the Undergraduate Teacher Candidates will negotiate in a timely manner with their collaborating teachers for the use of appropriate textbooks and supplementary materials to aid them in developing and delivering instruction to the class in which they are interning. Interns are expected to engage in all tasks and procedures as outlined in the course syllabus, the successful intern will meet professional standards for educators that include attendance, professional presentation, honesty in maintaining attendance and other records as well as demonstrating competence in classroom management and instructional tasks as outlined in the Florida Educator Accomplished Practices (FEAPs). Failure to adhere to the Elementary Education Program expectations may result in a loss of points, action plan, and/or inability to successfully complete the program.

**COURSE SCHEDULE:**

Classroom Schedule: Beginning Thursday, January 11, interns will be in placement classrooms, or participating in CT/Supervisor designed school-based learning activities, each Thursday from 7:30-2:30.

Seminar Schedule: (Tentative Schedule subject to change)
Beginning the week of January 9, seminar will meet each week on Thursday, from 2:30-4:00, in Ms. T’s room. Punctuality, preparation, and active participation at each seminar are minimum expectations.

Interns that are late, unprepared, or disruptive to the learning of others during seminar and field placement hours may experience a loss of points (up to 5% off of applicable assignment or overall letter grade) and are eligible for an action plan.
FORMAL OBSERVATIONS:
Each formal observation cycle (university supervisor and collaborating teacher) includes the following:

- Complete appropriate lesson plan template, submit to Canvas & provide hard copies to supervisor.
- Complete pre-observation conference reflection form. You must present this to supervisor or CT prior to teaching.
- Video record your lesson and collect student work.
- Post conference.
- Watch video and complete a reflection blog post. Tag your FEAPs

Supervisor Observation # 1 (20 pts) and CT Observation # 1 (10 pts) – (Brief Lesson Plan Template)
Small Group- Differentiation Focus: For the first two formal observations (CT #1 and SO #1) teacher candidates must create and execute a lesson targeted toward meeting the needs of a small group of learners. The lesson should demonstrate the undergraduate teacher candidate’s ability to consider the differing needs of learners within the small group context. Supervisors and CTs will look for evidence of differentiation to meet the needs of diverse learners within the lesson plan, pre- and post-conferences, and reflections. An intern that is capable of differentiating instruction to meet the needs of multiple learners in a whole group setting may do so at the discretion of the supervisor and/or CT.

CT Observation #2 (10 pts) – (Full lesson plan template)
Teacher candidate and CT will decide the focus of this lesson.

Supervisor Observation #2 (25 pts) ** Critical Task – (Full lesson plan template)
(FEAP: 2g, 2i, 3a, 3g, 4f; CF 2, 3, 6; ACEI 1.0, 3.4, 3.5, 5.1; Objectives: 1, 2, 4, 5)
Technology-Infused Lesson Plan and Teaching: Your second formal observation with your supervisor must be a technology-infused lesson. Undergraduate teacher candidates must create and execute a technology-infused lesson plan (excluding the ELMO). School available resources might include laptop carts, tablets, whole-group polling apps, etc. Please reference the Technology Integration Matrix for ideas.

**Note: Although PSTs may be enrolled in a content specific methods course, it is not required their observations reflect the content of the methods course. Also, interns might be placed in an English Language Arts (ELA) classroom while participating in the Mathematics Methods Courses. It is the responsibility of the Intern to make arrangements to visit a classroom to observe and participate in mathematics teaching.
Appendix C

IRB Approval Letter

6/18/2018

Elaine Cerrato, M.A.
Teaching and Learning

RE: Expedited Approval for Initial Review
IRB#: Pro00032952
Title: Illuminating Changes in Preservice Teachers' Perceptions about Teaching Elementary Mathematics in an Introductory Methods Course

Study Approval Period: 6/18/2018 to 6/18/2019

Dear Ms. Cerrato:

On 6/18/2018, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
IRB Protocol Pro00032952_updated.docx

Consent/Assent Document(s)*:
Informed_Consent_U118_version1.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR
56.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Please note, collecting names and email addresses of potential participants prior to IRB approval is determined to be non-serious, non-continuing noncompliance.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the IRB within five (5) business days.

We appreciate your dedication to the ethical conduct of human subject research at the University and your continued commitment to human research protections. If you have any questions regarding this matter, please call 5638.

Sincerely,

Kristen [Redacted], Ph.D., Vice Chairperson
Institutional Review Board
Appendix D

Blank IRB Consent Form

Informed Consent to Participate in Research Involving Minimal Risk
[If applicable:] and Authorization to Collect, Use and Share Your Health Information
Information to Consider Before Taking Part in this Research Study

Title: [Title of study, as it appears on the IRB application, grant/contract, or sponsored protocol. Best to bold title so it is more visible.]
Pro # __________________

[The 2018 Common Rule requires consent documents to begin with a concise and focused presentation of the key information that is most likely to assist a prospective participant or LAR in understanding why one might or might not want to participate in research. The first page of this template is designed to assist you with drafting that key information. For minimal risk research, the key information (the “Overview” herein) may comprise the majority of the consent document. Information in the Overview does not have to be reiterated in the sections below the Overview.]

Overview: You are being asked to take part in a research study. The information in this document should help you to decide if you would like to participate. The sections in this Overview provide the basic information about the study. More detailed information is provided in the remainder of the document.

Study Staff: This study is being led by [insert name of PI] who is a [list PI’s role] at/in [list name of PI’s employer]. This person is called the Principal Investigator. [The following sentence should be included if there is a faculty advisor involved] [He/She] is being guided in this research by [insert name of faculty advisor]. Other approved research staff may act on behalf of the Principal Investigator.

Study Details: This study is being conducted at [insert location at which research will be conducted] and is supported/sponsored by [insert name of sponsor]. The purpose of the study is to [insert brief summary of purpose]. Briefly explain in a few sentences, in lay language (understandable at a 7th grade reading level), the purpose of the study and the expected duration of the prospective participant’s participation. Example: The purpose of this study is to find out.... Tell the person, in lay terms, how the research will be carried out and whether the research includes a one-hour interview, a two-hour focus group, a 20-minute questionnaire, a 90-minute lab session in which you will solve complex puzzles, etc.

Participants: You are being asked to take part because [explain in lay language the condition(s) or situation that makes the prospective participant eligible for the research.]
Example: We are asking you to take part in this study because you have anxiety. We want to see how this behavioral intervention helps people with anxiety.

Voluntary Participation: Your participation is voluntary. You do not have to participate and may stop your participation at any time. There will be no penalties or loss of benefits or opportunities if you do not participate or decide to stop once you start. Alternatives to participating in the study include: [If there are alternatives, describe the procedures/treatments/interventions that the participant could receive such as taking a different course of treatment, etc.]. [If extra credit is offered for participation, please state that an alternative assignment will be offered to students as a non-research alternative involving comparable time and effort to that which is involved in the research. If participants are employees, include as applicable: Your decision to participate or not to participate will not affect your job status, employment record, employee evaluations, or advancement opportunities. If participants are students, include as applicable: Your decision to participate or not to participate will not affect your student status, course grade, recommendations, or access to future courses or training opportunities.]

Benefits, Compensation, and Risk: We do not know if you will receive any benefit from your participation. [If applicable: There is no cost to participate.] You [will /will not] be compensated [enter amount if compensated] for your participation. This research is considered minimal risk. Minimal risk means that study risks are the same as the risks you face in daily life.

Confidentiality: Even if we publish the findings from this study, we will keep your study information private and confidential. Anyone with the authority to look at your records must keep them confidential.

Why are you being asked to take part?

[Include additional information regarding the purpose of the study and why participants are being asked to take part beyond what is included in the Overview section.]

Study Procedures:
Explain in lay terms what will happen during the study. Make sure your explanation addresses what is being performed as standard of care and what is being performed strictly as part of the research. Explain what may happen at each study visit and at what intervals study visits will occur. Explain the study visit timetable – you may want to complement this description with a table or timeline. Explain what the participant will need to do before the first study visit, if anything.
At each visit, you will be asked to:

- **Describe the tests and procedures that will need to be performed, including the purpose of each. If there are multiple visits with different procedures occurring at each visit, it is suggested to list each in a separate paragraph and/or as bulleted items.**
- **Explain the questions that will be asked and/or interviews/surveys that may be conducted.**
- **If audio- or videotaping will be used, the participant must be informed of taping and, if applicable, given the option to agree to the recording. Explain who will have access to these tapes, whether the information will be identifiable, how long the tapes will be maintained, (noting our policy is 5 years after the Final Report is submitted to the IRB) and when the time comes, when and how they will be destroyed.**

**Total Number of Participants**

About [number of participants] individuals will take part in this study at USF. [If the study includes multiple sites, add the following statement: A total of [number of participants] individuals will participate in the study at all sites.]

**Alternatives / Voluntary Participation / Withdrawal**

[Use whichever statement is applicable:]

- You do not have to participate in this research study. [This statement is sufficient if there are no alternatives for the participant.]
- Alternatives to participating in the study include: [If there are alternatives, describe the procedures/treatments/interventions that the participant could receive such as taking a different course of treatment, etc.]

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. [If participants are students or employees, include as applicable: decision to participate or not to participate will not affect your student status (course grade) or job status.]

**Benefits**

[Use whichever statement is applicable:]

- You will receive no benefit(s) by participating in this research study.
- We are unsure if you will receive any benefits by taking part in this research study.

The potential benefits of participating in this research study include:

[List and explain any anticipated benefits the person may have from taking part in this study. Please note that compensation for participation IS NOT considered a benefit.]

**Risks or Discomfort**

[Use whichever statement is applicable:]
This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study.

[Or]
The following risks may occur:

- List and explain the physical, psychological, and social risks/discomforts and when known, indicate the relative chances of occurrence for each.
- When applicable, explain any risks that might be associated with a breach of confidentiality, including risks to employability, insurability, and/or criminal and civil liabilities.

Compensation

[If compensation for participation is available, include the dollar amount per visit and payment upon study completion of study activities. Please note raffles/random drawings of chance is not permitted.]

You will be compensated [enter amount] if you complete all the scheduled study visits. If you withdraw for any reason from the study before completion you will be compensated [enter $ amount here] for each study visit you complete.

[USF investigators must include the following for studies where compensation is more than $75 per payment or $300 per calendar year:]

To receive payment, you must provide your social security number, name and address so that we can comply with IRS (Internal Revenue Service) reporting requirements. When payments are reported to the IRS we do not tell them what the payment is for, only that you have been paid. If you do not wish to provide this information you can still take part in this study but you will not be paid.

[If participants are faculty/staff of who will be compensated please include the following language:]

If you do not want to complete the tax payer ID form you can still participate in the study, however if the form is not completed you will not be compensated.

[If no payment for participation is available, include the following:]

You will receive no payment or other compensation for taking part in this study.

[If commercial development is expected to arise from the study, include the following:]

The findings from this research, which may include your biospecimens (even if identifiers are removed), may result in and be used for the future development of products that are of commercial value and/or profit. There are no plans to provide you with financial compensation or for you to share in any profits if this should occur.

Costs

[Use only the following statements that apply to your research]

It [will / will not] cost you [amount / anything] to take part in the study.
[If the costs of the research are being paid by the study sponsor the following statement is required:]  
There will be no additional costs to you as a result of being in this study. However, routine medical care for your condition (care you would have received whether or not you were in this study) will be charged to you or your insurance company. You may wish to contact your insurance company to discuss this further.

[If there are costs associated with the study:]  
You or your insurance company will be expected to pay the costs for the following: [list all procedures which will be the responsibility of the participant outside of routine care.]

Conflict of Interest Statement

[Include the language outlined in your COI Management Plan.]

Privacy and Confidentiality

We will do our best to keep your records private and confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Certain people may need to see your study records. These individuals include:

- The research team, including the Principal Investigator, study coordinator, research nurses, and all other research staff. [Modify to match your study. Do not list the actual names of individuals, just their job class.]
- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.
- Any agency of the federal, state, or local government that regulates this research. This includes [List all federal, state, or local agencies/individuals authorized to access records including: the Department of Health and Human Services (DHHS) and the Office for Human Research Protection (OHRP).]
- The Institutional Review Board (IRB) and its related staff who have oversight responsibilities for this study, and staff in Research Integrity and Compliance.
  
[Include the name the sponsor(s) or others. If not applicable, please delete this item.]

[Please include one of the following statements if the research involves the collection of identifiable private information or biospecimens.]

Your identifiers might be removed from your private records or your samples. Your information or samples could be used and/or distributed to another investigator for future research studies without additional consent from you or your Legally Authorized Representative Or;

Your information or samples collected as part of the research, even if identifiers are removed, will NOT be used or distributed for future research studies.
We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are.

[Use the mandatory statement below if conducting an online survey:]

If completing an online survey, it is possible, although unlikely, that unauthorized individuals could gain access to your responses. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet. However, your participation in this online survey involves risks similar to a person’s everyday use of the Internet. If you complete and submit an anonymous survey and later request your data be withdrawn, this may or may not be possible as the researcher may be unable to extract anonymous data from the database.

[For study sites located in the EU or studies that will enroll EU participants, include the language in the following five paragraphs through “...with the data supervisory authority in your country.”]

Data collected for this research will be stored at the [insert name of USF study site, e.g. the Alzheimer’s Disease Neuroimaging Initiative Data Coordinating Center], located at the University of South Florida in the United States.

The following information may be used and disclosed to others:

- Your research records
- All of your past, current or future medical and other health records held by your study site
- Your contact information, including your name, e-mail address and your mailing address
- [Insert any other personal data that will be collected from EU participants, including, for example, information about participants’ ethnic or racial background, sexual history or sexual orientation, or political or religious beliefs.]

Your personal information collected for this research will be kept as long as it is needed to conduct this research. Once your participation in the research is over, your information will be stored in accordance with applicable policies and regulations. Your permission to use your personal data will not expire unless you withdraw it in writing. You may withdraw or take away your permission to use and disclose your information at any time. You do this by sending written notice to the Principal Investigator at the following address: [Insert appropriate business address.]

While we are conducting the research study, we cannot let you see or copy the research information we have about you. After the research is completed, you have a right to see the information about you, as allowed by USF policies.
If you have concerns about the use or storage of your personal information, you have a right to lodge a complaint with the data supervisory authority in your country.

If applicable (i.e. for studies involving surveys or interviews in which sexual violence or sexual harassment may be disclosed by a participant), include the following language.

A federal law called Title IX protects your right to be free from sexual discrimination, including sexual harassment and sexual violence. [Institution’s] Title IX policy requires certain [Institution’s] employees to report sexual harassment or sexual violence against any [Institution’s] employee, student or group, but does not require researchers to report sexual harassment or sexual violence when they learn about it as part of conducting an IRB-approved study. If, as part of this study, you tell us about any sexual harassment or sexual violence that has happened to you, including rape or sexual assault, we are not required to report it to the University. If you have questions about Title IX or [Institution’s] Title IX policy, please call [Institution’s] Office of Diversity, Inclusion & Equal Opportunity at (813) 974-4373.

If applicable (i.e. for studies involving focus groups, include the following language)

Please be advised that although the researchers will take every precaution to maintain confidentiality of the data, the nature of focus groups prevents the researchers from guaranteeing confidentiality. The researchers would like to remind you to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

If your research is NIH funded and you are conducting research involving sensitive, identifiable information, you have automatically received a certificate of confidentiality as a part of the terms and conditions of the award and are required to include this language. If your research is not NIH funded and you have applied for a certificate of confidentiality, insert this language as appropriate.

To help us protect your privacy, [we will obtain/we have obtained] a Certificate of Confidentiality from the National Institutes of Health. With this Certificate, the researchers cannot be forced to disclose information that may identify you, even by a court subpoena, in any federal, state, or local civil, criminal, administrative, legislative, or other proceedings. The researchers will use the Certificate to resist any demands for information that would identify you, except as explained below.

The Certificate cannot be used to resist a demand for information from personnel of the United States Government that is used for auditing or evaluation of federally funded projects or for information that must be disclosed in order to meet the requirements of the federal Food and Drug Administration (FDA).

You should understand that a Certificate of Confidentiality does not prevent you or a member of your family from voluntarily releasing information about yourself or your involvement in this research. If an insurer, employer, or other person obtains your written consent to receive research information, then the researchers may not use the Certificate to withhold that information.
The Certificate of Confidentiality does not prevent the researchers from disclosing voluntarily, without your consent, information that would identify you as a participant in the research project under certain circumstances. The investigative team will voluntarily comply with [Florida Statutes and federal regulations, which may mandate or permit certain disclosures of protected information by the investigative team to appropriate individuals.

[If this is a clinical trial add:] A description of this clinical trial will be available on www.ClinicalTrials.gov, as required by U.S. Law. This website will not include information that can identify you. At most, the website will include a summary of the results. You can search this website at any time.

**What if new information becomes available about the study?**

During the course of this study, we may find more information that could be important to you. This includes information that, once learned, might cause you to change your mind about being in this study. We will notify you as soon as possible if such information becomes available.

[Please include a statement regarding whether clinically relevant results, including individual research results, will be disclosed to participants, and if so under what conditions.]  

[If clinically relevant results will be returned, insert the following:] We may learn things about you from the study activities that could be important to your health or to your treatment. If this happens, this information will be provided to you. [Insert a description of the types of research results that may be returned, under what circumstances participants will be provided research results, and how participants will be notified.]  

The results will not be placed in your medical record. You may need to meet with professionals with expertise to help you learn more about your research results. The study team/study will not cover the costs of any follow-up consultations or actions.

[If clinically relevant results will not be returned, insert the following:] When [data/biospecimens/images] are collected and analyzed, there is the chance of finding something unexpected. The results from the [data/biospecimens/images] we collect in this research study may not be the same as what you would receive as a part of your regular health care. Because of this, you will not be informed of any unexpected findings. The results of your [data/biospecimens/images] will not be placed in your medical record. If you believe you are having symptoms that may require care, you should contact your primary care physician.

You can get the answers to your questions, concerns, or complaints.

If you have any questions, concerns or complaints about this study, call [name of principal investigator] at [telephone #]. If you have questions about your rights, complaints, or issues as a person taking part in this study, call the IRB at ( ) 656-5638 or contact by email at RSCH-IRB@edu. [Research conducted at Affiliates should insert Affiliate contact information here.]
Authorization to Use and Disclose Protected Health Information (HIPAA Language)

The federal privacy regulations of the Health Insurance Portability & Accountability Act (HIPAA) protect your identifiable health information. By signing this form, you are permitting the University of South Florida to use your health information for research purposes. You are also allowing us to share your health information with individuals or organizations other than USF who are also involved in the research and listed below. In addition, the following groups of people may also be able to see your health information and may use that information to conduct this research [delete bullets as applicable]:

- The medical staff that takes care of you and those who are part of this research study;
- Each research site for this study including [list all sites who will use and share PHI for this research study].
- Any laboratories, pharmacies, or others who are part of the approved plan for this study;
- All designated review committees such as [Add all that apply: Data and Safety Monitoring Board; VA Research Services; etc.];
- The Institutional Review Board (IRB) their related staff who have oversight responsibilities for this study, including staff in Research Integrity and Compliance and the Health Office of Clinical Research.
- Data Safety Monitoring Boards or others who monitor the data and safety of the study;
- There may be other people and/or organizations who may be given access to your personal health information, including [List any other persons, classes of persons, and/or organizations (including Hospital, Hospital for Children, etc.). Do not list persons who are likely to change over the course of the study, instead list them by title or category only.]

Anyone listed above may use consultants in this research study, and may share your information with them. If you have questions about who they are, you should ask the study team. Individuals who receive your health information for this research study may not be required by the HIPAA Privacy Rule to protect it and may share your information with others without your permission. They can only do so if permitted by law. If your information is shared, it may no longer be protected by the HIPAA Privacy Rule.

By signing this form, you are giving your permission to use and/or share your health information as described in this document. As part of this research, may collect, use, and share the following information [Modify to match what data will be collected and used in your study]:

- Your research record
• All of your past, current or future medical and other health records held by USF, other health care providers or any other site affiliated with this study as they relate to this research project. This may include, but is not limited to records related to HIV/AIDS, mental health, substance abuse, and/or genetic information.

• [List any other needed information not included above. The descriptions should have enough detail that one (or an organization that must disclose information pursuant to this authorization) can understand what information may be used or disclosed.]

You can refuse to sign this form. If you do not sign this form you will not be able to take part in this research study. However, your care outside of this study and benefits will not change. Your authorization to use your health information will not expire unless you revoke (withdraw) it in writing. You can revoke your authorization at any time by sending a letter clearly stating that you wish to withdraw your authorization to use your health information in the research. If you revoke your permission:

• You will no longer be a participant in this research study;
• We will stop collecting new information about you;
• We will use the information collected prior to the revocation of your authorization. This information may already have been used or shared with others, or we may need it to complete and protect the validity of the research; and
• Staff may need to follow-up with you if there is a medical reason to do so.

To revoke your authorization, please write to:
Principal Investigator
For IRB Study # [Insert your Pro IRB Study #]
[Insert complete business mailing address]

While we are conducting the research study, we cannot let you see or copy the research information we have about you. After the research is completed, you have a right to see the information about you, as allowed by USF policies.

Consent to Take Part in Research
[If applicable:] and Authorization for the Collection, Use and Disclosure of Health Information

I freely give my consent to take part in this study [If applicable: and authorize that my health information as agreed above, be collected/disclosed in this study]. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

_______________________________________________________________
Signature of Person Taking Part in Study

[If applicable: ]Authorization

Date
Statement of Person Obtaining Informed Consent and Research Authorization

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research participant speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research participant has provided legally effective informed consent.

______________________________
Signature of Person Obtaining Informed Consent

______________________________
Date

______________________________
Printed Name of Person Obtaining Informed Consent
Appendix E

IRB Consent Form

Informed Consent to Participate in Research Involving Minimal Risk

Pro # 00032952

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher to discuss this consent form with you, please ask her to explain any words or information you do not clearly understand. We encourage you to talk with your family and friends before you decide to take part in this research study. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

We are asking you to take part in a research study called: *Illuminating Changes in Preservice Teachers’ Perceptions about Teaching Elementary Mathematics in an Introductory Methods Course*

The person who is in charge of this research study is **Elaine Cerrato**, also known as the Principal Investigator. She is being guided in this research by Dr. Eugenia Vomvoridi-Ivanovic. Elaine Cerrato can be contacted at (727) 418-3789 or cerrato@usf.edu.

**Purpose of the study**

The purpose of this study is to:
- allow preservice teachers to reflect on their K-12 mathematics experiences
- describe and explain the perceptions of preservice teachers about their abilities to teach mathematics to elementary students
- allow preservice teachers to explore their own perspectives on reform-based mathematics as both theory and pedagogy in the elementary classroom
- familiarize others with challenges and rewards present in the classroom as related to participating in a mathematics methods course

**Study Procedures**

If you take part in this study, you will be asked to:
Participate in approximately four asynchronous email correspondences. The first email communication will occur during Spring 2018 (May) and continue through the early part of Summer 2018 (May/June). Research questions may include questions about personal history,
mathematics experiences, educational experiences, mathematics pedagogy, beliefs about mathematics teaching, feelings and attitudes about the mathematics curriculum, and feelings and attitudes about teaching ability.

The email communication will be stored on Elaine Cerrato’s password protected computer. The participants and principle investigator will be the only ones with access to the email files. The email communication will remain in Elaine Cerrato’s possession and will be destroyed five years after the close of the dissertation study.

**Total Number of Participants**
Three individuals will take part in this study.

**Alternatives**
You are not obligated to participate in this research study and may cease participation at any time throughout the study.

**Benefits**
We are unsure if you will receive any benefits by taking part in this research study. A potential benefit of participating in the study could be an increased understanding of dynamics surrounding teaching mathematics in the elementary classroom which could lead to further informing your personal understanding and practice of this theory and pedagogy.

**Risks or Discomfort**
This research is considered to be minimal risk. In other words, the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study and I do not anticipate participants will experience psychological distress and/or discomfort during the interviews.

**Compensation**
You will be paid $30.00 in the form of a gift certificate if you complete the face-to-face interview and all requested email correspondence.

**Cost**
There will be no additional costs to you as a result of being in this study.

**Privacy and Confidentiality**
We will keep your study records private and confidential. Certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are: The research team, including the Principal Investigator and other research staff. For example, individuals who
provide oversight on this study such as the Department of Health and Human Services (DHHS), the Office for Human Research Protection (OHRP) and the USF Institutional Review Board may need to look at your records. This is done to make sure that we are conducting the study in the appropriate manner. They also need to ensure protection of your rights and safety.

We may publish what we learn from this study. If we do, we will not include your name, or anything else that would let people know who you are.

**Voluntary Participation / Withdrawal**

You should only take part in this study if you want to volunteer. You should not feel there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study.

If you have questions about your rights as a participant in this study, general questions, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638.

**Consent to Take Part in this Research Study**

It is up to you to decide whether you want to take part in this study. If you want to take part, please sign the form, if the following statements are true.

I freely give my consent to take part in this study and authorize that my information as agreed above can be collected/disclosed in this study. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

______________________________________________  ______________________
Signature of Person Taking Part in Study                      Date

______________________________________________
Printed Name of Person Taking Part in Study

**Statement of Person Obtaining Informed Consent**

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I hereby certify that when this person signs this form, to the best of my knowledge, he/ she understands:

- what the study is about;
- what the potential benefits might be; and
- what the known risks might be.
I can confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in the appropriate language. Additionally, this subject reads well enough to understand this document or, if not, this person is able to hear and understand when the form is read to him or her. This subject does not have a medical/psychological problem that would compromise comprehension and therefore makes it hard to understand what is being explained and can, therefore, give legally effective informed consent. This subject is not under any type of anesthesia or analgesic that may cloud their judgment or make it hard to understand what is being explained and, therefore, can be considered competent to give informed consent.

__________________________________________________________
Signature of Person Obtaining Informed Consent / Research Authorization

_______________________________________________________________
Date

__________________________________________________________
Printed Name of Person Obtaining Informed Consent / Research Authorization
Appendix F

Questions/Prompts for Participants

Questions/Prompts for Participants – RQ #1

1) What type of Elementary, Middle, and High Schools did you attend? (e.g., public, private, charter, etc.)
2) What do you remember about learning mathematics as a K-12 student? Please be as specific as possible. No response is too long.
3) What did you like (if anything) about mathematics as a K-12 student? (e.g., Was it interesting? Did it apply to life outside of class? Did you learn math easily?)
4) What did you dislike (if anything) about mathematics as a K-12 student? (e.g., Did you dread going to math class? Did it make you anxious? Were you confused when learning math?)
5) Were there any occasions you remember that you think led to your positive or negative perceptions about mathematics?
6) Please describe a typical day in math class during each level (elementary, middle, high).
7) Do you think your former teachers influenced the way you feel about math today? Why or why not?
8) Please share any other information you would like me to know about your K-12 mathematics experiences.

Questions/Prompts for Participants – RQ #2

1) Before you entered MAE 4310 – Teaching Elementary School (K-6) Mathematics Methods I, how did you perceive yourself as a mathematics teacher?
2) What were you most interested in learning when you began the course?
3) What were you most excited about when you entered the course?
4) What was your greatest fear when you began the course and your internship?
5) What was your greatest expectation from the course before you began?
6) What grade level would you prefer to teach and why?
7) Do you think your past experiences learning math as a student had any influence on your response to any of the above questions? Please identify which question and respond to as many as you can.
8) Please share any other information you would like me to know about your thoughts, feeling, perceptions, etc. prior to beginning the course.
Questions/Prompts for Participants – RQ #3

1) After having participated in MAE 4310 – Teaching Elementary School (K-6) Mathematics Methods I, how do you perceive yourself as a mathematics teacher?
2) What was the most interesting thing you learned from participating in the course and from your internship?
3) What was the most exciting experience you had during the course and your internship?
4) What is your greatest fear now after participating in the course and your internship?
5) Do you believe your expectations for the course and the internship were met? Why or why not? Please be as specific as possible and remember that your responses will be kept confidential.
6) Have your changed your mind about the grade level would you prefer to teach? Why or why not?
7) Do you think your experiences in the course and your internship have better prepared you to teach mathematics? Why or why not? Please be as specific as possible and remember that your responses will be kept confidential.
8) Please share any other information you would like me to know about your thoughts, feeling, perceptions, etc. after participating in the course and your internship.

Questions/Prompts for Participants – RQ #4

1) What specific events or influences, relative to your experiences in the math methods course and your internship, do you consider significant in the development of your beliefs and pedagogy about teaching math to elementary students?
2) Please take some time to reflect on your responses from all the questions and share how your experiences during the past semester have changed your attitude toward teaching math.
3) Please share any other information you would like me to know about you as a math teacher.
Appendix G

Email Communication Sample of Thank You for Participating

Dear Participant:

Re: Preservice Teachers’ Perceptions about Teaching Elementary Mathematics Research Study

Thank you for volunteering to participate in my study. I appreciate and value your time and consideration. I have attached a set of questions that will guide our interview for you to look over. I would like to set up a time for us to meet as soon as our schedules allow, possibly by next week. Please let me know your availability for our face-to-face interview. The interview will take approximately 90-minutes.

If you have any questions, please email cerrato@usf.edu or call 727-418-3789.

Thank you for your time and assistance with the completion of my research.

Kindest regards,

Elaine Cerrato
Appendix H

Member Check Email - Transcripts

Date

Dear Amanda:

Thank you so much for taking the time to interview with me regarding your experiences as a mathematics learner and preservice teacher in the elementary education program.

Attached please find the transcript of our conversation for your review. Please check the transcript for accuracy to ensure your responses are being reported correctly. Please send any changes or comments to me within 5 business days. If I do not hear from you during that time, I will assume you agree that the document accurately indicates your responses during our interview session.

Feel free to contact me at 727-418-3789 or via email at cerrato@usf.edu if you should have any questions.

Thank you again for sharing your insight and experience. You have been a valuable part of my research study.

Sincerely,

Elaine Cerrato
Appendix I

Member Check Email - Interpretations

Date

Dear Amanda:

Thank you so much for taking the time to review the interview transcripts and for sharing your experiences as a mathematics learner and preservice teacher in the elementary education program.

Attached please find drafts of my findings and interpretations of the information you communicated with me for your review. Please check both documents for accuracy to ensure your responses are being reported correctly. Please send any changes or comments to me within 5 business days. If I do not hear from you during that time, I will assume you agree that the documents accurately indicate my interpretations of your thoughts and beliefs.

Feel free to contact me at 727-418-3789 or via email at cerrato@usf.edu if you should have any questions.

Thank you again for sharing your insight and experience. You have been a valuable part of my research study.

Sincerely,

Elaine Cerrato
Appendix J

Completion and Thank You Email

Dear Participant:

Re: Preservice Teachers’ Perceptions about Teaching Elementary Mathematics Research Study

Thank you for your continued participation in my research study. I appreciate and value your time and consideration. Thanks to your participation I have completed this part of my research.

If you have any questions, please email cerrato@usf.edu or call 727-418-3789.

Thank you for your time and assistance with the completion of my research.

Kindest regards,

Elaine Cerrato
Appendix K

CITI/IRB Certification

This is to certify that:

Elaine Cerrato

Has completed the following CITI Program course:

Human Research (Curriculum Group)
Social / Behavioral Investigators and Key Personnel (Course Learner Group)
2 - Refresher Course (Stage)

Under requirements set by:

University

Verify at www.citiprogram.org/verify/?wfc39fc3c-0e54-4af6-aa61-2b900e877b64-17868984