# EFFICACY AND UTILITY BELIEFS OF MOTHERS AND CHILDREN AS PREDICTORS OF MATHEMATICS ACHIEVEMENT FOR AMERICAN INDIAN STUDENTS

By

CYNTHIA C. ORONA

Bachelor of Science
University of Tulsa
Tulsa, OK
1998

Master of Science
East Central University
Ada, OK
2007

Submitted to the Faculty of the
Graduate College of
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
July, 2013

EFFICACY AND UTILITY BELIEFS OF MOTHERS

AND CHILDREN AS PREDICTORS OF

MATHEMATICS ACHIEVEMENT FOR

AMERICAN INDIAN STUDENTS

Dissertation Approved:

Dr. Julie Thomas

Dissertation Adviser

Dr. Adrienne Redmond-Sanogo

Dr. Diane Montgomery

Dr. Karen High

# ACKNOWLEDGEMENTS

The completion of my doctoral degree could not have been a success without the help of others beginning with God. When I began this mission, I did not know how or if I would make it to the end, and now I look back amazed at all the barriers I have overcome thanks to His help. The right people were placed in my path at the right moments to help get over those road humps of life. Thank you to the Mississippi Band of Choctaw Indians--Scholarship Office for their financial support over the course of my education.

I would like to thank my committee. I will begin by saying thank you to my chair, Dr. Julie Thomas. Thank you for being a positive role model with high expectations. I appreciate and recognize all the time, hard work, and faith you have in me. Words alone cannot express the overwhelming gratitude I have towards you. I must say that you have helped transform me into the person that I am today, both personally and professionally. In addition, thank you to Dr. Diane Montgomery for all your guidance and focus on this dissertation. Your help in moving forward is forever appreciated. Thank you to Dr. Adrienne Redmond-Sanogo for your guidance and support. Last, but not least, I would like to thank Dr. Karen High for her support and interest in my study.

In addition, I would like to thank a few other people who were instrumental in my success. Thank you to Dr. Patricia Jordan for the unconditional moral support and




Acknowledgements reflect the views of the author and are not endorsed by committee members or Oklahoma State University.

encouragement. Thank you for all you have taught me, but most importantly, thank you for being there when I needed to talk. Thank you for constantly reminding me, "It will be okay." I want to thank my family and friends who were supportive throughout this journey. I will begin by saying "thank you" to my children, Benjamin and Amelia, for their unconditional support. You two have endured a great sacrifice to see me achieve my dream. One day, it will be your turn to achieve great things! Thank you to my mom who continually encouraged me to move forward with my dreams. Finally, thank you to all my friends who provided words of encouragement along the way. Yakoki!



Acknowledgements reflect the views of the author and are not endorsed by committee members or Oklahoma State University.

Name: Cynthia C. Orona

Date of Degree: July, 2013

Title of Study: EFFICACY AND UTILITY BELIEFS OF MOTHERS AND CHILDREN AS PREDICTORS OF MATHEMATICS ACHIEVEMENT FOR AMERICAN INDIAN STUDENTS

Major Field: Professional Education Studies

Abstract: American Indians have the largest high school dropout rates of all ethnic groups in the United States. Though drop outs technically occur in high school, they actually begin with lowered academic achievement during elementary school years. Looking to mothers as the primary caretakers, this study sought to explore the correlations between American Indian mothers' and their 5th grade children's mathematics efficacy beliefs and utility values – to see if these beliefs and values could predict children's mathematics achievement. Particularly when it comes to mathematics, American Indian mothers are dually challenged to encourage their children's success in school because of (1) generalized school disconnect due to negative boarding school experiences and (2) limited understanding about how to assist children's success in mathematics as it is currently being taught. School mathematics lessons are different from those lessons mothers experienced when they were in school. New Common Core State Standards for Mathematics may contribute to mothers' disconnect. The purpose of this explanatory correlational research study was to determine the extent to which the relationship between American Indian students' and mothers' mathematical efficacy beliefs and utility values for mathematics influence student's mathematical achievement. This study, component to a larger National Science Foundation (NSF) project study (Award No. HRD-0936672), utilized data from 148 mother-child dyads. Participant children attended one of 23 rural, public schools in northeastern Oklahoma that included high American Indian student populations. The data included participants' responses to the Fennema-Sherman Mathematical Attitudes Survey (FSMAS) and children's mathematics achievement results from the Oklahoma Core Curriculum Test. Study results indicated that, although mothers mathematical efficacy belief and utility value for mathematics influenced their children's mathematical efficacy belief and utility value for mathematics, only a mother's utility value for mathematics significantly predicted children's mathematical achievement. In addition, children's own mathematical efficacy belief and utility value for mathematics was not predictive of their mathematical achievement. This research improves our understanding of the influence of parents, particularly mothers of American Indian children and can help guide supportive parent involvement in mathematics education efforts. Implications of this research relate to both theory and practice.

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## INTRODUCTION

High school graduation rates of American Indian students range from 30.4% to 63.8% across the twelve United States most populated by American Indians (Faircloth & Tippeconnic, 2010). Organizing 2005 data from the National Center for Education Statistics, Faircloth and Tippeconnic (2010) intended to illustrate the alarming rate of American Indian dropouts across the United States of America. This dropout rate is historic rather than a new phenomenon (Butterfield & Pepper, 1992; Hillabrant, Romano, Stang & Charleston, 1992; Klug & Whitfield, 2003; Tonemah, 1992).

American Indian high school dropout rates can be tracked to truancy and low-achievement in lower grades, but alienation from school may actually begin at home. American Indian parents and grandparents carry memories of boarding schools (Coleman, 2007), punishment for using Native languages (Coleman, 2007; Simonsen, 2006; Skinner, 1992), or low expectations for success by teachers (Butterfield, 1994; Dingman, Mroczka, & Brady, 1995; Klug & Whitfield, 2003; Nelson-Barber & Estrin, 1995). Though American Indian students are no longer confined to government-controlled boarding schools or reservation schools (Hillabrant et al., 1992), experiences of the American Indian children in early history continue to affect how American Indian people view education and its lack of importance, thus resulting in American Indians having the highest dropout rate of all ethnic groups (Butterfield & Pepper, 1992; Hillabrant et al., 1992; Klug & Whitfield, 2003; Tonemah, 1992). As it happens, American Indian parents are survivors of the boarding school experiences which impacted their views of education. As the primary caretaker, mothers particularly influence their children's many aspects of life including education. Unfortunately, negative views of education can be transferred from parent to child, and then reinforced in the classroom setting (Preston, 1992). As Sanders (1987) noted, the conflicting cultural values of American Indians and White culture in the classroom contribute to lower academic achievement by the negative image American Indian children have of their ability.

Although American Indian students represent a small portion of the public school population (and federal money is allocated to their education), instructional methods continue to isolate American Indian students (Hillabrant et al., 1992; Preston, 1992). Some suggest American Indian students are challenged to connect classroom learning with their everyday life experiences (Pewewardy, 2002). Others suggest American Indian students excel when they are encouraged to utilize their visual and spatial abilities (Pewewardy, 2002; Preston, 1992). Regardless, school curricula and pedagogy are much different from those parents or grandparents experienced as children (McLeod, 1999; Remillard & Jackson, 2006). Remillard and Jackson (2006) suggested these differences are especially true in mathematics. Today's parents and grandparents remember procedural mathematics curricula in which they were taught isolated skills and then practiced them until they reached mastery of each skill. In this, parents remember learning or memorizing mathematical facts and repeated practice with flashcards.

Today's mathematics classrooms focus more on standards-based, conceptual learning rather than the procedural learning familiar to parents and grandparents (Forgasz & Leder, 1996; Saracho & Spodek, 2009). A standards-based mathematics curriculum is both aligned to the National Council of Teachers of Mathematics content standards and the pedagogical approaches which the standards advocate (Riordan & Noyce, 2001). Thus, new, standards-based mathematics reform will likely help American Indian students apply natural learning styles to the concepts they are learning in school and thereby improve academic success.

This chapter reviews current research literature related to American Indian students' achievement in mathematics and identifies the specific niche of this dissertation research. Further this chapter introduces the theoretical framework undergirding the study, a research purpose statement, the research questions, and the research design as well as the expected significance, assumptions, limitations, and ethical concerns related to the study. Finally, this chapter provides definitions of important terms.

## Background to the Research Problem

Children are influenced by several sociocultural factors that affect their view of school mathematics and therefore their achievement in mathematics. Sociocultural factors like gender, race/ethnicity, income level, and parents are not variables that can be changed by educators. However, a better understanding of the influence of parents, particularly mothers of American Indian children, may be essential to support parent involvement in mathematics education efforts. Pewewardy (2002) reported, American

Indian children's lower achievement in mathematics may stem from the fact that school-math is not like the mathematics that they are learning at home.

**Changing Mathematics Curricula**

The standards-based mathematics reform has changed the way mathematics is viewed and handled in today's classroom. Mathematics affects both the students and the parents. Unfortunately, today's parents and students have differing views of how to do mathematics (Remillard & Jackson, 2006). These differing views of mathematics have been forthcoming for several years with the New Math era and the National Council of Teachers of Mathematics' (NCTM) initial draft of mathematics standards. The workings of this era are becoming more of a reality with the recently passed Common Core State Standards for Mathematics (CCSS-M), a national movement to create a common set of guidelines or standards for mathematics curricula across the United States.

In the early elementary grades, at the surface, mathematics lessons are viewed as easy. For example, Wu (2009) noted that asking children to add seems like an easy concept, yet in reality, the teacher is not only teaching the concept of addition, the teacher is teaching underlying concepts in place value as well. Although, addition is easier to teach since children come to school with an inquisitive mind and developed understanding of number and size concepts (CBMS, 2001), it is not a simple concept that early elementary grade students are ready to comprehend (Wu, 2009). The NCTM (2000) standards publication explained how mathematics in the early grades lays a foundation for the later, more difficult content of mathematics. During the early formative years, students are engaged and families are encouraging. As time goes on, families become discouraged as mathematics lessons become harder (due to their reliance upon foundational skills) and thus begin to provide less encouragement (Remillard & Jackson, 2006).

In the 1960's mathematics education underwent changes that morphed into mathematics standards publications by the National Council of Teachers of Mathematics (NCTM) in 1989 and 2000. This recent standards-based curriculum reform superseded the New Mathematics reform that attempted to change the way classrooms were arranged and how teachers taught. Based upon the National Advisory Committee on Mathematical Education's (NACOME) recommendations in 1975, the mathematics classroom should be based on the discovery learning model and focus on problem solving (Schoenfeld, 2004). In the 1980's, funding and publication of the report *A Nation at Risk* provided a new perspective on the then current state of mathematics. Shortly after this influential report was released, NCTM published their initial attempt at a set of national mathematics standards. NCTM (2000) took this idea further and worked to provide standards that would help improve mathematics education in the American educational system. Some changes focused on the actual teaching and some focused on the classroom atmosphere. From this time, mathematics curricula no longer focused on the basic number system; students began working with the number system in the form of different operations, primarily multiplication and division. In addition, students began to work with abstract concepts (like expressions and equations), which are distinctly different from those lessons experienced by the parents of today's students (Remillard & Jackson, 2006).

Remillard and Jackson (2006) found that, while today's parents want to help their children, they are unaware of how to help (beyond monitoring children's homework). Parents remember doing mathematics according to rules and a set of procedures; their children, however, are not required to follow a given set of rules. In fact, when multiple concepts are introduced simultaneously, parents are confused by the missing skills-practices that were once required. The difference in teaching is based on the move from procedural knowledge (old way) to blending conceptual and procedural knowledge (new way). Conceptual knowledge and procedural knowledge differ in that conceptual knowledge is knowledge about the structure of mathematics, whereas procedural knowledge is about the symbolic representations and the rules and algorithms associated with doing mathematics. Using basic facts as an example, procedural knowledge can be thought of as the rote memorization of facts to complete drill and skill activities; conceptual knowledge is the ability to understand why the rules work. In order for students to be mathematically proficient, an understanding of five interdependent strands (conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition) is necessary (NRC, 2001).

The mathematics curriculum of yesterday lacked connection to real-world contexts (Forgasz & Leder, 1996). For parents, guided understanding of mathematics was a stand-alone subject -- not the reformed subject in which today's students are learning (Remillard & Jackson, 2006). Yet, many aspects of real-life include mathematics to some degree. Therefore, mathematics is a part of students' lives, but they do not know how to apply the "naked" mathematics they are learning with the mathematics they face in their daily lives. According to Remillard and Jackson (2006), parents want their children to see the connections between school mathematics and real-world mathematics to the point where parents attempt to create real-world examples for the children with the mathematics that the parents do understand. Although parents are unsure of the methods through which students are learning because they grew up in a different era of mathematical instruction, they know the importance of making connections. Certainly, parents' interest in helping bridge the connection between mathematics and student's lives might help students understand mathematics in more of a real-world context. In addition, by helping children form positive views about their ability to do mathematics, parents can help children be more successful in mathematics (Fennema, 1996; Forgasz & Leder, 1996; Jayaratne, 1983).

The National Science Foundation (NSF) supports mathematics education in its mission to promote the progress of science (NSF, 1995). NSF promotes educational opportunities that encourage broad participation of underrepresented populations. The Science and Engineering Equal Opportunities Act of 1980 ". . . gave NSF standing authority to support activities to improve the participation of women and minorities in science and engineering" (NSF, 1995, para. 3). American Indians have extensive knowledge of mathematics and science rooted in their naturalistic traditions; yet do not typically complete science and mathematics courses (Nelson-Barber & Estrin, 1995). NSF can further its goal of women and minority participation in science, technology, engineering, and mathematics (STEM) career fields if curricula would utilize this knowledge that American Indian students bring to the classroom and females' innate desire to persist in order to be successful (Yee & Eccles, 1988). As Nelson-Barber and Estrin (1995) stated: "[American] Indian students may feel both confused by classroom approaches to mathematics and science that are not grounded in experience, and denigrated by a system that appears to assume they know nothing about these realms" (p. 174).

**American Indian Children**

American Indian children are a unique population in that they suffer lower academic achievement than any other ethnic group (Bradley, 1984). Parents' and grandparents' own early experiences in education (having been forced to go to boarding schools) engenders a negative view of education from the beginning for American Indian children (Butterfield & Pepper, 1992; Tonemah, 1992). Parents and grandparents tell stories of their experiences in the boarding schools, though they do not have a negative feel towards the experience as they look back (Simonsen, 2006). In order for American Indian students to move beyond these negative stories, American Indian parents need to positively promote schools as a place for educating their children (Coleman, 2007). Unfortunately, parents do not feel competent in helping their children obtain an education (Coleman, 2007). In the case of mathematics, more specifically, when children ask for homework help, their parents are dually challenged by their negative stories in regards to education and their unfamiliarity with the way mathematics is currently being taught (Butterfield & Pepper; 1992; Remillard & Jackson, 2006; Schoenfeld, 2004; Tonemah, 1992).

Within the American Indian culture, students are unable to connect with mathematics as it is taught in the classroom, because they are unable to connect school mathematics to their own cultural backgrounds, much less to the real world (Nelson-

Barber & Estrin, 1995). Nelson-Barber and Estrin (1995) found that American Indian students have a naturalistic way of understanding mathematics and science. Although this naturalistic view is a benefit to students, teachers are unaware thus unable to capitalize on American Indian students' mathematical and scientific experiences outside of the classroom. Teaching in this way may be preventing opportunities for American Indian students to demonstrate their understanding of mathematics.

**Influential Parents, Mothers**

Children's success in mathematics is reliant upon their ability to view it as useful (Hulleman, Godes, Hendricks, & Harackiewicz, 2010) and as something that they can accomplish (Bleeker & Jacobs, 2004). Parents are an important influence children bring to the educational system (Herrera & Owens, 2001; Jayaratne, 1983; Parsons, Adler, & Kaczala, 1982). Parents with a negative view towards their own mathematical ability and its usefulness embed that same viewpoint into their children's thinking, thus creating a cyclical pattern of dislike for mathematics (Parsons et al, 1982).

According to Parsons, Adler, and Kaczala (1982), the negative view parents' transfer to their children is not dependent on the child's mathematical performance but rather the parents' own experience with mathematics. Though parents were inevitably influential, they did not negatively influence children (Jayaratne, 1983). Parents' dislike of mathematics, however, can lead to limited opportunities for students to excel in mathematics (Matthews, 1984; Rule & Harrell, 2006). Importantly, a mother's view of her own mathematical ability and its usefulness is transferred to her children, especially when mothers are unaware of media influences that encourage negative views of mathematics (Eccles & Jacobs, 1986; Jacobs & Eccles, 1985).

Mothers are particularly influential when it comes to their children's view toward school subjects like mathematics. Mothers are typically the ones to oversee homework completion, thus being a role model for children (Parsons et al., 1982). Mothers may be unwittingly influenced toward stereotypical views of mathematics by the public media (Eccles & Jacobs, 1986; Jacobs & Eccles, 1985). These influences may negatively impact mother's views of their own children's ability to be successful in mathematics.

## Statement of the Research Problem

It has been established that both children's belief about their ability in mathematics and the utility value for mathematics influence achievement (Eccles & Jacobs, 1986). Yet, the connection of efficacy and utility to achievement in mathematics has not been adequately studied for American Indian children, particularly at the fifth grade when these beliefs may be forming into controlling systems. As well, it has been established that American Indian mothers play an important role in the achievement of their children (Houssain & Anziano, 2008). More research is needed to understand (a) the direct influences of beliefs about mathematics efficacy and utility related to mathematical achievement for American Indian children and (b) the indirect influences mother's beliefs about mathematics efficacy and utility related to children's mathematical achievement.

## Theoretical Framework

This study utilized Bandura's social cognitive theory. Social learning theory states that learning occurs by observation; Bandura extended the understanding of social learning theory to include the cognitive aspect of self-efficacy (Pajares, 2002). Self-efficacy is a person's belief in their ability to succeed at tasks (Bandura, 1977). Based on Bandura's definition of self-efficacy applied to mathematics students, who believe they can do well in mathematics, will be successful in completing mathematical tasks. In Bandura's work on self-efficacy theory, he explained that the amount of self-efficacy a person has towards a subject is based upon four sources of information (Bandura, 1977). The four aspects are: performance accomplishments (personal mastery experiences), vicarious experience (success or failure based upon the experiences of others in a similar scenario), verbal persuasion (leading oneself to success even with past failures), and physiological states (emotional arousal). These aspects are not isolated, but intertwined to create self-efficacy beliefs.

## Purpose Statement

The purpose of this study was to determine the extent to which the relationship between students' and mothers' mathematical efficacy beliefs and utility values for mathematics influence student achievement. In particular, this study looked at the following paths: mother's utility value for mathematics on children's achievement by their influence on children's utility value for mathematics; mother's mathematical efficacy belief on children's achievement by their influence on children's mathematical efficacy belief; children's utility value for mathematics on their achievement; and children's mathematical efficacy beliefs on their achievement.

## Research Questions

This study addressed the following questions:

1. How does mothers' mathematical efficacy belief and utility value for mathematics influence mathematics achievement for children, both directly and indirectly?
2. How does mothers' mathematical efficacy belief influence children's mathematical efficacy belief?
3. How does mothers' utility value for mathematics influence children's utility value for mathematics?
4. How do children's mathematical efficacy belief and utility value for mathematics influence their mathematics achievement?

## Research Design

This research followed an explanatory correlational research design in the form of a path analysis model. As Creswell (2008) explained, the purpose of a correlational research design is not to manipulate any variables but to make predictions and even explain the relationships that exist amongst variables. The purpose of this study was to identify direct and indirect influences of mothers' beliefs about mathematical efficacy and mathematical utility on children's mathematical achievement, as well as the influence that children's beliefs about mathematical efficacy and mathematical utility on mathematics achievement.

Explanatory design procedures allowed the researcher to determine correlations between variables and to interpret the statistical results. Explanatory design does not imply a cause-and-effect relationship; rather, this design establishes indication of the ways in which two variables are associated with one another. This degree of association can suggest causal inference, but such interpretation would be an inaccurate expectation of explanatory design. In the case of this study, path analysis was the best model for exploring the research questions.

Path analysis is a flexible form of analysis that is appropriate to use when dealing with achievement (Suhr, 2008). Path analysis utilizes both exogenous and endogenous variables in its analysis. Exogenous variables are variables that are outside of the model and have both a direct and indirect influence on the dependent variable. Endogenous variables are variables within the model, including the dependent variable. In order to look at the direct and indirect effects of the independent variables on mathematical achievement, paths were created from mothers and children's views of mathematical efficacy and mathematical utility to the dependent variable of criterion referenced test scores. In this study, mothers' mathematical efficacy belief and utility value for mathematics were the exogenous variables. The endogenous variables included children's mathematical efficacy belief and utility value for mathematics, as well as mathematical achievement.

A convenient sample of intact classrooms was utilized to define the participants for this study. The children attended one of 23 public schools in northeastern Oklahoma.

The schools were primarily rural and had a high American Indian student population. All parents consented and students assented to participation. Parents and children alike were surveyed about their mathematical efficacy and mathematical utility beliefs. These survey results were utilized to determine any relationships between the beliefs of mothers and their fifth grade children. In addition, mathematical achievement in the form of criterion referenced test scores was utilized to see the influence that mothers' and children's perceptions of mathematical efficacy and mathematical utility had on children's mathematics achievement.

## Significance

This study intended to bring new understanding about how mothers influence fifth grade American Indian children's mathematical beliefs, attitudes, and achievement. Since the targeted population was fifth grade students, the study can help manage interventions before students reach middle school. This research provided information about American Indian elementary students' success in mathematics. The results provided useful information that can be reported to tribal education departments to help increase student success. Tribal education departments and school curricula leaders are the intended audience since they can modify underlying messages that are inevitably portrayed to students.

Research results may direct ways in which American Indian students' mathematics efficacy can be increased. School districts and tribal education departments might focus new effort to help parents become more efficacious in their beliefs towards mathematics. With students becoming more efficacious and viewing mathematics as useful, American Indian student success in mathematics can become the new norm in the public school system. American Indian students can create their own success and interest in mathematics, thus leading to increased interest in mathematics related careers and other mathematically related subjects like the sciences.

## Assumptions

This research assumed that teachers are not the only source of influence in the lives of students. In fact, parents have a great influence on their elementary students' lives. Students spend a large portion of their time outside of the classroom (Jacobs & Eccles, 1985; Jayaratne, 1983; Parsons et al, 1982; Remillard & Jackson, 2006).

In Oklahoma, mathematics is one of four required subjects tested at the fifth grade. Emphasis is placed on all subjects, in order for students to be able to pass the state criterion referenced test; yet, students' experiences in the classroom are not the only influential experiences. Students begin to experience mathematics at home before ever stepping foot into the classroom. Due to children's natural curiosity about number and size they are exposed to shapes and single-digit numbers prior to entering a classroom (CBMS, 2001).

Parents were taught differently and do not feel confident in helping their children with this new method of teaching mathematics. In some cases, parents are unfamiliar with how to find the answer to a problem conceptually, so they resort to utilizing the standard algorithm which contradicts what the student is learning in school.

Mathematics is a part of real-life; yet, it is often viewed as a dreaded part of real-life because it is difficult (Yee & Eccles, 1988). Parents' negative view of mathematics inadvertently passes on to their children (Jayaratne, 1983). This negative viewing of mathematics may be detrimental to students in terms of higher mathematics and possible future careers. Thus, if parents inadvertently taint their children's view of mathematics, the parents are limiting their child's future possibilities of positive interactions with mathematics at school and in their real-lives.

## Limitations

This research study included a few limitations. One of the limitations is that the sample was not randomized. According to Creswell (2008, 2009), in a randomized sample, one in which the biases in the population at large are distributed equally amongst the sample of participants, each participant in the study has an equal opportunity of being selected for participation, thus creating a representative population sample. Such a representative sampling of the population would allow for results from the sample to be generalized to the population at large. According to Keppel and Wickens (2004), random samples are ideal, but they are difficult to obtain, thus samples of convenience are much more common in educational research.

This study was limited by a convenient sample or an intact population (Keppel & Wickens, 2004). Parent and student participants were picked from targeted research schools thus limiting the researcher's ability to generalize the study results to other populations. A randomized sample would have been more conducive to such generalization.

In another limitation, this study focused on participants in rural, northeastern Oklahoma. Although these schools had high American Indian populations, they were not located on reservations and were not specific to a single tribe. Each school met the two criteria required for the research (being a rural school and having a high American Indian population), but the sample of schools varied in size and location. Some schools were more remote than others. Some were large consolidated school districts and others were small. This variety in schools limits the researcher's ability to generalize the results of this study to other schools, like urban or suburban schools; in addition, the results cannot be generalized to other populations of American Indians in other states.

This study was also limited by the dated literature. Studies about American Indians are primarily reservation studies, which have a different dynamic that the public school setting. In addition, the literature is not heavily focused on mathematics at the elementary level. In terms of this dissertation, locating relevant reference material was difficult. This could be due to the diversity that exists within the American Indian population, but also due to a lack of published research utilizing the American Indian population. Mathematics studies typically have extremely low American Indian populations resulting in few if any recommendations for American Indians in regards to the findings that apply to the population as a whole. This lack of relevant literature in regards to American Indians indicates that further work must be done with American Indians, primarily in public elementary school settings.

## Ethical Concerns

All research studies have ethical concerns that need to be addressed and acknowledged by the researcher. For this study there were three ethical concerns of interest. The first ethical concern was the utilization of children as participants. As such, we took care to secure parents' permission and not to coerce children's participation. We helped children understand that one of the potential benefits of this study would be to improve the teaching and learning of mathematics, but we took care not to exploit these minors. Secondly, we exerted specific caution and effort not to inadvertently reveal the identity of the school. A third ethical concern involved the use of appropriate language with the children. In this, we took care not to sway children's responses via language or intonation.

## Definition of Terms

This study referenced a few key terms which need to be identified initially. Important terms include the following: academic achievement, mathematical utility, mathematical efficacy, and American Indian.

For purposes of this study, mathematical *academic achievement* was defined by the raw scores on state-mandated, criterion referenced tests. The state of Oklahoma regulates when public school students will take a criterion referenced test over the Oklahoma Priority Academic Student Skills (Oklahoma State Department of Education, n. d.). In the case of mathematics, beginning in third grade, students are tested yearly. Once students move to the ninth grade, they take more subject specific tests. This criterion referenced test allows for reliable results between Oklahoma schools.

*Mathematical efficacy belief* can be defined by utilizing Bandura's (1977) definition of efficacy as a person's beliefs about their ability to successfully perform specific tasks. People have efficacious beliefs in many regards, and mathematics is a specific context in which efficacy is an important attribute of successful students. In the context of mathematics, if students believe that they are capable of doing mathematics, then they are more likely to be successful in mathematics. In addition, if mothers believe that their children can do mathematics, they provide a more positive outlook towards the subject of mathematics (Jacobs & Eccles, 1985; Jayaratne, 1983) hence their children feel more efficacious and tend to be more successful in mathematics. As students learn mathematics and become efficacious in it as a subject, the more likely they are to view themselves as being able to do mathematics.

*Utility value for mathematics* can be defined as the usefulness of mathematics (Jacobs & Eccles, 1985). The usefulness of mathematics exposes itself through real-life contexts. When teachers teach mathematics as an individual subject, with no connections to real-world situations, students have difficulty bridging the gap between the mathematics they study in school and the mathematics in their everyday surroundings. While mathematics is typically taught with the idea that students need to master concepts, mastery typically comes in the form of short-term mastery. When examples of applied mathematics are limited to counting money or making measurements, students are not able to connect the mathematics they are doing in school to their personal lives -- and do not view mathematics as being an essential subject.

The term *American Indian* was used within this study as opposed to the term Native American. The term Native American can be viewed as a person that was born in America, which is not the population of interest (Garrett & Pichette, 2000). Instead, Garrett and Pichette (2000) noted that the United States government defines Native American as people who are enrolled or registered members of a tribal nation with some stipulation that the person be at least one-fourth or more; yet they note that community identification of a person as Indian is the important factor for American Indians. If American Indians view each other as American Indian, then blood quantum is no longer the identifying factor, as noted by Oswalt (2009). In order to remain true to how the American Indians view themselves, the term American Indian was utilized throughout this study.

## Summary of the Chapter

In this chapter, the research background, research problem, and theoretical framework of social cognition were introduced. In addition, the research questions, research purpose, and research design were presented. Finally, the significance, assumptions, limitations, ethical concerns, and definition of important terms were provided and discussed.

In the following chapters a review of the relevant literature and the methods of the study are discussed in more detail. As well, the results of the study will be presented and interpreted. Finally, a summary, conclusions, and recommendations are provided.

# CHAPTER II

# REVIEW OF RESEARCH AND RELATED LITERATURE

The purpose of this study was to determine the extent to which the relationship between students' and mothers' mathematical efficacy beliefs and utility value for mathematics influence student achievement. This chapter presents a review of important areas of research related to the proposed research study: historic mathematics reform, American Indian students, parental influence (and in particular American Indian mothers' influence), and Social Cognitive Theory.

## Mathematics Reform

Mathematics education has undergone major reform several times throughout history. In the 1960's, the mathematical reform was called New Math. This New Math era was born out of a concern for the education of American students, due to reports that the American educational system was falling behind that of others (Herrera & Owens, 2001; Saracho & Spodek, 2009). Concern for lagging mathematical ability led to changes in educational thinking, including the move to new mathematics and eventually a standards-based curriculum reform. This mathematical reform focused more on the pedagogy being implemented in classrooms. In addition, the New Math era extended higher level mathematical concepts to all students, thus requiring more mathematical knowledge of teachers (Schoenfeld, 2004). The mathematics being taught in the public school classroom was moving beyond arithmetic and into mathematics which provided teachers with a new challenge. As Schoenfeld (2004) noted, teachers were uncomfortable with implementing this curriculum for which they were not prepared to implement, therefore, they had two choices, to not implement it or implement it as best they could—whether the implementation be good or bad for both the teacher and the students. As Herrera and Owens (2001) noted, the New Math era is commonly referred to as a pedagogical failure. The new mathematics movement, however, led to a change in how the teaching of mathematics should take place.

By the 1970's the New Math era was over and a mathematics move of going "back to the basics" was implemented. The public school mathematics curricula focused more on arithmetic, particularly at the elementary and middle grade levels. The primary focus was on skills and procedures (Schoenfeld, 2004). In the 1980's, the mathematics focus shifted again to a more problem solving approach. Schoenfeld (2004) noted that unfortunately, the definition of problem solving was not universal, therefore creating a superficial movement. These mathematical movements began stirring the idea of a standards-based curriculum. The standards-based curriculum reform shifted thinking of mathematics in terms of rules and algorithms to understanding the underlying structure of mathematics (Eisenhart et al., 1993).

Traditionally mathematics has been taught as individual skills first practiced and memorized and then finally applied to a set of problems that children complete to show their mastery of the skill (Hickey, Moore & Pellegrino, 2001; Remillard & Jackson, 2006). The traditional classroom setting, focused on procedures and rules, was no longer sufficient for new mathematics teaching (which focused on concepts). The "back to the basics" movement and its' focus on skills and procedures was gone, thus required new pedagogical approaches that are unfamiliar to parents (Schoenfeld, 2004). Parents grew up in the time when mathematics was procedurally based; thus, parents became accustomed to solving problems in this one manner (Remillard & Jackson, 2006). The current standards-based reform calls for a focus on underlying mathematics concepts. Today's children are taught several concepts at one time, following the understanding that there are several ways to solve the problem (Remillard & Jackson, 2006). Teachers are encouraged to utilize innovative approaches which may take time away from the traditional drill time (Hickey et al., 2001). With the curricula focus no longer being on procedures and rules, but also being on underlying mathematical concepts, more time and new approaches were needed to help students develop and practice these concepts before moving on to the next concept.

Since the New Math era, the National Council of Teachers of Mathematics (NCTM) became more vocal in support of a national standards based curriculum. In the late 1980's and early 1990's and a few publications from NCTM, a first attempt at implementing a standards based curriculum occurred. The standards based reform took to heart a concern about the idea that students were graduating from public schools – but still lacking a sound mathematical foundation and knowledge base (CBMS, 2001; NCTM, 1989, 2000). Thus, NCTM has been influential in the emersion of national mathematics standards. In their 1989 publication, *Curriculum and Evaluation Standards for School Mathematics*, NCTM encouraged the thinking of mathematics in terms of both processes and concepts. Each grade level band had four process standards in common: mathematics as problem solving, mathematics as communication, mathematics as reasoning, and mathematical connections, as well as identified the specific content that should be covered within each grade level band. In their updated edition, NCTM (2000) makes the process standards even more explicit, expanding the reasoning process to include proofs and adding a new process standard for representation. These changes showed the importance that is placed upon integrating the process standards with the content standards, inevitably supporting the teaching of mathematics in a standards-based manner.

NCTM's original 1989 standards publication was a springboard for calling attention to the need for improved mathematics curricula. The National Science Foundation and the United States Department of Education requested the National Research Council (NRC) create a committee to examine the current mathematics learning in the elementary/middle grades and provide recommendations for teaching, teacher education, and curriculum (Kilpatrick, Swafford, & Findell, 2001). According to Kilpatrick, Swafford, and Findell (2001), mathematical proficiency consists of five components: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. These five components are interwoven to create a rope in which no one component allows for mathematical proficiency alone.

The five components have to be interwoven in mathematical teaching and learning in order for mathematical proficiency to be obtained. If one component is missing, then the level of mathematical proficiency a student has will be lacking, thus incomplete. The component of *conceptual understanding* refers to understanding the mathematical concepts, including their operations and rules (Kilpatrick et al., 2001). Kilpatrick et al. (2001) describe conceptual understanding as going beyond the knowledge of isolated facts and methods of computation into an understanding of the importance of mathematical ideas and their usefulness. *Procedural fluency* is the carrying out of procedures to solve mathematical problems (Kilpatrick et al., 2001). Procedural fluency was heavily concentrated on in the "back to the basics" movement and continues to remain a vital part of mathematical proficiency. As Kilpatrick et al. noted, procedural fluency requires knowledge of the procedures, when and how to appropriately use the procedures and skills to be able to flexibly, accurately, and efficiently use the procedures. Mathematics movements have gone back and forth between these two components, and left the other three components out.

The third component is *strategic competence* which Kilpatrick et al. (2001) define as an ability to understand, represent and solve the mathematical problem at hand. Kilpatrick et al explain that strategic competence is what has commonly been called problem solving in a very explicit manner. Problem solving has typically been subject to interpretation, but the component of strategic competence is much more guided, leaving little for individual interpretation. The fourth component is *adaptive reasoning*. Adaptive reasoning is being able to think logically, reflect, explain, and justify mathematical thinking (Kilpatrick et al., 2001). Mathematics requires students to think and reason, then justify their responses and adaptive reasoning encompasses these abilities. The final component is *productive disposition*. Kilpatrick et al. describe this component as seeing mathematics as useful and worthwhile, as well believing in one's own ability and efforts to persevere in mathematics as being a small price to pay. A students' productive disposition determines how they see themselves as learners and doers of mathematics. The real life applicability of mathematics beyond the classroom becomes of the utmost importance in terms of productive disposition. In addition, the ability of students to view themselves as being capable of doing mathematics is an important factor within this component (Kilpatrick et al., 2001).

**Standards Based Mathematics**

Saracho and Spodek (2009) discussed New Math as being a shift in educational thinking. According to the Conference Board of the Mathematical Sciences National Advisory Committee on Mathematical Education's (CBMS-NACOME, 1975) *Overview and Analysis of School Mathematics Grades K-12*, new mathematics was to be modeled out of discovery learning. John Dewey is known for his thoughts on discovery learning back in the early 1900's, yet his ideas continue to resurface today. Dewey's view of effective learning is that students must have experiences with the material that they are being required to understand in such a way that the experiences are meaningful to the student. In essence, the development of education must come from within a person, not outside of the individual (Ansbacher, 1998). The experiences can be moving forces that carry people over to explore further (Dewey, 1963). The meaningful experiences that teachers create have to fulfill the purpose of getting the student involved, keeping the student involved, and having the student desire to know more. Discovery learning can be empowering to students by requiring them to be active learners and not just banks of knowledge (Moula, Mohseni, Starrin, Scherp, & Puddephatt, 2010).

Peters (1970) explains how discovery learning works when applied to mathematics in the following manner:

> The discovery learning hypothesis suggests that if subjects are presented with learning situations where they may derive for themselves the rules or principles to be learned, they will learn better, retain the learning longer, and more readily transfer their learning to new situations. (p.76)

Unfortunately this idea of discovery learning has yet to come to fruition in educational practices of the United States. The discovery learning method works for many other countries because curriculum content and instructional practices are dictated by the minister of education, whereas in the United States, curriculum content and instructional practices are decided at the local level. Thus, there is no consistent curriculum across the nation. NCTM has made several attempts prior to the new mathematics movement of making curriculum changes but its voice has been rather weak. The NACOME (1975) report explains how conceptual knowledge plays into mathematics and that the traditional ideas of drill and skill are stifling students' interest in mathematics as a subject. (p.24)

The results of the NACOME Report spurred mathematics leaders, primarily NCTM to become more active in a reform plan that would work, thus, leading NCTM to work on its initial standards for school mathematics. After publication of these standards in 1989, NCTM believed it to be necessary to monitor the implementation of the standards and to begin revising the first standards. The result was the publication of *Principles and Standards for School Mathematics* (NCTM, 2000). While the 1989 standards were broken into three grade bands, the 2000 standards were broken into four grade bands. In addition, NCTM's vision for mathematics was explained in the first chapter. The second chapter explained the six principles upon which the NCTM standards were based. An overview of the standards for school mathematics briefly looked at all the standards from prekindergarten through grade 12. Finally, each grade band was presented individually, identifying the standards for the grade band, along with explanatory narrative and examples as necessary within each band.

The 2000 standards advocated for a different curriculum. The traditional mathematics classroom as a male domain that is competitive is counterintuitive to NCTM's principle of equity (Forgasz & Leder, 1996; NCTM, 2000). NCTM (2000) clearly states that "Excellence in mathematics education require equity—high expectations and strong support for all students" (p.11). In order to implement the changes that NCTM advocates, teachers must change their views and beliefs of mathematics (LaLonde, Leedy, & Runk, 2003). Mathematics classrooms need to focus on conceptual understanding. For elementary grades, conceptual understanding may be found through discovery learning, since students come to the classroom with ideas about number already (CBMS, 2001; LaLonde et al., 2003). A few studies about the effectiveness of a standards based curriculum indicate that mathematical achievement is greater in classrooms where a standards based curriculum is implemented and requires the use of cognitively demanding tasks (Cai, Moyer, Nie, & Wang, 2009; Ginsburg-Block & Fantuzzo, 1998; Riordan & Noyce, 2001). From the studies, it was found that the classroom experience was different from that of the traditional class in which procedures and rules are the focus. There are other benefits that a standards based curriculum has such as peer collaboration which inevitably affect academic motivation and self-concept as well as social competence (Ginsburg-Block & Fantuzzo, 1998). These other benefits alone will affect mathematics achievement as well.

## Common Core State Standards for Mathematics

Mathematics curricula have undergone several swings of the pendulum. Collaboration between the National Governors Association and the Council of Chief State School Officers (NGA/CCSSO) created the Common Core State Standards. The two entities worked together to create a common set of guidelines (standards) for both Mathematics and Language Arts. The move towards a standards based curriculum required the creation of a set of mathematics standards that would be nationwide, as opposed to state by state. According to the Common Core website (NGA/CCSSO, 2010), 45 states and several territories have adopted these standards. The standards fit nicely within the standards based mathematics reform by their very nature, being more conceptually based. The Common Core State Standards for Mathematics (CCSS-M) were created to focus on conceptual understanding, as well as procedural understanding (NGA/CCSSO, 2010). These standards intended to provide a common set of guidelines for teachers and students across the United States (ASCD, n. d.).

The CCSS-M are high quality mathematical expectations that serve as guidelines for curricula instruction. Each grade has specific content that is to be taught. In addition, there are eight standards of mathematical practice. These standards of mathematical practice are a compilation of NCTM's process standards (problem solving, reasoning and proof, communication, connections, and representation) and the components of mathematical proficiency (conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition) presented by Kilpatrick, Swafford, & Findell, (2001). NGA/CCSSO (2010) lists the eight standards for mathematical practice as follows:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning. (NGA/CCSSO website)

These standards for practice are not intended to all be used in every mathematics lesson. Certain lessons will be more fruitful in focusing in on one or two of these standards at a time. Yet, collectively, if these standards of mathematical practice are interwoven into classroom practice, students will be better equipped in their mathematics thinking and proficiency to be able to apply the skills that they are learning in the classroom to their everyday lives. In addition, the standards of mathematical practice are not intended to be taught as skills, but rather work with the teaching of mathematical concepts, to produce student practitioners (NGA/CCSSO, 2010). The focus on conceptual understanding would help students see the big picture of mathematics and better understand how the concepts fit together, thus is benefitting to all students, including American Indian students.

## American Indian Students

In the American Indian culture, there is not one set of cultural values that can be applied to all tribes (Bradley, 1984; Locust, 1988; Pewewardy, 2002). There are many federally recognized tribes within the United States and although similar in some regard, they can be quite different in other regards, thus complicating generalizations to all American Indian people as a whole (Pewewardy, 2002). However, American Indian people are generally known for valuing family and viewing the family as a cornerstone of their society (Red Horse, 1980).

Locust (1988) claimed that a majority of tribal members agree to the following ten basic belief statements quoted here:

1. American Indians believe in a Supreme Creator.
2. Humans are threefold beings made up of a spirit, mind, and body.
3. Plants and animals, like humans, are part of the spirit worlds.
4. The spirit existed before it came into a physical body and will exist after the body dies.
5. Illness affects the mind and spirit as well as the body.
6. Wellness is harmony in spirit, mind, and body.
7. Unwellness is disharmony in spirit, mind, and body.
8. Natural unwellness is caused by the violation of a sacred or tribal taboo.
9. Unnatural unwellness is caused by witchcraft.
10. Each of us is responsible for his or her own wellness. (p. 317-318)

These ten statements are commonplace to American Indian tribal populations and increase the discrimination they face regarding their traditional beliefs. Conflict then arises between the traditional American Indian beliefs and those of the dominant culture's educational system (Locust, 1988). Unfortunately, these conflicts often caused other problems when American Indian children attend school because of the influence of the dominant culture's belief system. The experiences that American Indian children bring to the classroom are unique and based upon home life experiences and American Indian learning styles which differ from the learning styles typically utilized in the school setting. In his extensive review of learning styles, Pewewardy (2002) approached the learning styles of American Indian students using seven classifications. The seven classifications are as follows: "field-dependence/field-independence; perceptual strengths: visual, auditory, and kinesthetic; reflectivity versus impulsivity; classroom management and behavior; role of family, tribe, and elders; teacher/pupil relationships; and cooperation versus competition" (p. 31-32).

While Pewewardy's (2002) meta-analysis of the research on American Indian learning styles discussed the classifications in some detail, only a synopsis of each classification will be provided here. The classification of *Field-Dependence/Field-Independence* refers to the global approach American Indian people utilize in learning. The field-dependent learner is a global thinker who requires learning to begin with the whole and builds the relationship of smaller subdivisions to the topic. On the other hand, the field-independent learner is more sequential and analytical, therefore, being able to see the individual subdivisions and how they work together to create the whole.

The classification of P*erceptual Strengths: Visual, Auditory, and Kinesthetic* focuses on those three learning tendencies of American Indian students.

The classification of *Reflectivity versus Impulsivity* focuses on the response time. In general, American Indians are reflective and consider the options available to them, thus needing more time to respond. This reflectivity is unlike the impulsive responses required in the classroom. *Classroom Management and Behavior* amongst American Indians and the dominant culture are conflicting. The motivational techniques that are used in the classroom are not appropriate for American Indians due to their noncompetitive nature. As a result, teachers often misinterpret American Indian students' lack of motivation as laziness.

Another classification is the *Role of Family, Tribe, and Elders*. This classification is vital to the tribe. Extended family plays a large role in American Indian students' lives as American Indian communities gather together to raise the children within the community. Learning styles can also be classified based on *Teacher/Pupil Relationships*. As with any culture, the relationship that exists between teacher and pupil is important. In the case of American Indians, this relationship can easily disintegrate due to a lack of knowledge of potential cultural differences. The instructional style of the teacher and the learning style of the American Indian student may be incompatible, thus creating conflict in the teacher/pupil relationship. Fortunately, this can be overcome if the teacher accepts students alternative ways to display their competence. The final classification, *Cooperation versus Competition,* is almost self-explanatory. In sports, the competitive nature of American Indian people is brought out. In all other aspects, cooperation is favored.

In terms of cultural relevance, the classifications of learning styles created by Pewewardy (2002) are at the essence of being American Indian. American Indians are family oriented and collective people who look to their elders for guidance. Information and teaching typically occur by having children watch, listen and then imitate the observed actions (Pewewardy, 2002). This type of learning utilizes the three modalities of visual, auditory and kinesthetic, which does not exist in school mathematics. American Indian students are reflective because they do not want to make mistakes, thus bringing attention to themselves and potentially bringing shame to themselves because of impulsivity; therefore, their behavior is viewed as passive (Pewewardy, 2002). In terms of behavior and management, American Indian children are given an explanation of the desired behavior and are rarely struck or beaten as a form of discipline. Respect for and approval of the elders is of utmost importance, so much so that grandchildren typically have a close relationship with their grandparents who are their teachers (Houssain & Anziano, 2008). Since American Indian culture is not individualistic, family and tribal communities exist as the essence of being American Indian. American Indian people exist in tribal communities where everyone helps out for the good of all people.

These learning styles inevitably affect how the child and his or her parent's view education. Regardless of employing any one learning style, American Indian children learn best when they are presented with the big idea first, then helped to see the details that relate to it. This learning style is similar to what is expected with conceptual learning. In addition, Pewewardy (2002) concluded, cooperative learning works best for American Indian children, due to the importance they place upon peer approval.

Butterfield (1994) stated that teachers typically perceive American Indian children as remedial students, thus lowering their expectations for American Indian students. In addition to these lowered expectations, American Indian students are subjected to racism by their public school peers (Butterfield, 1994). Pepper (1992) brought to light the fact that American Indians appear to have disappeared. Pepper further suggested American Indian students need to learn about historical accounts that have lead American Indian people to the place in which they exist now, which can be addressed through curricula. Due to the skewed curricula, American Indian students get the feeling that their pasts are unimportant when American Indians are portrayed as being nonexistent in today's society (Pepper, 1992). Unfortunately, these perpetual images of American Indian students continue to impact the view of education that many have, including parents.

## Parental Influence

Parental aspirations for their children are linked with mathematical efficacy as well. Bandura, Babaranelli, Caprara, and Pastorelli (1996) found that self-efficacious parents tend to hold high academic aspirations for their children. In addition, parents' own academic self-efficacy and educational aspirations relate to their child's perceived academic self-efficacy and educational aspirations, including other factors like scholastic achievement. In another study, Bandura, Babaranelli, Caprara, and Pastorelli

(2001) found that parental aspiration was the only link between parents' perceived academic efficacy and children's academic self-beliefs. In addition, they found that although boys and girls perceived mathematical capabilities do not differ initially, girls are more prone to losing confidence in their mathematical ability and begin to differ substantially from boys in this regard as they enter high school. Even beyond high school, parents, especially mother's beliefs about their child's future career choices remain important. Enduring links between a mother's early expectation for her child and her child's later career decision exist (Bleeker & Jacobs, 2004).

Parents influence their children's view of many things, including school subjects like mathematics. Parents who were educated in a different mathematical era are accustomed to mathematics based upon rules and procedures; children are learning new mathematics that consists of both conceptual and procedural learning, yet parents are uncomfortable with the conceptual learning (Remillard & Jackson, 2006). When it comes to gender beliefs, Jacobs and Eccles (1985) found that parents have stereotypical views of males and females with regard to their ability to do mathematics as well as how mathematics will be useful knowledge. These stereotypical views are manifested in mass media and negatively affect how mothers view their own ability, thus transferring a negative image on[to] their children about mathematics (Jacobs & Eccles, 1985).

Mother's mathematical ability has some effect on a mother's perception of her child's mathematical ability. Yee and Eccles (1988) found that mothers' perceptions of their child's ability were based on the child's ability. Mothers agreed that mathematics as a subject was difficult, yet believed that girls have a greater desire to persist and succeed in mathematics, as opposed to boys. Yee and Eccles also found that girls continuously try harder in order to be more successful. On the other hand, Parsons et al. (1982) found that parents' beliefs were more directly related to their children's self-concepts and expectancies than their children's past performance in mathematics. In summary, regardless of whether children show capability in mathematics, parents' beliefs align more closely with how the child views mathematics and what the child expects of mathematics.

Parent's educational experiences with mathematics learning may be closely related to that of elementary teachers although recent mathematics reform affected each group differently. Since teachers are required to teach to the standards based curriculum, they have been actively involved in the reform process (Remillard & Jackson, 2006). Parents have been excluded from this reform education, thus limiting their exposure and understanding of the mathematics that their children are learning. Remillard and Jackson (2006) identified four distinct differences in the way parents experienced school mathematics. First, the approaches to teaching and the conventions that the teacher uses are unfamiliar to parents. New conventions are geared toward specific curricula to the degree where parents view the conventions as a foreign language. Secondly, parents are accustomed to a simple, straightforward curriculum in which there is only one way to solve the problem. The new mathematics their children are experiencing is quite different. Teachers are encouraging students to solve problems in multiple ways, even using invented strategies. Thirdly, parents noticed the amount of reading that was required to do mathematics. When parents experienced mathematics, they relied upon rules and procedures, which did not require a lot of reading (Hiebert, 1984). Finally, parents learned skills in isolation and had considerable opportunity to practice the skill they were learning before moving on to the next skill. Today, children are learning concepts concurrently; this pedagogy further confuses parents.

## Mothers

A mother's primary responsibility is to care for her children in all aspects of life, ranging from social to emotional development and even their educational needs (David, Edwards, Hughes, & Ribbens, 1993). Inevitably, mothers' influence increases over time. Due to this influential role, children admire and aspire to be like their mothers. Thus, children's beliefs are influenced by their mother's beliefs. Due to the devotion mothers have to their children's upbringing, mothers pass on views of many aspects of life, including their views towards education in general (David et al, 1993).

Although a mother's role has historically been to care for the educational needs of her children, mothers were not perceived as educated due to their status in society (Simonsen, 2006). In a male dominated society, like Western civilization, mothers learned to cope with their children (David et al., 1993). As these historians noted, by the time mothers adapted to coping with their children, the children were subjected to compulsory attendance regulations and control of the child's education was moved from the mother to the school. This shift was difficult for mothers. As society has changed and mothers have begun to work outside the home, mothers' role in the education of their children has changed. Primarily, working mothers were considered to be ineffective in their child rearing abilities, giving rise to the need for compulsory education in the school systems (David et al., 1993).

David and colleagues further posited the diminishing role of mothers aligned with the shifting make-up of American families. More families had changes in the role of the stay-at-home mother to that of working-mother or single parent-mothers (David et al., 1993). The changes in the perceived role of mothers did not relieve them of this required responsibility, thus still producing a considerable influence over her children and their views of life. The role of American Indian mothers is even more impactful because of the early education experiences of American Indian people and females in general.

## American Indian Mothers

American Indian mothers hold a unique role in the development of children's view of education due to the typical pattern of educational experiences among American Indians (Coleman, 2007; Houssain & Anziano, 2008; Simonsen, 2006). American Indian women have historically held a lower status than American Indian men and have had less opportunity to study beyond the field of domesticity (Simonsen, 2006). American Indian women were educated to fit the stereotypical role of women in society. Although this role may be similar to their traditional views, the difference comes with matriarchal tribes.

In matriarchal tribes, women are the more prominent members of society (Simonsen, 2006). Simonsen (2006) discussed how American Indian women were accustomed to a certain amount of authority that was not undermined by males yet this privilege was lost in the process of assimilation. Thus, when forced to be educated, American Indian women were treated as insubordinates to males, and this conflicted with their role in tribal society. Though women play an important part in both American Indian and Western societies, American Indian women have been historically perceived as savages, who needed to be domesticated (Coleman, 2007; Simonsen, 2006). The need to be educated also created low parental self-esteem, thus causing an issue within American Indian communities (Butterfield & Pepper, 1992). This inferior view played a part in mothers' developing view of education, particularly as it pertained to their children.

## Social Cognitive Theory

Even young children enter the classroom with ideas about number (CBMS, 2001). Not only do they have ideas about number, but they are beginning to form ideas about mathematics based upon their experiences at home. Parents' views of mathematics, either positive or negative, holds true for their views of their children in regards to mathematics (Jayaratne, 1983). Sometimes parents are unaware of the views they transmit to their children, but nonetheless, parents influence their children's mathematical views. With the societal influences that parents face (due to communication media) boys are viewed as more capable of doing mathematics than girls (Jacobs & Eccles, 1985). In addition to the traditional view of mathematics as a male-domain, girls are at a definite disadvantage in the mathematics classroom.

This study focuses on mathematical efficacy and mathematical utility. Research suggests that if students believe they can do mathematics and be successful, then they can. Yee and Eccles (1988) found that girls have a desire to persist and be successful in mathematics. Girls may have to work harder, but they are able to be successful in mathematics. In addition, Fennema (1996) found that since females did not understand the usefulness of mathematics, they tended to be less confident in themselves as learners of mathematics. Mathematical utility is important and can be brought to the forefront of the classroom if the teacher makes connections to the real-world and to the child's community (Forgasz & Leder, 1996; Pewewardy, 2002).

**Efficacy Beliefs**

In order to define mathematical efficacy, an understanding of self-efficacy is required. Bandura (1977) defines self-efficacy as a person's beliefs about their own ability to successfully perform specific tasks. Utilizing Bandura's definition in a mathematical sense, the following definition of mathematical self-efficacy can be created: a person's belief about their own ability to successfully do mathematics. In Bandura's work on self-efficacy theory, he explained that the amount of self-efficacy a person has towards a subject is based upon four sources of information (Bandura, 1977). Bandura explained that in order to completely understand a person's self-efficacy, these four unique aspects must be addressed. The four aspects are: performance accomplishments, vicarious experience, verbal persuasion, and physiological states. The aspect of *performance accomplishments* refers to a person's own mastery experiences in regards to the subject at hand. A person's own mastery experiences in mathematics influence their mathematical self-efficacy. So, if a person has been successful in mathematics, they will believe they are able to successfully do mathematics. Another influential source is that of *vicarious experiences*. People are influenced by the vicarious lives they live within other people's experiences. As expected, people tell stories of their success and failures and when others judge their ability to be successful in a similar situation based upon the story they have heard, they are living vicariously through other people's experiences. This form of influence is not as direct as mastery experience, but is influential nonetheless.

The third aspect that Bandura's (1977) model accounts for is *verbal persuasion*. Bandura explains that verbal persuasion is easily used and readily available. Basically, a person can be led to success, even when the past contains failure in regard to the subject area. For example, if a teacher continually tells her students that they can do mathematics, the teacher can lead them to mathematical success, even though the student has had repeated experiences of failure in regards to mathematics. The final aspect is that of *emotional arousal*. If a person is not feeling overwhelmed emotionally when subjected to an unfamiliar mathematical task, they tend to feel like they are able to attempt and be successful with the task. This emotional arousal is influential to a person's perceived ability to attempt an unfamiliar task. All four of these aspects work together and are interdependent upon each other in the formation of self-efficacy. The way that children develop mathematical efficacy beliefs is similar. In particular, when trying to understand mathematical efficacy, self-efficacy must be understood and applied to the academic arena of mathematics. This understanding of mathematical efficacy provides a necessary foundation for this study.

Mathematical efficacy beliefs and mathematics performance are related. Norwich (1987) found that consistent self-efficacy measures were less accurate predictors of subsequent assertive behavior. Self-concept did not contribute to the prediction of self-efficacy. Multiple researchers have considered the ways in which self-efficacy and mathematical performance are related (Nicolaidou& Philippou, 2004; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004; Zarch & Kadivar, 2006). It appears that self-efficacy is a powerful predictor of mathematical performance, despite one's mental ability (Zarch & Kadivar, 2006). Furthermore, Zarch and Kadivar (2006) explained self-efficacy as an important portion of the relationship between mathematics ability and mathematics performance. Pajares (1996) compared regular education students with gifted students and found conflicting results aligned with cognitive ability. For regular education students, cognitive ability played no role in prior achievement directly influencing self-efficacy; whereas, the opposite was found to be true for gifted students. In working with elementary children, Nicolaou and Philippou (2007) found a significant correlation between efficacy about problem posing and the students' ability in problem posing. Overall, efficacy in problem posing positively correlated with general mathematics achievement. On the other hand, when looking at self-efficacy in problem solving, Nicolaidou and Philippou (2004) found a high proportion of children hold positive attitudes towards mathematics and most children feel quite efficacious in mathematics. Self-efficacy was the stronger performance predictor when compared to attitude towards mathematics (Nicolaidou & Philippou, 2004).

In elementary grades, mathematical self-efficacy beliefs increased and developed over time (Phan, 2012). This increase could be attributed to children's gaining more mathematical skills. NCTM (2000) breaks public school education into four unique grade bands in order to uniformly discuss appropriate content at a range of grades as opposed to a specific grade. NCTM explained that the early grade levels have standards intended to help children build a solid foundation in mathematics. The first grade band's standards (pre-kindergarten through grade 2), allows for children's naturally inquisitive nature to take over. The next grade band's standards (grade 3 through grade 5) contain "increasingly sophisticate[d] mathematical ideas" (NCTM, 2000, p. 143). Therefore it is no surprise that Phan (2012) found children's mathematical self-efficacy beliefs increased over time between the third and fourth grade years of schooling. The third grade band (grade 6 through grade 8) occurs at a time when children are entering adolescence. Adolescence is a time of change, and Friedel, Cortina, Turner, and Midgley (2010) found that the average levels of self-efficacy beliefs in mathematics across middle school students did not change over time. Unfortunately, Usher (2009) found that students do not rely on their own experiences in mathematics to refine their efficacy judgments; rather they utilize Bandura's idea of vicarious learning

**Utility Value**

Jacobs and Eccles (1985) defined utility value for mathematics as the usefulness of mathematics. In understanding utility value, children reason with themselves to understand the usefulness of a subject. If children do not have a sound reason for the importance of a subject, children tend to have lower levels of confidence in that subject. In mathematics, Fennema (1996) found "young women do not think of mathematics as useful, thus they have less confidence in their own ability to be learners of mathematics" (p. 13).

Mathematics has traditionally been viewed as a male domain (Fennema, 1996; Hanna, 2003; LaLonde et al., 2003). Although this image is implicit, Becker (1981) found female children initiate interactions with their teacher, primarily in the form of asking questions, but teachers provided discouraging comments more frequently to female children. This negative reaction from teachers stifles the image of how useful mathematics is for female children; connections between mathematics and its application in the real world, as well as how future careers can be beneficial to students (Forgasz & Leder, 1996). Rule and Harrell (2006) concurred that a lack of connections results in limited career choices. The usefulness of mathematics is necessary in helping children see it's applicability to their own lives (Forgasz & Leder, 1996; Pewewardy, 2002) Children who do not give importance to the usefulness of mathematics tend not to enroll in additional mathematics classes and thereby limit their future career choices. (Sherman & Fennema, 1977)

## Summary of the Chapter

This chapter reviewed the relevant literature to the research problem in the area of mathematics reform, including the standards-based curricula being used in classrooms and the implementation of the Common Core State Standards for Mathematics. In addition, literature related to American Indian children and mothers, in particular American Indian mothers was reviewed. Finally, the social cognitive theory was discussed in terms of mathematical efficacy belief and utility value for mathematics.

In the next chapter, the context of the study will be provided, in particular, information about the community setting and the project from which the data come will be discussed. The participants, ethical considerations, and instruments will be reviewed. The chapter will conclude with the procedures and data analysis of the study.

# CHAPTER III

# METHOD

The purpose of this study was to determine the extent to which the relationship between students' and mothers' mathematical efficacy beliefs and utility values for mathematics influence student achievement. This chapter discusses the context of the study, the ethical considerations, and the participants' demographics. This chapter reviews the procedures that were used throughout this study. This research addressed the following questions:

1. How does mothers' mathematical efficacy belief and utility value for mathematics influence mathematics achievement for children, both directly and indirectly?
2. How does mothers' mathematical efficacy belief influence children's mathematical efficacy belief?
3. How does mothers' utility value for mathematics influence children's utility value for mathematics?
4. How do children's mathematical efficacy belief and utility value for mathematics influence their mathematics achievement?

## Context of the Study

This research data is drawn from a larger National Science Foundation (NSF) funded project called *Signals*. The project utilized students in twenty-three rural public schools located in northeastern Oklahoma. These schools were fairly isolated from urban or metropolitan areas and varied in size from 200 students (small schools) to schools over 1,000 students (consolidated schools).

### Community Setting

Though school is the center of cultural activity in these communities, one could usually find a flower shop, funeral home, branch bank, dollar store, and a local, home-style restaurant a few large communities also included Wal-Mart with at least one or two chain restaurants (typically Sonic or Simple Simon's Pizza). Local services often included some new stores that came to town over the time of this research study, while other businesses had a look of the past and still others were abandoned and/or boarded up. According to "Homefacts" (n.d.), the unemployment rate in these communities averaged 6.8% (somewhat higher than the state average of 6.4%). These data evidenced limited employment opportunity in the local area and pointed to the reality that employed residents drove considerable distances to work.

### *Signals* Project

This dissertation study stemmed from *Signals*, an NSF funded, longitudinal research study (Award No. HRD-0936672) about American Indian boys' and girls' beliefs and attitudes towards mathematics and science. This larger study included survey data from third to fifth grade students, parents and teachers. *Signals* schools included primarily Kindergarten through eighth grade districts. These student participants included similar numbers of students who were males and females (46.4% males and 53.6% females) and American Indian and non –American Indian (46.7% American Indian and 53.3% non-American Indian).

Parents' consent allowed each student to participate in the study and gave the researcher access to students' achievement records. *Signals* schools met two criteria: the schools had to be rural and they had to have a high American Indian population. Based upon these two criteria, a doctoral student went through the state schools directory and identified possible schools. The *Signals'* goal was to include about 600 participants per year so that at the end of the longitudinal study there would be at least 300 students that were continuous through all three years of the study. The initial list of schools was modified after utilizing the following techniques in an attempt to gather more participants.

Potential *Signals* schools were organized according to their proximity (30 – 150 mile radius) to the research institution. In addition, the primary investigator met with the Osage County Inter-local Cooperative (OCIC) to discuss the project and potential target schools. This meeting gave rise to a second meeting with interested superintendents. In addition, the Cherokee Nation, located in Tahlequah, Oklahoma, was targeted due to their large presence in the intended research area. The Executive Director of Education in the Cherokee Nation volunteered a list of schools that might be willing to participate in the study. These processes generated 23 participant *Signals* schools.

The Principal Investigator (PI) contacted each school principal and obtained permission to conduct the study within the school.  Once the researcher gained principal permission, a meeting was set up with the teachers.  At the meeting with the teachers, the PI described the study, obtained teacher consent to participate, left student permission forms, and determined a time when the research team might return to conduct surveys with the students.  Teachers were given consent forms with instructions to send them out to parents prior to the survey date.  The teachers would then hold the consent forms until the research team returned.

The research team consisted of one Principal Investigator, three doctoral students, and varying numbers of undergraduate students from year to year (undergraduate students (n = 3-7).  My role in *Signals* was to be a member of the research team.  As a doctoral student, my primary duties consisted of all aspects of data entry and collection. In addition, I supervised undergraduate student work efforts both in the field, collecting data and in the office with data entry and other preparatory tasks.  My largest and most important role in the final year of the project was that of community liaison with American Indian tribal nations.  As the *Signals* community liaison, I established contact within various tribal education departments to begin a relationship between the tribe and the project.  I met with the education directors to discuss the project, our intentions, and how the project desired to work with the tribe in the efforts of increasing parent and child awareness of STEM careers and the importance of mathematics and science.

The research team size varied depending on the size of the school and the number of classrooms that were going to be surveyed.  If there were not enough research team members to administer to individual classrooms, classrooms were combined in some way, so as to minimize the loss of classroom instructional time for teachers. In some instances, students needed to have the survey items read (when students were not able to read the survey questions on their own). Following this procedure, the researcher read the items on the survey instrument and waited for students to answer each statement before moving on to the next item. In most instances, students were confident in their reading ability and wanted to move forward individually. In either case, the researcher was available to answer questions as needed. In addition, the researcher would repeat the item, as requested by the students. As the students responded, the researcher walked around, to ensure that students were on the same item. In addition, students were given a laminated card they could use as a guide across the page (so that their answers correctly aligned to the item that they were reading).

All student data collection occurred at the school, usually within the students' own classroom. Parent data were obtained by sending home survey instruments via children's backpacks. Parents completed survey instruments at home, mailed them back to the project researchers, and received a stipend by return mail.

## Participants

The participants for this dissertation study included only the fifth grade students and their mothers' component to the *Signals* project. There were 784 students that completed the survey instruments and 435 parents who also completed the survey instruments. The data were filtered through six criteria: state mandated test score data, parent data, if the participant was American Indian, whether or not the parent was a mother, whether or not the student participated in Oklahoma Modified Alternate

Assessment Program (OMAAP), and whether or not complete data existed. In any case where the criteria were not met, the participant was disqualified from participation and their data was removed. There were a total of 704 students who had an OCCT test score. Of these cases, the data were filtered by marking cases where parent data existed resulting in n = 374. Participants who self-identified as American Indian were selected from this sample and resulted in a total of 195 cases. The criteria of whether or not the parent identified themselves as a mother were selected, resulting in n = 160. An additional disqualifying criteria was if a student participated in (OMAAP) since the scoring criteria are different (n = 150). Finally, cases where incomplete data of either the child or the mother's efficacy belief or utility value for mathematics existed were disqualified from analysis. Upon application of all criteria to the participants of the *Signals* study, a sample of 148 was obtained. For this population, the gender division mimicked that of the *Signals* project in that 47.6% of the participants were male and 52.4% of the participants were female.

## Instrumentation

The instruments used in this study were preexisting instruments modified for the purposes of the longitudinal research study. Modifications to the existing instruments were adaptations to allow for parents and teachers to respond to similar survey items. For this study, only children and parent responses were utilized.

**Mathematical Attitudes Survey**

Questions from the Fennema-Sherman (1976a) Mathematical Attitudes Survey (FSMAS) were utilized for this study. Reported split-half reliability coefficients ranged from .86-.93 (Fennema & Sherman, 1976a; Mulhern & Rae, 1998). Since this dissertation focused on mathematical efficacy belief and the utility value for mathematics, the items on mathematical efficacy with an original reliability coefficient of .93 and the utility value of mathematics with an original reliability coefficient of .88 (Fennema & Sherman, 1976a; Mulhern & Rae, 1998) were of the greatest concern. In order to initially establish validity on the FSMAS, Fennema and Sherman defined the scale dimensions, wrote questions representing the dimension, then tested and revised the items before issuing the shorter final version (Fennema & Sherman, 1976a). In addition, the scales of mathematical efficacy belief and utility value for mathematics have proven valid through a number of other studies (Doepken, Lawsky, & Padwa, 1993; Fennema & Sherman, 1976b; Wikoff & Buchalter, 1986)

Data were collected from both the parent and child instruments. Parent and child instruments were similarly constructed in terms of content. The child instruments had a total of 30 questions, with six questions addressing each of the following categories: mathematical efficacy, utility value for mathematics, and mother's belief of her child's mathematical efficacy. The parent instrument consisted of 18 questions, with six questions addressing each of the following categories: mathematical efficacy belief and utility value for mathematics. The child instrument was modified in terms of wording to create a parent instrument. The parent instrument included survey items about parent's beliefs in their children's ability. In addition, items from the child's version were modified to ask parents about their perceptions of the utility value for mathematics. Parent and child surveys utilized a five point Likert-type scale ranging from 1 to 5 where 1 indicated a strong disagreement, 2 indicated disagreement, 3 indicated neutrality, 4 indicated agreement, and 5 indicated strong agreement with each statement. Demographic responses of parent relationship and child gender were utilized as well. Sample questions are included in Table 1 for parents and Table 2 for students.

Table 1

*Parent Survey Examples*

**Parents Efficacy in Children's Mathematical Ability**

- I think my child could do well in mathematics.
- I have strongly encouraged my child to do well in mathematics.

**Parents Utility Value for Mathematics**

- Mathematics is a worthwhile and necessary subject.
- Knowing mathematics helps me earn a living.

Table 2

*Children Survey Examples*

**Children's Mathematical Efficacy**

- Generally, I feel comfortable about doing mathematics.
- I am sure I could do advanced work in mathematics.

**Children's Utility Value for Mathematics**

- I'll need mathematics for my future work.
- Knowing mathematics will help me earn a living.

## Oklahoma Core Curriculum Test

The state mandated test in Oklahoma is the Oklahoma Core Curriculum Test (OCCT) for each grade in reading and math beginning in third grade. (Oklahoma Department of Education, 2011) The OCCT is a criterion referenced test given to students based upon the Oklahoma Priority Academic Student Skills (PASS) objectives that the state department of education has approved (Oklahoma State Department of Education, n.d.). Some students are permitted to participate in the Oklahoma Modified Alternate Assessment Program (OMAAP). The OMAAP is an alternative to the OCCT and has a different scoring range than the OCCT; thus OMAAP scores were not used. The child's mathematical score was used as the dependent variable of mathematical achievement.

## Procedures

For this dissertation study, the researcher obtained IRB approval to use archived data from the *Signals* project. The IRB approval is provided as the Appendix. Since the data was archived data, the procedures were limited to receiving a copy of the database from the *Signals* project that included the variables of interest for this study. The variables of interest were MAS responses for parents and children, as well as demographic information including ethnicity, and the child's criterion referenced state mathematics achievement test score. This database contained all participant data from the third year of the *Signals* project. The database was received in a Statistical Package for Social Sciences (SPSS) version 20 file. Upon receipt of the database, a path analysis was conducted via AMOS within the SPSS software. The data were filtered to only include the participants that had complete mother and child data with respect to mother's mathematical efficacy belief, mother's utility value for mathematics, child's mathematical efficacy belief, child's utility value for mathematics, and child's mathematical achievement score. The results were then interpreted and reported as study findings.

## Data Analysis

Data analysis in a correlational study relies upon correlations that are present amongst the variables. In the case of this dissertation study, the data were analyzed initially by conducting a correlational statistic to identify whether a relationship existed between the mother's mathematical efficacy belief and utility value for mathematics and the children's mathematical efficacy belief and utility value for mathematics. In correlational analysis, there could be other confounding variables that contribute to the differences in group means. Since the data were collected by survey instruments, the outcome variable could be affected by several other factors besides mathematical efficacy belief and utility value for mathematics.

In addition, a path analysis was conducted to determine whether the mother's mathematical efficacy belief and utility value for mathematics and children's mathematical efficacy belief and utility value for mathematics influenced children's achievement. A path analysis was the most appropriate form of analysis since it allowed the researcher to look at direct, indirect, and total effects of the variables on mathematical achievement. By utilizing a path analysis, the researcher was able to clearly see the influence that each variable had on children's mathematical achievement. In this, the researcher was able to identify how mothers influenced mathematical achievement, directly and indirectly. In addition, the researcher determined how the mother's views of mathematical efficacy belief and utility value for mathematics influenced the child's mathematical efficacy belief and utility value for mathematics. The researcher also determined the influence of mother's mathematical efficacy belief and utility value for mathematics on child mathematical achievement. Finally, the researcher determined the influence of children's mathematical efficacy belief and utility value for mathematics on their mathematical achievement.

## Summary of the Chapter

In this chapter, the researcher described the context of the study along with information about the participants, ethical considerations component to participant selection, and the survey instruments used in this study. Finally, the researcher identified the research procedures and data analysis used in this dissertation study.

In the next chapter, the results of the data analysis will be presented. The paths that were explored and their results will be discussed. In the final chapter, key findings will be discussed as well as implications for theory, practice and future research.

# CHAPTER IV

# FINDINGS

The purpose of this study was to determine the extent to which the relationship between students' and mothers' mathematical efficacy beliefs and utility values of mathematics influence student achievement. The specific research questions this study sought to address were:

1. How does mothers' mathematical efficacy belief and utility value for mathematics influence mathematics achievement for children, both directly and indirectly?
2. How does mothers' mathematical efficacy belief influence children's mathematical efficacy belief?
3. How does mothers' utility value for mathematics influence children's utility value for mathematics?
4. How do children's mathematical efficacy belief and utility value for mathematics influence their mathematics achievement?

This chapter presents the descriptive statistics and results of a path analysis to address each of the four research questions.

## Descriptive Statistics

This study utilized data from 148 mother–child dyads. The combined data consisted of mothers and children who filled out the instruments and child test score data were available. A listwise deletion was performed for all cases in which parent data or test score data was unavailable. In addition, students who participated in the Oklahoma Modified Alternate Assessment Program (OMAAP) which has different scoring criteria were deleted from this analysis.

Overall, high variability in mean scores of mathematical efficacy exists amongst children as opposed to mothers. Children's mathematical efficacy and mothers' mathematical efficacy were quite different from each other. The standard deviation for children was 2.38 points greater than that of mothers, indicating that children's mean scores varied more than mothers'. The mean score for children (M = 23.47, SD = 5.14) was lower than that of mothers (M = 27.22, SD = 2.76). The differences in mean scores for mathematical efficacy showed that the variations are quite different. Mothers have a more compact set of mean scores than children. Children have a lower mean and the data are more spread out than their mothers who have a higher mean and the data are closer to the mean. In terms of the utility value for mathematics, the means and standard deviations are similar for children (M = 25.03, SD = 3.73) and mothers (M = 24.94, SD = 4.14). Although CRT math scores could range from 440 to 999, the mean was 741.51 with a standard deviation of 101.56.

The reliability of children and mothers mathematical efficacy and utility value for mathematics ranged from .83-.89, thus indicating a good reliability of the measures. Correlations amongst the variables existed. Children's mathematical efficacy and children’s utility value for mathematics were moderately correlated, and mothers’ mathematical efficacy and utility value for mathematics were highly correlated. Mothers’ mathematical efficacy weakly correlated with children’s mathematical efficacy and utility value for mathematics, while mothers’ utility value for mathematics was not correlated with either. Finally, CRT math scores had a weak correlation with children and mothers’ mathematical efficacy, as well as mothers’ utility value for mathematics. The means, standard deviations, reliability coefficients, possible scale ranges, and correlations are presented in Table 3.

Table 3

*Descriptive Statistics*

| | M | SD | α | Range | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| Child Efficacy | 23.47 | 5.14 | .89 | 6-30 | - | | | |
| Child Utility | 25.03 | 3.73 | .83 | 6-30 | **.48 | - | | |
| Mother’s Efficacy | 27.22 | 2.76 | .85 | 6-30 | **.22 | **.26 | - | |
| Mother’s Utility | 24.94 | 4.14 | .88 | 6-30 | .02 | .02 | **.66 | - |
| CRT Math Score | 741.51 | 101.56 | - | 440-999 | *.17 | .10 | *.17 | **.21 |

*Note*. **p* <.05, ***p* <.001

## Path Analysis

A path analysis was used to determine direct, indirect, and total effects for mother’s mathematical efficacy belief and utility value for mathematics on children’s mathematical achievement. In addition, the path analysis was used to determine the direct effects for children's mathematical efficacy beliefs and utility value for mathematics for their mathematical achievement. A path diagram was constructed utilizing mothers' mathematical efficacy and utility value for mathematics as the exogenous variables. The endogenous variable was mathematical achievement. In addition, children's mathematical efficacy belief and utility value for mathematics were treated as endogenous variables in order to determine the direct effects of these variables on mathematical achievement. The two exogenous variables had both a direct and indirect influence on children's mathematical achievement. In addition, the exogenous variables indirectly influenced mathematical achievement by means of two endogenous variables: children's mathematical efficacy and utility value for mathematics. The path diagram (See Figure 1) illustrates the direct and indirect influence from each of the independent variables on OCCT math scores, with their corresponding path coefficients.

Table 4 shows the direct, indirect, and total standardized effects of the variables on mathematical achievement.

Table 4

*Standardized Effects on Mathematics Achievement*

| | Direct | Indirect | Total |
|---|---|---|---|
| Child Efficacy | .159 | - | .159 |
| Child Utility | .019 | - | .019 |
| Mother's Efficacy | -.022 | .066 | .044 |
| Mother's Utility | .224 | -.041 | .183 |

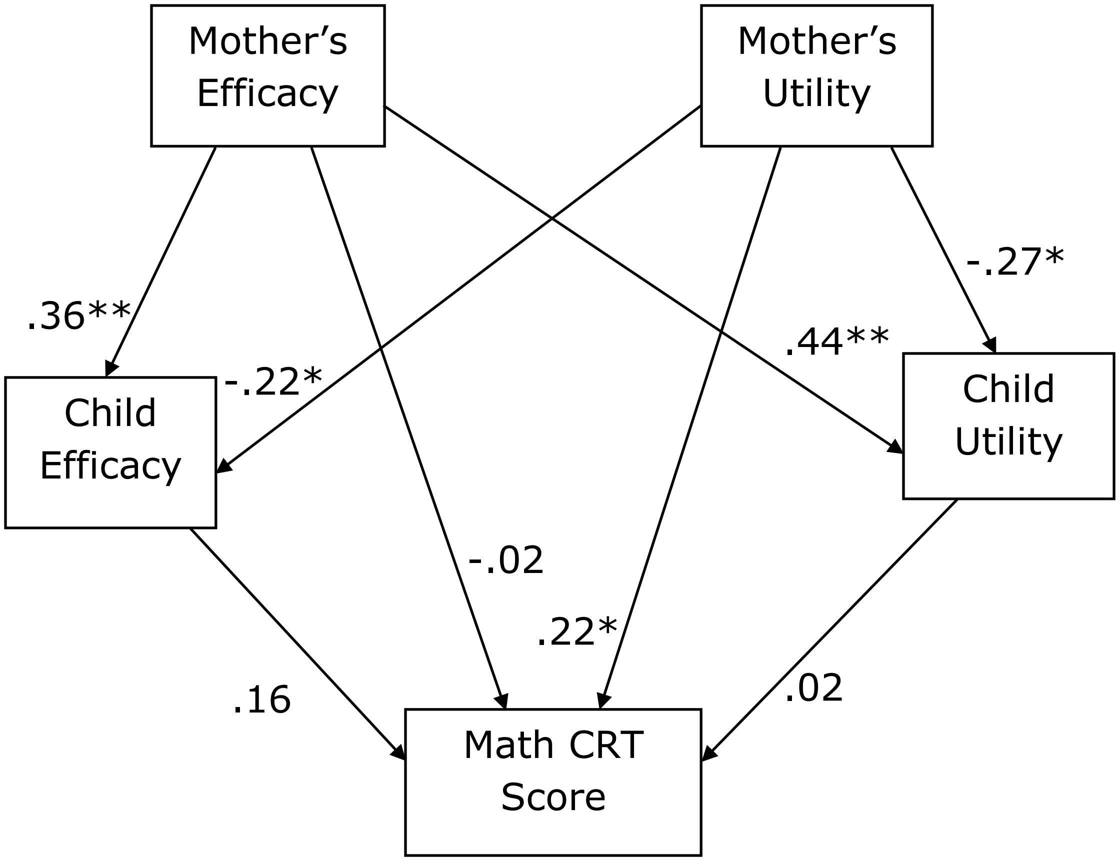


*Figure 1.* Path diagram for mother's and children's mathematical efficacy beliefs and utility value for mathematics on mathematical achievement.

*p<.05. **p<.001.

**Mothers' Influence on Child Mathematical Achievement**

This first three research questions in this study focused on the influences that mothers' mathematical efficacy belief and utility value for mathematics had on children's mathematical achievement, directly and indirectly. Mothers' mathematical efficacy belief and utility value for mathematics were hypothesized to directly and indirectly influence children's mathematical achievement.

There was no direct relationship between mothers' mathematical efficacy belief and children's mathematical achievement (β = -.02). However, mother's utility value for mathematics directly influenced children's mathematical achievement (β = .22). Thus, the more value a mother perceived mathematics as holding, higher achievement is predicted for her children.

Mothers' belief of mathematical efficacy had a slightly significant positive influence on children's belief of mathematical efficacy (β = .36). A direct prediction of children's utility value for mathematics from mothers' belief of mathematical efficacy was significant (β = .44). In terms of mothers' mathematical utility value, as mothers placed more value on mathematics, the level of their children's efficacy in mathematics decreased (β = -.22). In addition, the level of value children placed on mathematics decreased as well (β = -.27). Therefore, the more value that mothers placed on the usefulness of mathematics, the less children valued mathematics.

A difference is noted in looking at the indirect influence of mother's mathematical efficacy belief and utility value for mathematics on children's mathematical achievement. In terms of mothers, although direct influences had mixed results, the indirect influences were very small. On the other hand, the influence of mothers' mathematical efficacy belief on children's mathematical achievement was non-significant. The indirect influences for mathematical efficacy belief was β = .066 and for utility value for mathematics was β = -.041.

**Children’s Influence on Mathematical Achievement**

In this study, the focus was on the influence of both mothers’ and children on children’s mathematical achievement. The fourth question focused specifically on how children’s mathematical efficacy belief and mathematical utility value predicted children’s mathematics achievement. Children’s mathematical efficacy belief did not significantly influence mathematical achievement ($\beta = .16$). In terms of children’s mathematical utility value, no statistically significant influence was found either ($\beta = .02$). The fact that the variables of children’s mathematical efficacy and mathematical utility did not significantly influence mathematical achievement is a unique finding of this study.

## Summary of the Chapter

In this chapter, the findings of the study were presented. The descriptive statistics of the variables of interest and the direct, indirect, and total effects were presented. In addition, the path model was explained in terms of each research question. The final chapter will discuss the findings in the context of implications for theory, practice, and further research.

# CHAPTER V

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the extent to which the relationship between students' and mothers' mathematical efficacy belief and utility value of mathematics influence student achievement. This study addressed the following research questions:

1. How did mothers' mathematical efficacy belief and utility value for mathematics influence mathematics achievement for children, both directly and indirectly?
2. How did mothers' mathematical efficacy belief influence children's mathematical efficacy belief?
3. How did mothers' utility value for mathematics influence children's utility value for mathematics?
4. How did children's mathematical efficacy belief and utility value for mathematics influence their mathematics achievement?

Archived quantitative data was utilized in this correlational study. These archived data were component to the *Signals* study, a National Science Foundation (NSF) funded longitudinal study (Award No. HRD-0936672). The data of interest in this study consisted of (a) mother's and children's responses to the Fennema-Sherman Mathematics Attitudes Survey instrument (FSMAS) (1976a) and (b) measures of children's achievement. The FSMAS instrument measured participants' mathematical efficacy and the utility value for mathematics via survey responses calculated on a 5-point Likert type scale. In addition to the FSMAS, children's mathematical achievement was determined by their scores on the Oklahoma Core Curriculum Test (OCCT) (a mandated, criterion referenced state test).

While the original *Signals* data set included 700 child participants and 400 parent participants, this study focused on148 mother-child dyads. Identification of these dyads was determined by a data filtering process according to the following six criteria: OCCT test score data, parent data, whether or not the participant was American Indian, whether or not the parent was a mother, whether or not the student participated in Oklahoma Modified Alternate Assessment Program (OMAAP), and whether or not complete data existed. This sorting process resulted in a total of 148 eligible pairs. Gender of the student participants broke out in a manner such that 47.6% were male and 52.4% were female. All data were entered into an SPSS database. The database was utilized within the AMOS software program to conduct a path analysis of the variables of interest. The following discussion presents an analysis of the findings, including interpretation. The progression of the analysis remains true to the order of the research questions.

## Summary of Key Findings

The findings were reported in terms of mothers' and children's influences in order to review individual variables and their direct and indirect influences on mathematical achievement. This study utilized a path analysis requiring the identification of exogenous and endogenous variables for the model. The exogenous variables lie outside the model, but have both a direct and indirect influence on the dependent variable. Mother's mathematical efficacy and mother's mathematical utility value were the exogenous variables, thus they are indicated in the upper most region of the path diagram. The endogenous variables are those variables contained within the model, including the dependent variables. Children's mathematical efficacy, children's utility value for mathematics, and mathematical achievement were all considered endogenous variables in this study.

### Mothers' Influence on Child Mathematical Achievement

The influence that mothers have on their children dominated the research questions in this study. Results proved mothers both directly and indirectly influence their children's mathematical achievement. The first research question addressed the direct and indirect influences that mother's mathematical efficacy belief and utility value for mathematics had on mathematics achievement. No direct influence between mothers' mathematical efficacy belief and children's mathematical achievement ($\beta = -.02$) existed. On the other hand, mother's utility value for mathematics had a direct influence on children's mathematical achievement ($\beta = .22$). These results suggest that a mother's confidence in her child's ability to be successful in mathematics does not influence her child’s mathematical achievement, but the usefulness that mothers place on mathematics does influence her child’s mathematical achievement.

The second research question addressed the influence that mothers’ mathematical efficacy belief had on children’s mathematical efficacy belief. Results proved mothers’ mathematical efficacy belief directly influenced both children’s mathematical efficacy belief ($\beta = .36$) and children’s utility value for mathematics ($\beta = .44$). Although mother’s had a direct influence on children’s mathematical efficacy belief and utility value for mathematics, the indirect influence on children’s mathematical achievement was so small.

Finally, the influence of mothers’ utility value for mathematics on children’s utility value for mathematics was addressed. Mother’s utility value for mathematics had a statistically significant negative influence on children’s efficacy belief ($\beta = -.22$) and utility value for mathematics ($\beta = -.27$). Mothers’ indirect influences were very small, almost insignificant.

**Children’s Influence on Mathematical Achievement**

The final research question addressed how children’s mathematical efficacy belief and their utility value for mathematics predicted their mathematics achievement. Surprisingly, results regarding children’s direct influence on their own mathematical achievement were insignificant. Neither children’s mathematical efficacy belief ($\beta = .16$) nor children’s utility value for mathematics directly influenced their mathematical achievement ($\beta = .02$). The researcher expected that either children’s mathematical efficacy belief or their utility value for mathematics, if not both, would be predictive of their mathematics achievement, yet that was not the case.

## Conclusions

This research studied the influences of (a) American Indian mothers' belief about mathematical efficacy and utility value for mathematics and (b) children's belief about mathematical efficacy and utility value for mathematics on fifth grade children's mathematical achievement. Data analysis yielded some interesting results, particularly regarding the negative influences of mothers' utility value for mathematics on children's utility value for mathematics and children's mathematical efficacy belief. This significant negative influence suggests that regardless of how much they attempt to positively influence their children, mothers are not promoting mathematics as useful. As well, mothers' utility value for mathematics does not increase children's mathematical efficacy belief, but rather provides a hindrance.

Mother's mathematical efficacy belief and utility value for mathematics had a small total effect on children's mathematical achievement. It seemed mother's mathematical efficacy belief predicted children's mathematical efficacy belief, and the same was true for mother's utility value for mathematics. Yet, these positive predictions did not display in terms of children's mathematical achievement. Children's mathematical achievement cannot be accurately predicted by the combination of children's and mother's mathematical efficacy beliefs and their corresponding utility values for mathematics due their low statistically significant nature. This interesting phenomenon required a closer look at mother's efficacy belief, mother's utility value for mathematics, and children's mathematical efficacy belief and utility value for mathematics on their own achievement. As Brody, Flor, & Gibson (1999) found, a mother's self-efficacy is linked to developing the goals that they endorse in their children. Other researchers have found that, when positive views about mathematics ability are encouraged, children will be more successful in mathematics (Fennema, 1996; Forgasz & Leder, 1996; Jayaratne, 1983). In terms of mathematical efficacy belief and mathematical achievement, Bandura's (1977) model holds true and is seen in this study as well, where efficacy beliefs transferred from mothers to their children.

Interestingly, however, Bandura's model does not stand when it comes to children's efficacy beliefs and their own mathematics achievement. It appears mothers' mathematical efficacy belief influences children's mathematical efficacy belief and utility value for mathematics, but does not manifest itself in terms of children's mathematical achievement on the mathematics portion of the OCCT. According to Bandura's theory of Social Cognitive Learning (1977) one would expect that mothers' and children's high efficacy beliefs would positively influence children's mathematics achievement, yet his theory does not hold for this population. One possible explanation may be due to a gender stereotype effect (though this study did not look at gender differences).

Gender differences exist in many aspects and manifest themselves in various ways. Mathematics has been historically viewed as a male dominated subject area (Fennema, 1996; Hanna, 2003; LaLonde et al., 2003). Herbert and Stipek (2005) found that beginning in third grade, girls rated their mathematical competency lower than boys. Furthermore, Fennema (1996) found that young women did not believe mathematics was useful and they tended to be less confident in their own ability to be learners of mathematics, inevitably continuing this view of mathematics being a male dominated subject area. This historical view of mathematics has been difficult to break, thus creating a need for increased attention to involving females in the mathematics realm. Becker (1981) found that females were not being encouraged by teachers in the area of mathematics. Later, Hanna (2003) noted that over the past thirty years, there has been a drastic decrease in gender differences in mathematics which is almost nonexistent today. At the same time, LaLonde et al. (2003) found that females had lowered expectations in mathematics. These lowered expectations suggest parent and teacher practices in dire need of change in order for females to become more active in mathematics.

These study results, indicating mother's mathematical efficacy belief influences children's mathematical efficacy belief and children's utility value for mathematics, contrast the findings of Tapia and Marsh (2004). Tapia and Marsh (2004) developed a new instrument to measure student's attitudes towards mathematics and found that parental influence did not contribute to children's attitudes towards mathematics. Yet, as found in this study, self-efficacious parents influence their children to also be self-efficacious. As others have found, self-efficacy is the link between parent's beliefs and their children's beliefs (Bandura et al., 1996; Bandura et al., 2001; Parsons et al., 1982).

Interestingly, mother's utility value for mathematics negatively predicted children's efficacy belief and utility value for mathematics, but positively predicted children's mathematical achievement as measured by the OCCT mathematics results. Thus, the utility value mothers place on mathematics did not translate to their children, but did predict mathematical achievement scores. Fennema's (1996) research on mathematics utility value can help us further understand these interactions. As Fennema determined, when mathematics is not viewed as useful, people have a lower level of confidence in their ability to be successful at mathematics. Thus, in this dissertation research, it is likely that the usefulness of mathematics mothers are encouraging in their children is not aligned with that of the teacher, school, and mathematics in the OCCT. For some American Indian tribes, mathematics is part of their everyday lives and looks different from the procedural drills children complete in the classroom. Parents already feel disconnected from the mathematics that their children are learning because parents learned mathematics differently as children themselves (Remillard & Jackson, 2006). As Nelson-Barber & Estrin (1995) noted, many American Indian children have extensive knowledge of mathematics and science that is rooted in their communities and arrived at by observation and direct experience which is not procedural in nature. When mathematics instruction focuses on procedural drills, American Indian students are not allowed the opportunity to connect the mathematics that they are learning at home with the mathematics that they are learning in the classroom, thus creating a gap in their understanding of the mathematics and its usefulness. Unfortunately, as the results of this study suggest, for the American Indian population, this disconnect between school mathematics and home mathematics may be a contributing factor to children's lowered mathematical achievement.

In an additionally surprising result, neither children's confidence in their ability to do mathematics nor the value they place on the usefulness of mathematics predicted their mathematical achievement on the OCCT. Children need to successfully experience mathematical concepts numerous times in order to gain confidence in their ability to be successful in mathematics. These types of experiences will be commonplace with the implementation of the Common Core Standards for Mathematics (NGA/CCSSO, 2010). The move to the Common Core State Standards for Mathematics will allow implementation of conceptual understanding through numerous experiences that the National Research Council (NRC) (2001) found to be a critical component of learning mathematics. The NRC explains how mathematics is not a single dimension study; as an interwoven subject, mathematics lacks cohesiveness when separated into and taught by individual units. In addition the disconnect (that students feel between school mathematics and home mathematics) resurfaces and points to a need for further exploration. The focus population, American Indian students, succeeds when different learning styles are used, as well as how math is taught in the classroom. As Pewewardy (2002) explained, American Indian students tend to be global thinkers. In his meta-analysis, identifying American Indian students as global or field-dependent learners, Pewewardy suggested learning would be most successful when individual components are explained in relation to the big picture. This type of thinking resonates in standards based learning since students are focusing on concepts which may be multifaceted. Simple, procedural instruction does not allow American Indian to make the necessary connections amongst parts and the big picture. Other researchers have found self-efficacy to be a predictor of performance, yet the results obtained in this study are in conflict with those results (Nicolaidou & Philippou, 2004; Zarch & Kadivar, 2006).

## Implications and Recommendations

This study has been informative to the researcher on many levels, as an American Indian, parent, educator, and researcher. The implications of this research relate to theory and practice. In addition, there are a few recommendations for further research.

### Implications for Theory

This research was based on Bandura's Social Cognitive Theory though the findings of this study of rural American Indian students did not overwhelming concur with Bandura's theory. The mothers' efficacy in children's mathematical ability transferred to children, but the children's efficacy in their mathematical ability was not demonstrated on the mathematics section of the OCCT. Children's confidence in their mathematical ability and their view of the usefulness of mathematics did not influence their mathematical achievement, as Bandura's theory would predict. It seems Bandura's Social Cognitive Theory does not apply to this population in terms of mathematical efficacy.

Further research along these lines with American Indian children can help us better understand the population's mathematical efficacy belief system. As well, more research is needed with regard to the utility value for mathematics. There was little specific research that informed how students' utility value for mathematics influences student mathematical achievement. The utility value for mathematics was a very influential variable, yet needs further exploration. For this study, it provided a direct influence on mathematical achievement, yet without a base to draw from, the results are less powerful.

## Implications for Practice

This study informs mothers and tribal education departments about the overall influence of a mothers' mathematical efficacy belief and utility value for mathematics, as well as the influence of children's mathematical efficacy belief and utility value for mathematics on children's mathematical achievement. This study suggests that both mothers and children need to aware of both positive and negative influences that arise in children's views of mathematics. Tribal education departments in Oklahoma can help bring this awareness to the American Indian community, thereby improving mathematics achievement for American Indian students. This study also explains the influential nature of mothers and children on children's mathematical achievement.

A mother's confidence in her child's ability to be successful in mathematics influences children's confidence in their own ability as well as children's view of the usefulness of mathematics. Mothers will need to develop increased awareness about the changes that have taken place in the mathematics classroom. Open houses at school can create opportunities where the changes in mathematics pedagogy are explained to mothers. To help mothers understand these changes, mothers will also need to be able to see the changes in action. Mothers need to be able to see their children experiencing this new mathematical teaching style. Tribal education departments can host back to school events or education nights where mothers would get to participate and interact with their children utilizing some of these different mathematics teaching practices. Once mothers are able to see their children being successful, mothers can encourage their children to excel in mathematics. In addition, this would allow mothers specific instances to connect the mathematics that their children are learning at home with the mathematics that they are learning at school. These informal events could provide an opportunity to help American Indian students in their mathematics achievement by providing them with confidence in their own abilities as well.

On the other hand, a mother's view of the usefulness of mathematics is significantly harmful to children's mathematical efficacy belief and utility value for mathematics, while being beneficial to children's mathematical achievement. The influence of utility value for mathematics has created a confounding relationship which needs to be further researched and clarified. Therefore, the utility value for mathematics needs to be emphasized with American Indian students, in order to increase mathematical achievement. Since the utility value for mathematics passed from mother to child is potentially harmful, schools, curricula developers, and tribal education departments can help students see mathematics as useful.

American Indian students bring a unique ability of understanding mathematics and science in a naturalistic manner (Nelson-Barber & Estrin, 1995). Tribal education departments can help parents reinforce this naturalistic learning style, while providing training to teachers, both in-service and pre-service teachers, on the utility value for mathematics from the American Indian perspective. Tribal education departments can work with mathematics teachers and specialists (as well as elders) to develop activities which could be used in teacher professional development workshops to inform teachers. Universities can build relationships with local tribes that have a high percentage of students in the local school district to help meet this goal of providing culturally relevant professional development to both in-service and pre-service teachers. Sievert, LaFrance, and Brod (2011) discussed the need for more culturally congruent instruction (CCI) because the small body of research available indicates that CCI is beneficial to diverse students' achievement. Sievert et al. explain that there is a small base of literature that is increasing and suggestive that CCI is beginning to close the achievement gap for American Indian and African American students in relation to their White counterparts. Mathematics taught in the classroom is not connecting with the mathematics that American Indian students are learning outside of the classroom and applying in their everyday lives.

Another way to emphasize the usefulness of mathematics is to host family math nights. Nonesuch (2009) conducted qualitative research that determined Aboriginal parental participation in family math nights did changes parents' attitudes towards math and helped parents find the usefulness of mathematics beyond the classroom. Tribal education departments can host these nights to provide both parents (mothers in particular) and their children opportunities to view mathematics in real-world contexts that are more relevant to the community in which they reside. Educational events of this nature will provide opportunities for parents to see how children are learning the concepts in the classroom, while actually completing meaningful mathematical activities and tasks.

**Implications for Further Research**

This study is yet another glimpse into the ever evolving research on mathematics achievement within the American Indian population. Studies exist that look at achievement on reservation schools, whereas little research focuses on American Indian students in public schools – and the location of the school may be quite important. For example, Whitbeck, Hoyt, Stubben, and LaFromboise (2001 ) studied fifth grade students from three reservations while considering the effect of three dimensional enculturation: involvement in traditional activities, cultural identity, and traditional spirituality. Researchers found the level of traditional involvement varied based on the location of the students' proximity to the reservation where the activities are occurring. For some American Indian students in Oklahoma public schools, the reservation can be located in another state and thus limit students' their ability to participate in traditional activities on a regular basis. As Whitbeck et al. explained, American Indian children's operations in an environment contradictory to their values and worldviews engenders cultural discontinuity.

With an eye to better understanding the dynamics of enculturation, this study might be replicated with a sample that is more representative of the larger American Indian population in Oklahoma. Such a research study, looking at more than a small region of the state, would allow for more generalizable results for American Indian mothers, their children, and their children's mathematical achievement. Generalizable results will allow for best practices to be implemented in terms of the mathematics education of American Indians in public school classrooms. Self-efficacy and mathematics is heavy within the literature, but the usefulness of mathematics and its relationship with mathematical achievement is less prevalent.

Another possibility for further research would be to utilize an American Indian population within public schools that have an American Indian population that resembles the students in reservation schools. There are numerous studies that look at reservation schools, but do not look at the schools near reservations that have a similar population. With American Indian people moving off the reservation into urban areas (Hillabrant et al., 1992), children are limited to fully participate in traditional activities on a regular basis, inevitably creating a different population with its own features that are worthy of study. Looking at a similar population to that of the reservation will balance the rural culture of this population while allowing for an ethnic cultural difference. The results may be more informative of the influential role mothers have in their children's education.

This is an initial study looking at the usefulness of mathematics and the mathematical efficacy beliefs of students and its influence on mathematics achievement. The literature available on self-efficacy is abundant, due to Bandura's Theory on self-efficacy and achievement. Unfortunately, literature is lacking in terms of the usefulness of mathematics. Fennema's (1996) research discusses mathematical utility and its importance. Fennema and Sherman (1976a) developed the Mathematics Attitudes Survey which contained a subscale of mathematics utility, but not much else has been done with the usefulness of mathematics and its influence on mathematics achievement. Specifically, a look at how mothers are displaying the usefulness of mathematics to their children is necessary. A qualitative study utilizing interviews and focus groups with mothers and their children could help further explain the disconnect between mother's utility value for mathematics and the utility value for mathematics that is emphasized in the classroom. It is necessary to understand the manner in which mothers display the usefulness of mathematics, so as to be able to determine why the relationship between mothers and children's utility value for mathematics is inversely predictive of children's mathematical achievement.

Finally, this research could be replicated using a different theoretical model, perhaps that of an ecological viewpoint. Since this study did not uphold Bandura's understanding of self-efficacy and achievement in regards to American Indian students, the researcher is left to believe that other factors influence mathematical achievement that were not included in this particular study. A new study looking at children's home and school environments would provide greater understanding of the influencing factors of American Indian mathematics achievement. Children are influenced by their home environments. A study of the possibly conflicting environments (between home and school) could allow for greater emphasis to be placed on the factors that directly influence American Indian student mathematical achievement. Identification of these influential factors is crucial to reversing the historic trend in American Indian students' low achievement and eventual high school dropout.

## Concluding Comments

Research on the mathematical achievement of American Indian students is important for educators and parents alike. As an American Indian parent, I recognize it is important to bring awareness to other parents, the influential role that mother's play in the lives of their children, especially in regards to their mathematical views and beliefs. Mathematics is not a subject that American Indians should shy away from, in fact American Indian students should be encouraged to utilize their innate, naturalistic methods of understanding mathematics in order to best understand and connect to the mathematics they are learning in school (Nelson-Barber & Estrin, 1995). NSF (1995) suggests increased school achievement in science and mathematics can serve to broaden the future participation of minorities and women in Science, Technology, Engineering, and Mathematics (STEM) careers. Teachers, schools, parents, and tribal education departments can all help to facilitate mathematics instruction that incorporates learning styles that work best with American Indians and help to build students' confidence in their abilities, as well as increase achievement.

American Indian mothers and parents in general play an important, influential role in our children's lives, thus we must recognize the effect that we have on our children. Mathematics is one subject that we talk about with our children on a regular basis, so why not encourage our children to excel in mathematics. As an American Indian parent, I understand the importance that I place on mathematics impacts my children, thus I place a high importance on mathematics. The unexplainable relationship of a child's confidence in their ability and utility value for mathematics that the child has is interesting to me and worthy of further investigation. This study has equipped me with information to help tribal education departments and school districts help parents, especially mothers see the importance in the mathematics that our students are learning in today's classroom, thus bridging the gap from old ways of viewing mathematics to a more current view of mathematics.

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# APPENDIX

Office of University Research Compliance

219 Cordell North
Stillwater, Oklahoma 74078-1038
Phone: (405) 744-1676
Fax: (405) 744-4335

July 16, 2013
Cynthia Orona
240 Willard Hall
Stillwater, OK 74078-4042

Dear Cynthia:

This letter is to inform you that the OSU-Stillwater IRB has reviewed your project entitled "Efficacy and Utility Beliefs of Mothers and Children as Predictors of Mathematics Achievement for American Indian Students", and determined that your project does not qualify as human subject research as defined in 45 CFR 46.102(f), which states "Human subject means a living individual about whom an investigator conducting research obtains 1) data through intervention or interaction with the individual, or 2) identifiable private information". The project description states that all identifiers previously collected from other investigators have been removed and replaced with codes that you will not have access to and therefore will never be able to connect the codes to specific individuals. De-identified data in which the investigator will never have access to the code that links the identifiers to the participants is not considered human subjects research. Therefore, this study is not subject to OSU IRB oversight.

Should you have any questions or concerns, please do not hesitate to contact me.

Sincerely,

Dawnett Watkins
IRB Manager
University Research Compliance
217 Cordell North
Stillwater, OK 74078-1038
405-744-5700
dawnett.watkins@okstate.edu

VITA

Cynthia C. Orona

Candidate for the Degree of

Doctor of Philosophy

Dissertation: EFFECTS AND UTILITY BELIEFS OF MOTHERS AND CHILDREN AS PREDICTORS OF MATHEMATICS ACHIEVEMENT FOR AMERICAN INDIAN STUDENTS

Major Field: Professional Education Studies—Mathematics Education

Biographical:

Education: Completed the requirements for the Doctor of Philosophy in Professional Education Studies—Mathematics Education Specialization at Oklahoma State University, Stillwater, Oklahoma in July, 2013.

Completed the requirements for the Master of Education in Elementary School Principal at East Central University, Ada, Oklahoma in 2007.

Completed the requirements for the Bachelor of Science in Mathematics and Elementary Education at The University of Tulsa, Tulsa, Oklahoma in 1998.

Experience:

2010 – present **Graduate Teaching Assistant,** School of Teaching and Curriculum Leadership, Oklahoma State University, Stillwater, OK. *Courses Taught*: Teaching Mathematics at the Primary Level; Teaching Mathematics at the Intermediate Level.
**Graduate Research Assistant**, *Signals* Project, Oklahoma State University, Stillwater, OK. *Primary Duties:* All aspects of data entry and collection; serving as the community liaison with American Indian tribal nations; and supervising undergraduate student work efforts for the National Science Foundation – Research on Gender in Science and Engineering grant #07-582.

2003-2010 **Justice Elementary School: Grade 4 and Grade 5-8 Reading and Math Teacher.**

2001-2003 **Pegasus Charter School: Grades 7 & 8 Math Teacher.**

Professional Membership:
Member, Research Council on Mathematics Learning