THE IMPACT OF LESSON STUDY PROFESSIONAL DEVELOPMENT ON TEACHER SELF-EFFICACY AND OUTCOME EXPECTANCY

by

DEBORAH ANNE NAUERTH

B.S., Kansas State University, 1995
M.S., Kansas State University, 1999

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Curriculum and Instruction
College of Education

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Manhattan, Kansas

2015

Abstract

The purpose of this mixed methods case study was to examine the impact of lesson study professional development on teacher self-efficacy and outcome expectancy using Bandura's Social Cognitive Theory as a framework (1977). The focus of this lesson study was implementing Common Core State Standards for mathematics. Thirteen K-6 teachers participated in the lesson study professional development, completed a pre/post Mathematics Teaching Efficacy and Expectancy Beliefs Inventory (MTEEBI) and completed ongoing journaling prompts while the researcher conducted observations throughout the process.

Qualitative and quantitative data gathered in this research indicated the lesson study professional development had a positive impact on both self-efficacy and outcome expectancy of the teacher participants. Though the teachers possessed a satisfactory level of self-efficacy and outcome expectancy at the onset of the study, a measurable gain was evident. Comparison of the pre and post MTEEBI surveys, through statistical analysis using a Paired-Samples t-test, indicated a significant positive change in both self-efficacy and outcome expectancy scores. Though growth for both constructs was significant at the .05 level of probability, self-efficacy growth was greater than outcome expectancy. This finding is supported in historical research of the challenge of yielding outcome expectancy growth. The qualitative analysis of observations and journal prompts corroborated the MTEEBI results, indicating a majority of the teachers' self-efficacy and outcome expectancy beliefs were positively impacted by the lesson study professional development. Bandura's four sources of efficacy (mastery experiences, modeling, verbal/social persuasion, physiological responses) positively impacted personal self-efficacy, while three of the four sources (mastery experiences, modeling, physiological responses) impacted outcome expectancy. Qualitative data indicated mastery experiences were most critical for both constructs. Lesson study professional development is a natural catalyst for addressing Bandura's four sources of efficacy and thus building self-efficacy and outcome expectancy.

Given the demands of rigorous educational reform, lesson study professional development is a promising approach to positively impact teacher self-efficacy and outcome expectancy, through engaging Bandura's four sources of efficacy to develop and strengthen these beliefs. Therefore lesson study ought to be a more frequent component of teacher professional development and teacher preparation.

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We did it! AAWWOOOOOO!!!!!

Dedication

To my husband, Joel~

Joel, your love and never-ending support helped see me through the journey of fulfilling a lifelong dream. Your patience and sacrifice will forever be remembered. Time spent writing meant time spent away from you. Thank you for your continuous care and encouragement, always believing in me. I could not have completed this dissertation without you!

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Preface

Imagine walking through the halls of a school and stepping into a classroom where all the desks are in a row and the teacher is instructing from the front of the room. As the teacher instructs, a process for solving isolated equations is told to the students and the teacher models the process again and again with different examples on the board. The students do not take an active role in the lesson, rather they are an audience watching the teacher move through the process to solve the equations. When the teacher is finished, the students are given a lengthy assignment to complete and are told to use the same procedure they observed. As the students begin their assignment, lack of understanding and frustration is immediately evident as students look around the room at each other. Some ask, "What do I do first?" while others simply comment, "I don't get this." The teacher returns to her desk and tells them to try their best.

Walking through the halls once again, another classroom catches your attention. The hum of the classroom, as you move closer, reveals students who are collaborating in teams discussing and problem solving together. Upon closer inspection, you notice the students have manipulatives in hand and are using them to construct the equation. They are solving the problem in a concrete manner. The students are justifying their method of problem solving with peers by sharing their understanding of the relationships present within the equation that is embedded in a real world problem. Students share their process for solving the problem and they compare/contrast their findings discussing the plausibility of each response. The teacher in this classroom is moving from team to team asking guiding questions to evaluate student understanding and misconceptions. The teacher takes notes of these interviews to follow up during the whole class wrap-up discussion.

One must ponder, what accounts for these two very different hypothetical learning environments? Is it lack of mathematics content knowledge? Does weak pedagogical content knowledge factor into this inconsistency? Perhaps a disparity in professional development opportunities exists? Does lack of self-efficacy for teaching mathematics play a part in such a profound variance of instruction? How does outcomes expectancy play a role in the instruction provided to the students? A critical question remains, are both teachers adequately preparing their students for meeting the demands of the rigor required by the recently adopted Common

Core State Standards in an effort to ensure all students are college and career ready upon their graduation from high school?

The target of this proposed research is to study the impact of lesson study professional development on self-efficacy and outcome expectancy within actual teaching practices in an elementary school setting. In chapter one an overview of the issues, purpose of the study, guiding research questions, significance of the study, limitations and definitions reveal the foundation which girds this research project.

Chapter 1 - Introduction

Overview of the Issues

The Kansas State Board of Education adopted the Common Core State Standards (CCSS) for mathematics on October 12, 2010 (CCSSI, 2010). These same common standards have been adopted by 45 states, the District of Columbia, 4 territories, and the Department of Defense Education Activity since they were introduced on June 2, 2010. The CCSS provide for a more focused and coherent set of standards, to be shared across the nation. This cohesiveness allows for collaboration from state to state as materials, curriculum, and assessments are created to meet the demands of the CCSS. These standards outline what "students should understand and be able to do in their study of mathematics" (p. 4) and present a vision for all students to be prepared for success in their future, whether entering college or the workforce. This preparation for success in college or career readiness will ultimately put the U.S. in a better position to compete in a global economy (CCSSI, 2010). Therefore, the instruction students are engaged in within classrooms throughout the U.S. must allow students to be challenged with the rigor intended by the CCSS. Through the CCSS, understanding is defined as a hallmark through justification of, "why a particular mathematical statement is true or where a mathematical rule comes from" (p. 4).

A great deal of effort has been put into creating a national assessment system based on the CCSS. Shifting from the ambiguity of having separate standards for each state with an assessment to accompany each set of standards, the clarity of moving to common standards and assessments in most states will allow for a meaningful comparison between the mathematics instruction and learning that is taking place in states that adopted the CCSS. This continuity supports the need for equitable access to high quality mathematics instruction for all students throughout the nation. Analyzing the sample CCSS mathematics questions released by the Smarter Balanced Assessment Consortium (SBAC) will allow any reader to identify the degree of complexity required of instruction to meet demands of the performance based and technology integrated assessment items. Full CCSS implementation will be assessed in its entirety with the 2014/2015 assessment cycle in all adopting states. SBAC embedded some of the recently created CCSS test items into current Kansas State Assessments to analyze performance on these new demands. SBAC pilot assessments were made available to volunteering districts during the

2012/2013 school year, to review progress with teaching the CCSS prior to the final assessment. During the 2013/2014 school year, a field test was administered to selected districts in CCSS adopting states. These assessment questions move far beyond procedural knowledge of lessons from a century ago, that are far too typical in current day to day mathematics instruction (Kilpatrick, Swafford &Findell, 2001; Larson, 2011) to application of knowledge in a sophisticated manner that demands justification to demonstrate understanding.

The CCSS include standards for mathematical content as well as mathematical practice. To ensure CCSS are implemented, there must be a shift in classroom instruction to include the Standards of Mathematical Practice taught in conjunction with the new mathematics content standards. According to Hiltabidel (2012), when implementing CCSS, the teacher's role must shift to that of a facilitator, where students take the lead in persevering with problem solving. This change in practice, both curriculum and assessments, must be brought about through effective professional development and time for teacher collaboration within a community of practice (Sergiovanni, 2009).

Larson (2011) suggested that the best way to improve mathematics instruction is to make "a substantial investment in professional development" (p. 41). Therefore, a proactive approach to this challenge is to provide ongoing professional development focused on the new standards that are being implemented in classrooms throughout the nation. In addition, providing a support system to assist teachers in their acquisition of new skills where teams of teachers collaborate to help implement quality lessons to promote lasting change is important (Schmoker, 2011). A smaller team setting also provides a safe haven for teachers to ask questions they may otherwise not feel comfortable asking in a larger group setting.

The CCSS initiative needs to be owned by individual schools through a collaborative educational vision and mission for implementation. Follow-up activities are an essential part of continued development of skills and use of CCSS in the classroom. Building leadership capacity within a school is essential to ensure the shift in mathematical teaching occurs and remains regardless of administrative changes within the school. According to Lambert (2003), "Leadership capacity can refer to an organization's capacity to lead itself and to sustain that effort when key individuals leave" (p.4). Implementation of CCSS must, therefore, be a collective district and school vision, not just a vision held only by the administrator leading the school. Shared leadership through developing a community of practice strengthens leadership capacity, allowing teachers to take on a leadership role. Establishing a community of practice is a way for teachers to come together to share methods they have used in their own lessons and discuss ways to improve instruction, creating a bond in reaching a shared common goal (Sergiovanni, 2009). Learning from each other is a strong way for educators to build synergy for a new initiative. In addition, having teachers observe in each other's classrooms to begin discussions of effective methods to incorporate and enhance lessons built around CCSS is a powerful tool for improving performance (Barth, 2006). All of these essential cornerstones of effective professional development were built into this research design.

The successful implementation of any change, including the CCSS initiative, is dependent upon what teachers do as well as what they believe (Fullan, 2010). Teachers must believe they can teach the CCSS and they must believe students can learn these standards as well. These beliefs are referred to as a teacher's self-efficacy and outcome expectancy.

Teaching efficacy is a crucial construct to education because it is a variable that has been demonstrated to contribute to teacher behaviors and teaching effectiveness (Gibson & Dembo, 1984). Gibson and Dembo's research (1984) revealed that teachers with a higher self-efficacy tended to attain higher student achievement through specific behaviors such as: more active engagement during more time spent in whole group instruction, the use of games was not observed during instruction time, more time was spent on preparation or paperwork activities, criticism was not evident when responding to incorrect student responses, and persistence was demonstrated through questioning to guide a student to a correct response rather than moving on to another student for a correct response or moving on to a different question. Brookover et al. (1978) found in their research that teachers spent more time in their instruction and showed more concern for student learning when employed at schools that were higher achieving schools. Further, Brophy and Evertson (1977) found that teachers who were able to demonstrate gains in student learning were more likely to hold high expectations and viewed student achievement as their personal responsibility. In addition, these teachers viewed learning difficulties as hurdles they, as the teachers, needed to address and overcome, rather than placing blame on the students' ability. Gibson created the Teacher Efficacy Scale (TES) as way to measure the self-efficacy construct (Gibson & Dembo, 1984). This initial scale was a global non-content specific measure of teaching efficacy that has been modified to create efficacy scales specific to content areas such as science and mathematics.

In Bandura's social cognitive theory (1977), he identified two related constructs: self-efficacy and outcome expectancy. Both of these constructs are explored further in chapter two. However, it is important to the introduction of this study to have a firm foundational working definition of the constructs as discussed within this research including self-efficacy, teacher self-efficacy, personal mathematics teacher efficacy and outcome expectancy. Bandura (1997) defines Self-Efficacy (SE) as, "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). When considering self-efficacy from a teacher's perspective, Teacher Self-Efficacy (TSE) refers to a teacher's belief in his/her own ability to teach (Gibson & Dembo, 1984). Narrowing the definition to look at the content specific nature within this research focusing on mathematics, Personal Mathematics Teacher Efficacy (PMTE) refers to a teacher's belief in his/her own ability to teach math effectively. Finally, Outcome Expectancy (OE) is a teacher's beliefs in students' ability to learn, despite circumstances including student background (Gibson & Dembo, 1984).

Bandura reasons, "The task of creating learning environments conducive to development of cognitive competencies rests heavily on the talents and self-efficacy of teachers" (Bandura, 1997, p. 240). Research by Ashton and Webb (1986) concluded that teachers with higher efficacy had students with higher levels of achievement. This direct correlation between teacher self-efficacy and student learning is the foundation for educational reform in pursuit of educational excellence. Teachers who embody a strong self-efficacy also demonstrate professional fortitude that has a positive impact in the classroom, such as willingness to devote concerted effort in their instruction and persistence in teaching even if things do not go as anticipated, and an ability to navigate challenges as they arise (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998). In addition, a strong sense of self-efficacy also inspires teachers to attempt new forms of innovative instruction (Guskey, 1988).

The complexity of teacher self-efficacy is multifaceted with many factors having influence on this critical construct. Bandura identified four such factors as: 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions. Hoy asserted that “mastery experiences,” or prior success, that take place during student teaching or the induction period are instrumental in shaping teacher efficacy beliefs (Hoy, 2000, p. 2). She further pointed out that support from other teachers and administrators can influence a teachers’ sense of efficacy. Support that is most meaningful is, “not ‘cheerleading’ or close supervision but help in doing the work of teaching, help in reaching the teachers’ goals of reaching the students” (Shaughnessy, 2004, p. 163). This support might include modeling, verbal/social persuasion, and physiological response and ideally would lead to additional mastery experiences. Milner’s research found that respect from both students and parents helped support teacher self-efficacy (Shaughnessy, 2004). This lesson study research attempted to arouse all four factors that influence self-efficacy, creating a support system for teachers in the process of implementing change with the CCSS math standards.

We cannot continue to ask teachers to do more and more without building in the resources of support that are needed to help teachers be successful in meeting the demands of high quality teaching and effective learning. In so doing Hoy offers, “both teachers and students share an authentic sense of efficacy for learning” (Shaughnessy, 2004, p. 165). With the adoption of CCSS, we need to provide effective professional learning opportunities for teachers to grow in their teaching craft. Creating communities of practice to allow teachers to learn and improve their instruction together will provide a springboard for teacher self-efficacy. Ashton and Webb (1986) reported, “Teachers’ beliefs concerning their efficacy predict students’ level of mathematical and language achievement over the course of the academic year, with variations in students’ entering ability statistically controlled” (Bandura, 1993). In this time of transition with CCSS, it is imperative that we continue to strive to build teacher self-efficacy, or the consequences of low teacher self-efficacy will be paid with inadequate student learning and teachers leaving the profession.

Given the research, a strong sense of teacher self-efficacy is critical for meeting the needs of students in math classes throughout the U.S. and meeting the mission of CCSS that all high school students will be college and career ready upon high school graduation. Teachers need to believe their efforts in the classroom can result in student achievement. Providing quality professional development in a community of practice will support the development of self-efficacy. All four factors Bandura identified as influencing self-efficacy: mastery experiences, modeling, verbal/social persuasion, and physiological response are natural components of professional development involving lesson study. Using a lesson study model of professional development should therefore enhance teachers' self-efficacy as well as their teaching practices.

Purpose of the Study

The central purpose of this study was to ascertain the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, the lesson study professional development being examined focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy viewed through an indepth examination of the entire process, grounded in actual teaching practice through observations by the researcher to effectively capture and study teacher efficacy in a natural setting revealing teacher beliefs and practices in action, rather than relying solely upon teacher self-reporting.

This lesson study professional development program was provided through support of a University Small Research Grant (USRG) from Kansas State University for the project, *Modeling and Characterizing Elementary School Students' Mathematical Arguments*, written by Dr. Chepina Rumsey. This professional development was centered around mathematics instruction that embedded student argumentation as set forth in the Common Core State Standards for Mathematical Practice 3: *Construct viable arguments and critique the reasoning of others*. A common theme was woven through each of the K-6 lesson studies by focusing on the overarching Domain of Number and Operations. The professional development incorporated the lesson study model to provide a team-centered approach to support teachers as they align their instruction with Common Core Standards. This case study integrated both qualitative and quantitative data collection methods to examine the impact of the professional development on teacher self-efficacy and outcome expectancy.

The researcher anticipates the findings of this study will lead to a deeper understanding of the impact of professional development, involving lesson studies, on teacher self-efficacy during a transition to the new CCSS. In addition, the study will fill a gap in research on teacher self-efficacy by utilizing actual classroom observations and videotapes, rather than relying solely on self-reports from classroom teachers as is more typical of research on teacher self-efficacy. Including actual observational data will provide valid input on classroom teacher practice to support self-reports. Finally, the researcher hopes to contribute to the literature by addressing a significant issue within the field of research on self-efficacy by addressing the need for content specificity with a quantitative content specific self-efficacy and outcome expectancy measure. This study will focus on self-efficacy and outcome expectancy within a mathematics context by utilizing the MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument), a recently designed instrument to assess self-efficacy and outcome expectancy beliefs specifically related to the CCSS for mathematics.

Research Questions

The impact of lesson study professional development on self-efficacy and outcome expectancy was examined through the following overarching research question:

1. In what ways does lesson study professional development impact teachers' self-efficacy and outcome expectancy?

This overarching question was explored through two more specific subquestions.

A. In what ways does the lesson study process impact teachers' personal mathematical self-efficacy?

B. In what ways does the lesson study process impact teachers' mathematical outcome expectancy?

Research Design

The methodological approach most appropriate for this research was a case study to examine the impact of lesson study professional development on self-efficacy and outcome expectancy. The case study is that of professional development brought to the school, supported by a Kansas State University USRG. To more fully understand the impact of the lesson study professional development, both qualitative and quantitative measures were used as a means of data collection in this case study (Yin, 2009). Three main sources of data were collected including a survey, observations recorded through videotaping, and type written journal responses.

Data was initially gathered from a group of fourteen teachers participating in the lesson study using the Mathematics Teaching Efficacy and Expectancy Beliefs Instrument (MTEEBI) survey. This instrument was given before and after the professional development, for a pre and post comparison. The MTEEBI is a teacher reported survey that addresses both self-efficacy and outcome expectancy beliefs within a mathematics context. The MTEEBI was updated from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) to include items that addressed the rigor of the CCSS.

After completing the MTEEBI pre-survey and the Planning Phase Journal prompts, participants completed a lesson study cycle with their grade level team that was observed in person and videotaped for further review and analysis. This lesson study cycle included the following cycle: (1) A team planning session was held where a lesson was created to focus on the standard numbers and operations and the mathematical practice standard of mathematical argumentation; (2) One teacher member of the team taught the lesson; (3) A meeting was held with all observers and participants to discuss the lesson and suggest changes for improving the instruction; (4) The second teacher taught the lesson with the modifications suggested; (5) A final reflection meeting was held to discuss the impact of the changes on student learning.

The researcher conducted ongoing observations of all parts of the lesson study professional development. These observations provided an authentic view of the teaching in action to add rich discussion to the teacher reported survey and journal entries. Observations also included collegial observations by the participants themselves, as they both observed a colleague and modeled teaching a lesson for their colleague participants.

In addition, teachers completed reflection journals before, during, and after the lesson study to share their perspective of the lesson study experience. These journal prompts were specifically designed by the researcher to understand the perceived impact of lesson study on the teacher participants' self-efficacy and outcome expectancy. All planning meetings, lessons that were taught, and debriefing/reflection meetings were videotaped to provide data for further review and analysis of evidence of self-efficacy, outcome expectancy and evident impact throughout the process.

The researcher further shaped the study through the paradigm of social constructivism. As defined by Creswell (2007), social constructivism brings about a goal of the researcher to, "rely as much as possible on the participants' views of the situation" (p. 20). With this guiding paradigm, the researcher developed questions that were open-ended and broad to intentionally invite the rich description of the participants' experiences to be shared.

The professional development and lesson study process began in January 2013 and was completed in May of 2013. Qualitative and quantitative data collection spanned this five month period. Dr. Chepina Rumsey, of Kansas State University, disseminated the pre and post MTEEBI surveys and led the professional development sessions, lesson study planning sessions, lesson modification discussions, and debriefing discussions. Observations were conducted in person and/or through review of videotaped sessions with the all participants before, during, and after the lesson study. Reflection journal entries were requested by the researcher from all participants during the lesson study planning phase before the lesson study, during the lesson study phase, and during the reflection phase after the lesson study process was complete.

Analysis

At the culmination of the study, the researcher initially took a holistic data analysis approach (Yin, 2003). The researcher examined all data including pre and post MTEEBI survey results all lesson study observations, planning sessions, teaching observations, debriefing/reflection meetings and videotaped documentation (to include the entire lesson study cycle with planning sessions, lessons, debriefing, and reflection sessions), and journal entries. Then data was analyzed separately using qualitative and quantitative strategies described below.

The researcher used memoing throughout the analysis process to record insights or reflections on the data as they occurred.

Qualitative Analysis

Observations and Videotaped Documentation

The researcher reviewed the field notes that were taken during the observations and viewed the videotaped episodes a multitude of times to write a thick, rich description of the complete lesson study process. The observations were categorized by the main events of lesson study process. Teacher participant quotes were extracted verbatim, when possible, to provide depth to the experience from the participants' perspectives.

Journal Entries

While the journal response typescript data was reviewed from a holistic perspective initially, the researcher took notes on potential patterns and categories that began to emerge through repetition and correspondence between the multiple data sources collected. A coding system was used to track similar participant responses, which were then coded and later became themes. Codes that seemed to overlap were refined and combined into a singular theme. Open coding was implemented throughout this process, continually adding to codes as they became evident and analyzing previously coded data with respect to the new codes that emerged. This cyclical analysis continued until all textual data had been coded. Deductive coding was implemented as all codes were applied based upon the theoretical framework of Bandura as previously discussed, during the analysis including priori codes of sources of self-efficacy including mastery experiences, modeling, verbal/social persuasion and physiological response. In vivo coding was applied when possible to utilize the specific language of participants to more closely represent their experiences.

Quantitative Analysis

MTEEBI Survey

The MTEEBI was analyzed using a Paired-Samples t-test to determine the statistical differences in the pre and post self-efficacy and outcome expectancy responses in relationship to the lesson study professional development experience. This analysis is the recommendation given from the instrument developer and is traditionally the most commonly used in the field with the MTEEBI. Given the small sample size of this research, N=13, and the likert response scale of the MTEEBI not representing true interval data, the researcher chose to compare the parametric t-test results to the results from a non-parametric Wilcoxon Signed Ranked Test.

This quantitative analysis tested the following Null Hypotheses:

Null Hypothesis 1: There will not be a difference in the MTEEBI pre and post self-efficacy mean scores collected before and after the lesson study professional development.

Null Hypothesis 2: There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores collected before after the lesson study professional development.

Significance of the Study

This study contributes to the research by ascertaining the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, it provides a deeper understanding of lesson study professional development directly related to mathematics CCSS. By viewing self-efficacy and outcome expectancy during instructional mathematics practices carried out in elementary classrooms, changes in self-efficacy were identified in relation to participation in lesson study professional development focused on CCSS. Viewing self-efficacy through the lens which incorporates professional development with a focus on CCSSM is important because little research can be found connecting professional development with CCSSM and self-efficacy. This research will shed light upon ways in which to provide support for teachers to make the goal of the CCSSM standards based instruction a reality and in turn provide avenues to deliver professional development that increases self-efficacy to retain teachers and also create high quality mathematics instruction to all students, to help ensure they are prepared for college and career readiness upon graduation from high school.

Further, this research addressed two of the most significant issues within the field of research on self-efficacy in the educational setting, which includes specificity and teacher self-reporting methods. Much of the research has indicated the need for content specific measures to look at self-efficacy within a specific domain. The MTEEBI, with its specific focus on personal mathematics teaching efficacy (PMTE) aligned to the rigor of CCSS, is the most specific tool available at this time. The MTEEBI used in this research has been designed to look more specifically at mathematics teaching self-efficacy with items embedded that explore the complexity of teaching to the Common Core State Standards with respect to self-efficacy and outcome expectancy.

The second major issue within the field is the need for reliance on actual observations of teaching episodes versus utilizing only teacher self-reports of their classroom practice. Much of the research examining self-efficacy beliefs in education discuss the issue of teacher self-reporting methods and the potential discrepancy that could be present between what teachers say and what they do in the classroom. To address this concern, the design of this research was strategically planned to ensure direct observation of teaching episodes throughout the study, including in-person researcher observation, teacher peer observation, and videotaping to allow for reviewing and reflection of the teaching and all aspects of the lesson study professional development.

The researcher took these two major issues into consideration when carefully designing this study to specifically address this gap in research. This study addressed both major underlying issues in the field by including a mathematics content specific self-efficacy belief instrument that takes into account the rigor of the new CCSS, as well as, utilizing first hand researcher observations and videotaping of all teaching episodes.

Limitations and Addressing Limitations of the Study

The purpose of this study was to ascertain the impact of the lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, the lesson study professional development being examined focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy in an elementary mathematics setting, utilizing direct observations in the classroom by the researcher in person and through videotaped lessons. This allowed for the researcher to study teacher efficacy in a natural setting revealing teacher beliefs and practices in action, rather than relying solely upon teacher self-reporting.

The research was conducted in one elementary school in a city in a Midwestern state. This school is unique in that it was established as a Professional Development School (PDS) with the local university in 1989. Through this strong partnership, the university has supported this school with quality professional development, such as the one completed in this study. The study's findings are limited to the school and sample group as the school and teachers are not a reflection of all schools and teachers in this state or the U.S. The results can only be applied to the 14 teacher participants in this unique setting. A rich, thick description was provided from the researcher about the school setting and context of the study, as well as the participants in the study, and methodology within Chapter 3. This rich description will help readers determine transferability of findings of this study to their own setting by determining if there are any characteristics that are shared with their own scenario and setting (Guba & Lincoln, 1989).

Second, the researcher is also the principal of the school where the study took place. Creswell (2007) notes caution in conducting research in your own "backyard" where one is employed because it could potentially "raise questions about whether good data can be collected when the act of data collection may introduce a power imbalance" (p. 122) and "may keep him or her from acknowledging all dimensions of the experience" (p. 139). The researcher was cognizant of the potential concern of conducting research within the school with teachers, given this dual role. Knowing this duality, the researcher took much care in determining if the study should take place at all. As a precaution and protection of the teacher participants, the researcher gave a survey to faculty to determine both their comfort level with the dissertation research being completed within the school and their willingness to participate in the lesson study professional development. Their comfort level with dissertation research within the building and willingness to participate, or preference to create their own action plan in lieu of the professional development, was deemed essential to allow teacher participants the opportunity to decline dissertation research being done within the school and participation in the professional development and have an alternative way in which to demonstrate their plan of action to implement Common Core State Standards (CCSS) into their daily mathematics instruction. Teachers were assured if they were uncomfortable with such research being conducted in the school, this would not be done at the time of the request nor in the future under the leadership of the principal/researcher. Recruitment for this research study was based upon an invitation to volunteer to participate. In a written survey, prior to beginning the research project, teachers were queried about their comfort level with research being conducted in the school by the principal and their willingness to participate in the professional development with questions found in Appendix A. Teacher participation in the data collection phase for the dissertation research was optional. Teachers that completed all three parts of the data collection received a gift card purchased through the USRG.

Of the fourteen classroom teachers at the school that were surveyed, twelve surveys were returned for a total return rate of 86%. Analysis of the surveys found that 100% of the participants responded they were comfortable with dissertation research being done within the school. In addition, 100% of the respondents said they preferred to participate in the professional development as opposed to creating their own action plan for incorporating CCSS into their mathematics instruction.

The careful consideration for participants by the researcher throughout the planning phase served to alleviate any concern that teachers would feel they "must" participate in the research and provided ample opportunity for teachers to "opt out" of the research if they preferred. In addition, teacher participants had the right to voluntarily withdraw from this research study at any given time. Participants also were assured confidentiality and anonymity of their responses in any written summaries of the research. The researcher strived to be sensitive to participants by anticipating any ethical implications and addressing them readily to assure their integrity was honored and respected fully throughout this entire study.

Finally, the professional development and lesson study was conducted by Dr. Chepina Rumsey from Kansas State University. The researcher did not take an active role in leading either the professional development or the lesson study. Rather, the researcher was an observer and participant. In adhering to Creswell's (2007) caution, he offers a remedy to the need to study one's own workplace by using "multiple strategies of validation" (p. 122). Prolonged engagement and persistent observation within the field were both established as the researcher worked in the environment and participated in planning and/or observation throughout the entire 2012/13 school year. The researcher spent August through December leading, participating, and observing ongoing professional development within the school where the research was conducted. In addition, the researcher planned with Dr. Rumsey the lesson study professional development and calendar of implementation during this time period as well. The actual research took place from January through May of 2013. During this time, the researcher was both participant and observer of the lesson study professional development process. Throughout this year of prolonged engagement and persistent observation, the researcher was able to better understand the learning culture of the school and build a trusting relationship with the participants. "Triangulation" (Creswell, 2007, p. 208) of data was apparent as validation included the observations, MTEEBI survey, and journal responses. "Member checking" (p. 208) was utilized to ensure the accuracy of reflections and interviews as participants were afforded the opportunity to review the dissertation drafts. Finally, "rich, thick description" (p. 209) was included throughout the study to include detailed description to inform the reader and allow him/her to determine transferability to his/her own setting independently.

Given that qualitative research relies upon the interpretation of the researcher, direct quotes from participants were used. Johnson (1997) asserts that the use of verbatim descriptions in the way of direct quotes from participants further enhances reliability due to their low inference descriptive nature. The researcher embedded direct quotes when possible to promote authenticity in the analysis and reporting of findings in this study. In addition, the inclusion of both qualitative and quantitative data promoted balanced support for the findings.

Definition of Terms

College and Career Ready: College and career readiness is a goal of the Common Core State Standards for all U.S. high school graduates. The Kansas state definition as adopted and approved by the Kansas State Board of Education on 12/12/12 is as follows, "College and Career Ready means an individual has the academic preparation, cognitive preparation, technical skills, and employability skills to be successful in postsecondary education, in the attainment of an industry recognized certification or in the workforce, without the need for remediation," retrieved from http://www.ksde.org/Portals/0/Learning%20and%20Innovative%20Services%20Documents/Kansas%20CCR%20Definition%20Approved.pdf.

Collaboration: "A systematic process in which teachers work together to analyze and improve their classroom practice" (DuFour, 2004, p. 6).

Common Core State Standards (CCSS): Standards created with the collaboration of many organizations including teachers, parents, and content experts to provide rigorous Mathematics and English Language Arts standards, adopted by many states, with a goal to ensure students in the U.S. are college and career ready upon graduation from high school (CCSSI, 2010).

Common Core State Standards Initiative (CCSSI): "The Common Core State Standards Initiative is a state-led effort to establish a shared set of clear educational standards for English language arts and mathematics that states can voluntarily adopt" (CCSSI, 2010, p. 1).

Communities of Practice: According to Wenger (2006), "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 1).

Domains: "Larger groups of related standards," as noted in CCSSM (p. 5).

Lesson Study: As defined by Stepanek, et al (2007), lesson study is, "a professional development practice in which teachers collaborate to develop a lesson plan, teach and observe the lesson to collect data on student learning, and use their observation to refine the lesson" (p. 195).

Outcome Expectancy: A teacher's beliefs in students' ability to learn, despite circumstances including student background (Gibson & Dembo, 1984).

Personal Mathematics Teaching Efficacy (PMTE): A teacher's belief in his/her own ability to teach math effectively.

Professional Development: The National Staff Development Council defines professional development as, "a comprehensive, sustained and intensive approach to improving teachers' and principals' effectiveness in raising student achievement," retrieved from http://www.aypf.org/documents/62609NSDCDefinitionofProfessionalDevelopment908.pdf.

Self-Efficacy: Bandura (1997) defines self-efficacy as, "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3).

Smarter Balanced Assessment Consortium (SBAC): A state-led consortium that is designing assessments aligned with the Common Core Standards for Mathematics and English Language Arts.

Standards for Mathematical Practice: "…varieties of expertise that mathematics educators at all levels should seek to develop in their students" (CCSSI, 2010). These standards were born out of the NCTM process standards and strands of mathematical proficiency as outlined in the National Research Council's report *Adding It Up.* The Standards for Mathematical Practice are: Standard 1: Make Sense of Problems and Persevere in Solving Them; Standard 2: Reason Abstractly and Quantitatively; Standard 3: Construct Viable Arguments and Critique the Reasoning of Others; Standard 4: Model With Mathematics; Standard 5: Use Appropriate Tools Strategically; Standard 6: Attend to Precision; Standard 7: Look For and Make Use of Structure; Standard 8: Look For and Express Regularity in Repeated Reasoning.

Teacher Self-Efficacy: A teacher's belief in his/her own ability to teach (Gibson & Dembo, 1984).

Summary

Professional development has been highlighted as an important component to enhancing teaching self-efficacy, which in turn impacts student learning. Given the challenges before us in implementing the Common Core State Standards and to continue our goal of school improvement and school reform, it is essential for educators to have high quality professional development opportunities to improve their content knowledge and pedagogy skills. This increased understanding builds teaching self-efficacy, which has been demonstrated to have a positive impact on student learning.

This research project has included many of the pivotal components of high quality professional development in an effort to improve self-efficacy and outcome expectancy. This study seeks to examine the impact of lesson study professional development on teacher self-efficacy and outcome expectancy.

Chapter 2 - Literature Review

Along with a review of research-based constructs that support this study, chapter two provides an overview of the theoretical framework in which the study was grounded. Since Social Cognitive Theory was the basis for this study and is deeply entrenched with self-efficacy, which plays a major role in the literature review set forth, organizationally this was the most ideal placement.

Theoretical Framework

This study used the theoretical framework provided through Albert Bandura's Social Cognitive Theory as a means of grounding (1986). His theory explains how the interactions of a person and varying social influences can shape human behaviors in the way of beliefs, motivation, goals, accomplishments, and personal well-being. Bandura reasoned, "Persons are neither autonomous agents nor simply mechanical conveyers of animating environmental influences" (1999, p. 22). His theory describes that people are active participants in their life experience and their cognitive functioning serves as a significant determinant that impacts one's life. The Social Cognitive Theory suggests that a person has control over his or her own thoughts and actions, which in turn impact behaviors that are influenced by or influence one's environment. Bandura further described this phenomenon through outlining human behavior as a result of triadic reciprocal causation in which personal, behavioral, and environmental determinants have simultaneous influence upon one another, in a process which is recursive (Bandura, 1986).

The illustration in Figure 2.1 demonstrates the bidirectional confluence of each of the three determinants of The Social Cognitive Theory.

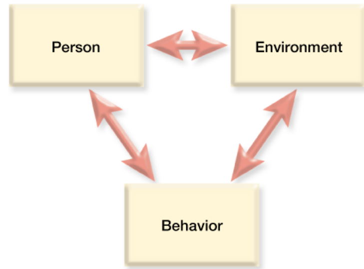

Figure 2.1: Reciprocal Determinism Model

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In recognizing the social influences that impact one's life, Bandura asserted that our direct personal experiences are rather limited. This is in part due to the repetition of daily life with interactions within the same circles. However, when we account for symbolic environmental modeling, such as televised sources, our experiences broaden to include societal diffusion of ideas that are not directly experienced personally. It is through these symbolic environmental modelings that individuals begin to shape additional beliefs, attitudes, and competencies, which in essence forms one's image of reality (Evans, 1989).

Direct personal experiences combined with environmental modeling form beliefs, attitudes, and competencies which drive one's motivation and behaviors. The Social Cognitive Theory asserts that an individual who feels confident in their ability to successfully complete a task are more likely to be motivated to attempt it (Bandura, 1977). Bandura's Social Cognitive Theory defined two important constructs: self-efficacy and outcome expectancy. Bandura (1997) defines self-efficacy as, "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). "An outcome expectancy is defined as a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977, p. 193). Self-efficacy and outcome expectancies are clearly distinguished from one another, in that self-efficacy is built upon the perceived ability to do a certain behavior, whereas outcome expectancies are judgments about the likelihood of the outcomes that result from behavior (Bandura, 1977). In this research, self-efficacy and outcome expectancy are viewed in terms of a teacher's beliefs. Teacher self-efficacy refers to the beliefs a teacher holds about his/her ability to teach effectively and the definition of outcome expectancy used will be based upon Gibson & Dembo’s research (1984) where outcome expectancy is considered a teacher’s beliefs in students’ ability to learn, despite additional circumstances including student background. Research indicates that outcome expectancy beliefs tend to be more difficult to change than self-efficacy beliefs (Cantrell, Young & Moore, 2003; Liang & Richardson, 2009; Schoon & Boone, 1998; and Tosun, 2000).

Self-Efficacy

Bandura’s (1977) interest in studying self-efficacy stemmed from a research project in which he utilized his mastery modeling treatment to help individuals with extreme, life impairing phobias. The mastery modeling treatment was adjusted from having the participants work directly guided by a therapist to help them overcome their fears, to working more independently to continue to address their fears on their own. Through this transference to independence, the participants viewed their success as a result of their own abilities, rather than attributing the success to assistance from a therapist. Participants reportedly shared they felt they could overcome other obstacles in their life as well, given their progress (Bandura, 1977). Bandura (1977) realized, through the study, helping the participants with their phobia, in fact had an unexpected positive impact on other areas of their life as well. Reflecting on this phenomenon inspired his research and discovery of self-efficacy as a construct of a cognitive mechanism guiding human functioning. Bandura realized as he was helping people overcome their fears he had also altered their beliefs of their own perceived coping efficacy (Evans, 1989).

Bandura’s efficacy research has determined that people, even with similar skills, can vary significantly in their performance. Bandura (1999) identified fluidity of ability, whereas it is a less fixed characteristic than was once believed. Given the same skills one person might reach an optimal level of success, while another person performs poorly. One's beliefs and efficacy can affect the motivation with which one pursues to use their skills to reach accomplishments (Bandura, 1999). A person with a high sense of efficacy tends to persevere with a high level of effort, even when confronted with obstacles. They tend to view a challenging task as one to be mastered. Individuals with a high self-efficacy tend to pursue activities with deep interest and display a strong sense of commitment to their interests and activities. In addition, self-efficacy impacts the way in which cognitive function is applied in problem solving scenarios. Individuals who possess a high sense of efficacy tend to view success and focus their thinking on solutions and are productive in their problem solving attempts. When they are presented with setbacks or disappointments, they tend to recover more quickly from that experience (Bandura, 1999).

However, low efficacious individuals tend to avoid tasks which they perceive as challenging and hold a belief that these difficult tasks are beyond their capability. Those who have a low sense of efficacy tend to view failure and focus their thinking on negative possibilities (Bandura, 1993). Focus on personal failings or negative outcomes results in a loss of confidence in personal ability.

Bandura (1977) identified four contributing sources that influence one's self-efficacy beliefs. These sources are: 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions. Though all of these sources have an impact on self-efficacy, mastery experiences continually, "emerge in empirical studies as the most powerful source of self-efficacy across domains" (Blonder, Benny & Jones, 2014, p. 6).

Woolfolk argues that, "self-efficacy is the most useful self-schema for education because it relates to choices and actions that affect learning such as goal setting, persistence, resilience, effort, and strategy" (Shaughnessy, 2004, p. 172). Bandura's research has demonstrated that self-efficacy has a direct impact on a person's motivation, behavior, and psychological state. In a collaborative research project Bandura and Schunk (1981) explored the effects of proximal goal setting as a way of motivating students in mathematics. Bandura and Schunk discovered the students in the study that were presented with short-term specific goals that were attainable were more motivated, than were those presented with long-term goals that were more distant (Bandura & Schunk, 1981).

Self-efficacy plays an important role in how one goes about setting and achieving goals, completing tasks, and facing challenges that are presented in life. Those with higher self-efficacy beliefs tend to pursue more challenging goals with greater perseverance than those with lower self-efficacy beliefs. Though beliefs of self-efficacy begin to form in early childhood, self-efficacy continues to evolve throughout one's life with acquisition of new skills and experiences.

Teacher Self-Efficacy

The construct of teacher self-efficacy beliefs was born from Bandura's social cognitive theory (1977). Teacher self-efficacy (TSE) is the beliefs held by a teacher about his/her ability to teach effectively, while outcome expectancy beliefs are a teacher's belief in the ability of his/her students to learn. Teacher self-efficacy and outcome expectancy beliefs are important factors that influence the education of students, as these beliefs impact teacher behaviors within their classroom (Gibson & Dembo, 1984). Bandura asserted, "The task of creating environments conducive to learning rests heavily on the talents and self-efficacy of teachers" (Bandura, 1993, p. 140). Further, Bandura asserted that these teacher self-efficacy beliefs are the impetus which thus influence teacher behaviors. Bandura's social cognitive theory revealed that individuals are more inclined to attempt a task if they feel they are capable of being successful with it (Bandura, 1977). Blonder, Benny & Jones (2014) posit, "Self-efficacy can shape how a teacher will implement a new curriculum, predict the success or failure of a textbook or other curricular material, influence the effectiveness of professional development, or effectively frame a teacher's response to a student's question" (p. 3).

Tschannen-Moran, Hoy, and Hoy (1998) conducted a review of the literature on teacher self-efficacy and revealed a relationship exists between a teacher's self-efficacy and the achievement of his/her students and the actions of the teacher within the classroom, including commitment to the profession. Teachers with a high sense of self-efficacy believe that they are able to effectively teach students regardless of any obstacle that might be presented, including students who struggle with learning (Gibson & Dembo, 1984). Teachers with a high sense of self-efficacy are likely to spend considerable amounts of time planning engaging lessons for their students, considering the way in which their students think and understand a subject (Shaughnessy, 2004). They will search for various ways in which to reach students with multiple representations of a single concept to ensure deep learning and understanding is taking place. A teacher with high self-efficacy is one who will embrace the challenges of teaching students with special needs on both ends of the spectrum. This teacher will find resources to meet the needs of the students to scaffold instruction to build a solid foundation for learning, filling any gaps in understanding, for a struggling student (Shaughnessy, 2004). In addition, this teacher will also find materials to bring in complexity and depth of a topic to appropriately challenge gifted students. Teachers who are self-efficacious are more likely to be confident about their ability to overcome the roadblocks in teaching. They are often more optimistic about their profession and view their own successes and failures as their responsibility (Shaughnessy, 2004). In contrast, teachers who have low self-efficacy believe they are not able to effectively teach a student when presented with an obstacle, such as lack of motivation for learning or a learning disability. Teachers with low self-efficacy tend to view their failures related to external factors, such as limited student background knowledge or family influences, rather than looking internally within themselves for an explanation for the failure (Tschannen-Moran et al.,1998).

Teaching self-efficacy is cyclical in nature and any teaching performance that is completed becomes a past experience and a viable source for which future teaching self-efficacy beliefs are founded upon, which would include any perceived successful or failed teaching experiences. This cycle is well described by Tschannen-Moran et al. (1998),

> …the proficiency of a performance creates a new...experience, which provides new information that will be processed to shape future efficacy beliefs. Greater efficacy leads to greater effort and persistence, which leads to better performance, which in turn leads to greater efficacy. The reverse is also true. Lower efficacy leads to less effort and giving up easily, which leads to poor teaching outcomes, which then produce decreased efficacy. (p. 233)

According to Bandura (1997), beliefs become future-oriented judgments about one's ability to execute the necessary actions to produce a given result. For instance, a teacher who exerts sustained effort in planning, creating and teaching a lesson that produces the desired results of meaningful student engagement and learning will then become a past mastery experience a teacher will reflect on as a source of future teaching efficacy beliefs.

Bandura describes teaching self-efficacy as a domain specific construct. In other words, a teachers' self-efficacy beliefs are situation and context specific (Bandura, 1981) and the self-efficacy a teacher feels in one school setting or in one subject area may not generalize to another setting or another subject area. This dilemma was noted in early attempts of measuring self-efficacy through Gibson and Dembo's general efficacy instrument, the Teacher Efficacy Scale (TES) proved to be ineffective in gathering content specific self-efficacy beliefs. Therefore, modifications to the TES were made to create measures that were more content specific. Riggs and Enochs (1990) created the Science Teaching Efficacy Belief Instrument (STEBI) while Enochs, Smith, and Huinker (2000) adapted the STEBI for mathematics as the Mathematics

Teaching Efficacy Beliefs Instrument (MTEBI). Then Fischman, Lewis, Riggs & Riggs (2014) designed the Mathematics Teaching Efficacy and Expectancy Beliefs Instrument (MTEEBI), used in this study, based on the MTEBI.

Darling-Hammond (2003), described that not only does teacher self-efficacy have influence upon teaching performance and commitment, it also influences teacher retention. Fullan (2010) referred to a teacher survey conducted to determine how teachers view the teaching profession. In the survey, 37% of the teachers reported that they were "contented" and when identifying the reasons they felt contentment, it was noted that the teachers "believe they have been efficacious in helping students learn" (Fullan, 2010, p. 88). Finally, it must be noted that teacher self-efficacy is based upon a teacher's perception of his/her teaching ability, which may not always be a true and accurate assessment of his or her authentic ability.

Bandura's four sources of efficacy naturally apply within the educational setting and more often than not more than one source is present during given experiences. Mastery experiences include teaching episodes in which the teacher makes judgments about his/her ability to teach, given the success or failure with the instruction in previous lessons taught. Positive teaching experiences serve as successful mastery experiences that build self-efficacy beliefs in the teacher. Whereas, unsuccessful lessons taught serve as negative mastery experiences that can diminish teacher self-efficacy. However, Bandura (1994) and Usher and Pajares (2008) noted that resiliency in self-efficacy can be established when an individual experiences adversity which is overcome through continuous effort. Teachers who struggle with teaching a lesson or a particular struggling student and persevere to experience success will have a foundation for stronger self-efficacy. These prior mastery experiences set the stage for future teaching, given the self-efficacy beliefs that resulted. Of the four sources that contribute to self-efficacy, according to Bandura, mastery experiences is the most influential because it is the most authentic experience which can demonstrate success with a given task (Bandura, 1994).

Teachers observing a colleague modeling a lesson can be an important vicarious experience for them to see themselves as capable of achieving the same outcome, thus being a source for building self-efficacy beliefs. This is especially true when the observer sees the model as effective, where the observer hopes to be as a teacher, and sees the model as similar to him/her (Bandura, 1977). Collegial observations of teachers that teach the same grade or subject would provide a more realistic model that the observer can identify and connect with. Blonder, Benny and Jones (2014) propose that in fact this is sought out, “People seek proficient models that hold the competencies to which they aspire. These models can influence their behavior, thinking, the way they transform knowledge and the strategies used for managing environmental demands” (p. 5). However, modeling mastery experiences alone is not always sufficient; the thought processes and strategies used to create the mastery experience must be understood by the observer. Bandura (1997) explained it as,

> [i]t is difficult to acquire cognitive skills through modeling when covert thought processes are not adequately reflected in modeled actions. The problem of observability is overcome simply by having models verbalize their thought processes and strategies aloud as they engage in problem-solving activities. The covert thought guiding the actions are thus made observable through overt representation. (p. 93)

Given this knowledge, to make modeling as effective as possible, pairing the observations with discussions including debriefing and reflective discussions before, during, and after the observation will provide an opportunity for the observer to better understand the rationale for actions taken during the lesson taught. This process allows for teachers to more fully understand and achieve the successful mastery experience they observed.

Verbal/social persuasion can be used as a source for building self-efficacy to promote perseverance in effort in a given task when positive feedback or evaluative feedback is given to persuade others they can be successful at a given task, especially when they have been challenged by the task previously (Bandura, 1977). Purposeful thought must be taken with the use of verbal/social persuasion, however, as it alone cannot build a strong sense of self-efficacy. In addition, verbal/social persuasion has the potential to diminish self-efficacy if not used with care (Bandura, 1994, 1997; Usher & Pajares, 2008). Evaluative feedback, must be presented in a way as to protect rather than diminish teacher self-efficacy (Bandura, 1997). False praise or unrealistic success also can lead to a decrease in self-efficacy, while strong mentors will help others see the importance of individual self-improvement versus viewing success in terms of competition with others (Bandura, 1994; Usher & Pajares, 2008).

Individual physiological responses to tasks including mood, emotional state, physical reaction, stress level, anxiety and one’s interpretation of these responses can either bolster or hinder self-efficacy. These reactions are often a source by which people tend to judge their own abilities and skills. The physiological responses alone are not what impacts self-efficacy so greatly; rather, it is the way in which these physiological responses are viewed and interpreted that impacts self-efficacy (Bandura, 1994; Usher & Pajares, 2008). One can experience much stress and anxiety just before giving a speech to a large audience. However, if this response is taken into consideration as a normal reaction experienced by many people in the same situation and is not taken as an indication of being a poor public speaker, the response is not perceived as having a negative impact on self-efficacy. If given this same scenario, an individual perceives that he/she is not an effective public speaker and the physiological response of stress and anxiety is one that others do not experience and is being experienced solely because of his/her perceived inability with public speaking, this response will negatively impact self-efficacy. These negative thoughts and moods can be a self-fulfilling prophecy, whereas positive thoughts and moods can result in more successful outcomes. Bandura explains this,

> "People then act in accordance with their mood-altered efficacy beliefs, choosing more challenging tasks in a self-efficacious frame of mind than they do when they doubt their efficacy…[B]y raising efficacy beliefs that heighten motivation and performance accomplishments, good mood can set in motion an affirmation reciprocal process." (Bandura, 1997, p. 113)

In this same way, teachers must take into account their physiological responses during teaching and take time to reflect on the accuracy and legitimacy of their judgments of their teaching capabilities based upon these physiological responses. Efforts to increase positive physiological responses and decrease negative physiological responses can strengthen self-efficacy beliefs (Bandura, 1997).

According to Bandura (1984), although the judgments one makes about personal competence are different from the judgments one makes about the results or outcomes of behaviors, the two are related. Thus, self-efficacy beliefs, in part, influence outcome expectancy. For example, a person who anticipates being successful in a specific situation will also envision successful outcomes. Bandura illustrated this point by proposing, "one cannot conjure up outcomes without giving thought to what one is doing and how well one is doing it" (1984, p. 232). From an educational perspective, Gibson and Dembo (1984) proposed, "One would predict that teachers who believe student learning can be influenced by effective teaching, and who also have confidence in their own teaching abilities, should persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning" (p. 570).

The Development of Self-Efficacy Measurements

The development of self-efficacy instruments originated with the RAND study. The RAND study designed and used the first self-efficacy instrument by creating two self-efficacy items that examined the beliefs of teachers as a function of their "locus of control," or their idealogy perceptions of control or influence within their school and achievement and motivation of their students (Shroyer, Riggs & Enochs, 2014). The RAND study included 100 Title III projects that were connected with the Elementary and Secondary Act of 1965 (Berman, McLaughlin, Bass, Pauly & Zellman, 1977). The two items included in the survey (Armor et al., 1976; Berman & McLaughlin, 1977) were:

1. When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment.
2. If I really try hard, I can get through to even the most difficult or unmotivated students (Berman & McLaughlin, 1977, p. 159-160).

The findings from the RAND study provided a pivotal foundation for self-efficacy research in education because they revealed that the self-efficacy beliefs of the teacher were the most important factor influencing students' learning and motivation. Therefore, much of the research that was conducted throughout the latter part of the 1970s and early 1980s was based upon these survey items and the locus of control a teacher has over student achievement and motivation.

Gibson and Dembo (1984) created the widely used Teacher Efficacy Scale (TES) that was modeled after the RAND items. However, the TES was based on the framework of the social cognitive theory (Bandura, 1986) rather than locus of control idealogy (Shroyer, Riggs & Enochs, 2014). Additional studies conducted using the TES at the elementary, middle, and high school levels such as the research of Ashton and Webb (1986) further supported that a teacher's self-efficacy beliefs had an impact on student outcomes, such as achievement and motivation, confirming the initial findings of the RAND study (Shroyer, Riggs & Enochs, 2014). Gibson and Dembo (1984) added to the research in their study that revealed self-efficacy was a multidimensional construct, comprised of two factors they named personal teaching efficacy and teaching outcome expectancy.

Due to the global nature of the TES, it was determined to be ineffective in fully measuring the self-efficacy construct due to the nature of domain specificity of self-efficacy. For this reason, self-efficacy measures that are more content specific were created to gain a clearer understanding of self-efficacy within a specific content area. Using the TES as a framework for reference, the Science Teaching Efficacy Beliefs Instrument (STEBI) was created by Riggs and Enochs (1990). This instrument was used to measure self-efficacy within the specific content area of science within the elementary classroom setting with preservice teachers. Further, the STEBI included items that measured both outcome expectancy and personal teaching self-efficacy to further examine and quantify the measurement of the findings of Gibson and Dembo (1984) into two subscale measures. Studies using the STEBI provided evidence that there was a correlation between the two constructs (Riggs & Enochs, 1990; Shroyer, Riggs & Enochs, 2014).

Since the creation of the STEBI, it has been modified for use in many other content areas including chemistry (STEBI-CHEM: Rubeck & Enochs, 1991) and mathematics (MTEBI: Enochs, Smith & Huinker, 2000). In addition, the STEBI has been adapted and translated for international research in many countries including Australia, Denmark, South Africa, Turkey, and Singapore (Shroyer, Riggs & Enochs, 2014). The STEBI's effectiveness for use in measuring current teacher self-efficacy in the classroom today has been brought into question (Henson, 2002; Wheatley 2005). Holden, Grouix, Bloom and Weinburgh (2011) modified the STEBI for use in viewing teacher self-efficacy in terms of professional development with outdoor education and found the STEBI may not effectively measure teacher self-efficacy given the shifts with teacher accountability and the rigor of standards in today's classrooms. Suggested interventions when using the STEBI or modified versions, include classroom observations and teacher "think alouds" (Henson, 2002), while Wheatley (2005) suggested including teachers in the research.

More recently Fischman and colleagues (2014) have designed a new instrument to measure self-efficacy in mathematics with an even greater specificity based on the Common Core State Standards in mathematics (I. Riggs, personal communication, November 10, 2012). This instrument, the MTEEBI, a modified version of the MTEBI was selected for use in the current research because of the reliability and validity anticipated in its use, the specificity it provides by evaluating the two subscale measures of personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectations (MTOE) in relation to CCSS, as well as the ease of administration. Thus, the MTEEBI was specifically created to address some of the criticisms of the STEBI.

Mathematics Education Reform

The last century has provided a journey of change in mathematics teaching and learning. This history has included periods of struggle and disagreement, as well as, periods of advancement of efforts to support a collective vision for implementing standards-based practices in classrooms throughout the U.S. (Bay, 1999). This journey has resulted in many discussions that often have had a contentious overtone as change was sought to improve instruction and performance in mathematics. The debate over purpose vs. means of education, as well as, content vs. pedagogy has fueled much conversation during the last century (Davidson & Mitchell, 2008).

There are three major mathematics reform efforts that have taken place over the last century, including the Chicago Movement, New Math, and Standards-Based Mathematics Reform (Bay, 1999). The Chicago Movement was an attempt in 1903 by E.H. Moore to establish a more unified curriculum for grades 9-12. This was also the time renowned educational philosopher, John Dewey, founded his laboratory school in Chicago. Dewey took a child-centered approach to learning and adopted a vision for learning that education should be connected to real-life experiences (Davidson & Mitchell, 2008). However, the Chicago Movement reform effort did not take hold and in the 1930's the focus for instruction once again centered on basic skills (Bay, 1999).

New Math was the second major reform effort that was brought about by concern in the 1950's that high school students were not well prepared for the rigor of post-secondary mathematics courses. As a result, university mathematicians began to launch study groups to determine what high school students needed to study to be prepared for college courses. In 1952, the University of Illinois Commission on School Mathematics (UICSM) was created, as was The School Mathematics Study Group (SMSG) at Yale in 1958 (Davidson & Mitchell, 2008). This effort, however, was not supported by all university mathematicians. Amit and Fried (as cited in Davidson & Mitchell, 2008) indicated that the reform efforts were not a success in light of the fact that the reform was not brought about through participation of teachers, parents, and politicians, rather it was a top-down reform. A valuable lesson was learned through the New Math reform attempt, as noted by Davidson and Mitchell (2008), “The reform process cannot be isolated from the educational system as a whole” (p. 148). The Chicago Movement and the New Math reform efforts yielded little change experienced within U.S. classrooms as a result (Bay, 1999). However, the lesson learned through the New Math reform effort was heeded with the newest reform efforts with Common Core State Standards as the development of these recent standards was done with the inclusion of all the important stakeholders that were absent in the New Math reform. This experience illustrates that reform efforts, though not always as impactful as hoped at inception, can still yield results of substantial improvement over time.

The standards-based mathematics reform initiative has been driven, in part, by national and international assessments indicating the U.S. is not performing as well as a nation as hoped (Martin et al., 2007). The government’s release of the report, A Nation at Risk (ANAR), brought about national attention to mediocre performance of U.S. student achievement in 1983. This report from the National Commission on Excellence in Education (1983) created a climate of urgency as the report placed blame for a diminished U.S. economy on education. Of specific concern in ANAR was U.S. student achievement lagging behind the achievement of students in other countries (Davidson & Mitchell, 2008). ANAR established the need for rigorous curriculum, which was not specific to mathematics only. In addition, ANAR, as cited in Bay (1999, p. 4), resulted in a call for action to improve teaching and learning allowing students to:

> (a) understand geometric and algebraic concepts; (b) understand elementary probability and statsistics; (c) apply mathematics in everyday situations; and (d) estimate, approximate, measure, and test the accuracy of their calculations

ANAR provided recommendations for improvement; however, like many other reform efforts, no federal funds accompanied ANAR to support full implementation of the recommendations. ANAR was not alone in communicating a need for change. Other initiatives followed that also called for action and change. In 1991, *America 2000 Excellence in Education Act* was proposed by President Bush and in 1993, *Goals 2000: Educate America Act* was proposed by President Clinton (Heise, 1994). It was hoped both efforts would increase student achievement. In addition, the standards-based reform was highly influenced by mathematics standards proposed by The National Council of Teachers of Mathematics (NCTM, 2000), The *Trends in International Mathematics and Science Study*, TIMSS, (Williams, Jocelyn, Roey, Kastberg, and Brenwald, 2009), and *Adding it Up (*Kilpatrick, J., Swafford, J., & Findell, B., 2001)*,* headed by the National Research Council. In April of 2000, NCTM released *Principles and Standards for School Mathematics* to establish an outline of the components necessary for a high quality mathematics program as it established a common mathematical foundation for all students. The TIMSS assessment began to provide student performance trend data with an international comparison in 1995. This data has been used ever since to gauge American reform efforts. *Adding it Up* provided a look at needed change to help all students become proficient in mathematics. It suggests ways teachers, parents, administrators, and policy makers could help all students become proficient in mathematics. The No Child Left Behind (NCLB, 2002) legislation of 2001 provided the expectation that all children would reach proficiency by 2013. Accountability continues to be held tightly through ongoing assessments to determine Adequate Yearly Progress (AYP). If schools and districts do not meet the goals for AYP, sanctions come in the way of continued monitored progress, reduction of funding and ultimately school closure if improvements are not attained (Larson, 2011).

Research makes it clear that efforts are continually being made to improve mathematics instruction for all students throughout the U.S. This call for reform is pivotal for continued advancement. An unrelenting push towards excellence in mathematics education, partnered with high expectations, effective professional development, and an abundant support for teachers leading this reform will continue the momentum toward change.

Common Core State Standards

Currently, we are undergoing an unprecedented change as we embark upon a new era of national standards provided by the Common Core State Standards (NGAC, 2010). The CCSS were formally released in final form in June of 2010. This reform is being led by states, without federal government participation, in association with the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO). Learning from past reform failures with the New Math movement, the CCSS effort was developed in collaboration with state leaders, teachers, administrators, parents, content experts, and university faculty to provide a grass-roots approach. The goal of CCSS is to prepare all students throughout the U.S. to be college and career ready when they graduate from high school. It should be noted that in reflecting upon American mathematics reform history, the goal of having students prepared for success in college is not a new idea. The New Math reform effort of the 1950's was founded upon this very goal, though it was led only at the university level. With statewide support, initially, and only a few states opting not to adopt the CCSS, the support of the NGA Center and CCSSO, and the support of many stakeholders, this vision is now moving forward some sixty years later. In addition, the CCSS seeks to coalesce standards from state-to-state, and when considering the goal of the Chicago Movement, unification was the aim as well. Consequentially, the big ideas and recommendations from reform efforts, including preparing students for college readiness, providing high-quality mathematics teaching and learning, and curricular/standards unification have remained constant throughout the passage of time (Larson, 2011). Despite the grassroots efforts in creating the CCSS, adoption of these standards has not come without backlash. Opponents of the standards are now making their voices heard and some states are beginning to reconsider their adoption.

Having common standards nationwide allows states to collaborate and share resources and innovations to teach the standards. The CCSS were designed to solve equity and access issues state to state. Inconsistent test scores were a concern upon examination when comparing state assessments. Students from some states reported strong state mathematics assessment scores. However, when compared to performance on national assessments such as TIMSS or National Assessment of Educational Progress (NAEP), these same students were not scoring as well as other students, indicating these students were not getting an equivalent education (Larson, 2011). CCSS provides the framework needed to ensure consistency with rigorous standards that all students, regardless of where they live, are prepared to be successful in college and/or career as they enter the workforce. CCSS are currently available in English Language Arts (ELA), Mathematics, Science (Next Generation Science Standards), and History/Social Studies (NGAC, 2010). CCSS provides fewer and deeper standards to focus learning and instruction with clarity and consistency. Adopting states and the Smarter Balance Assessment Consortium (SBAC) are currently creating assessment items to address the CCSS. Drafts are being released which indicate the rigor of the new standards, including the infusion of technology and performance based assessment items (Larson, 2011).

Common Core State Standards (CCSS) represents a tri-level reform shifting down from the national level to the state level and finally to the district level. The CCSS were adopted to provide a vision for students to have the ability to be college and/or career ready when all students leave high school; thus providing learning to meet the needs of the diverse students within our pluralistic society (NGAC, 2010). The CCSS initiative is a national reform to provide the opportunity for continuity of standards from state to state, thus providing equity for all learners driven by common standards for education in all states that adopt CCSS. Therefore, our continuously changing student population, including military students, will be supported as a student who moves from one state to another has the same opportunity for a high-quality education regardless of special education needs, socioeconomic status (SES), ethnicity, English for Speakers of Other Languages (ESOL), etc. This continuity will also allow for state-to-state collaboration as the resources created in one state will be useful in other states as well since the foundational standards will be the same CCSS.

Best Practices for Teaching Mathematics

Riddile (2010) contended school improvement must be considered a journey, an ongoing process. All stakeholders must continue the dialogue and forward motion to improve teaching and learning for all students. As educators we hold a moral and ethical obligation to provide the very best education to all students. As a nation we must be productive in our global economy and students lead the future of our success in this endeavor. If students leave our schools unprepared to play a viable role in this capacity, our society as a whole will carry the burden (Riddile, 2010).

Learning is shaped by expectations, which hold promise for achieving reform recommendations. When we set high expectations for all learners they are more apt to achieve the rigorous standards set forth. As educators we must continue to hold the expectation that all students will be proficient in mathematics to be successful in college and career entry. However, in order for our nation to truly accomplish this goal changes are needed in the way we teach mathematics, the materials we are using including text books, and the way we assess student performance. This systematic change must be supported by a broader educational system including all stakeholders such as parents/guardians, teachers, administrators, school board members, etc. to make this change a reality (Kilpatrick, Swafford & Findell, 2001). As our world continues to grow and advance, so does the demand for mathematical knowledge and understanding. The future job market will require students to solve complex problems that far surpass computational competence (Larson, 2011). Students must be able to use mathematics as a tool to better understand the world around them. To enable our students to compete successfully, meeting the demands of the future, as educators it is our moral obligation to ensure that our students are equipped with the skills and knowledge to use mathematics in a sophisticated manner. Students who are ill prepared will consequentially suffer fewer opportunities to access more advanced learning and job opportunities (Larson, 2011).

Unfortunately, too many math classes throughout the country today still resemble classes from a century ago (Kilpatrick et al., 2001; Larson, 2011). Lessons that focus on procedural methodology are typical, with many repetitious practice problems based on the procedure demonstrated by the teacher. Textbooks still often include curriculum that is a mile wide and an inch deep, resulting in a superficial understanding of math concepts. Students are often assessed on low levels skills instead of rich real world embedded problem solving (Kilpatrick et al., 2001). This method of instruction does not match the mathematical demands of the future, therefore, we are not adequately preparing our students to be successful in their future. Though progress has been made in the last decade and some school districts have adopted curriculum and assessments that build mathematical proficiency, this growth is uneven at best (Kilpatrick et al., 2001).

International Comparisons

Assessment is a powerful tool to be used to improve teaching and learning (Larson, 2011). Thus, looking at trends in student performance is important in guiding our decisions for improving teaching and learning of mathematics as previously mentioned. The Trends in International Mathematics and Science Study (TIMSS) was established in 1995 and is designed to measure mathematical and science knowledge and skills of fourth and eighth grade students. This measure provides for an international comparison of U.S. students and their international peers. The test is given every four years to students in participating countries with an overall goal to study trends over time to improve instruction and learning in mathematics and science. The work of Williams et al. (2009) indicated in 2007, thirty-six countries participated in grade four while forty-eight countries participated in grade eight TIMMS assessments. Williams et al.

(2009) also shows that both U.S. fourth grade and eighth grade students scored above the TIMSS scale average score of 500 with scores of 529 and 508 respectively. U.S. fourth graders scored higher than 23 of the 35 countries and lower than 8 countries (which were Asian and European countries) and no measurable difference was evident in the remaining 4 countries; while U.S. eighth graders scored higher than 37 of the 47 countries and lower than 5 countries (all Asian countries) and no measurable difference was found in the remaining 5 countries (Williams et al., 2009). When comparing 1995 scores to 2007 scores, both the U.S. fourth grader and eighth graders showed improvement. Fourth graders increased their 1995 score of 518 by 11 points to earn a score of 529 in 2007 and eighth graders increased their 1995 score of 492 by 16 points to earn a score of 508 in 2007. On the one hand we should be encouraged there has been some improvement in test scores of U.S. students in 4th and 8th grade based upon the TIMSS assessment from 1995 to 2007. On the other hand, though there is an increase, the U.S. still trails significantly behind countries on both comparisons. In addition, although schools with higher percentages of students living in poverty did increase their scores in 2007 compared to 2003 scores, the discrepancy has not diminished over time. Of U.S. 4th graders, 10% (which was higher than the international median of 5%) scored at or above the advanced benchmark set at 625, which is an indicator of ability to demonstrate application of mathematical skill and knowledge to complex mathematical problems. While 95% of U.S. 4th graders scored at or above the low benchmark set at 400, an indicator of ability to add and subtract whole numbers, familiarity with coordinates and triangles, and reading simple graphs and tables. Of U.S. 8th graders, 6% (which was higher than the international median of 2%) scored at or above the advanced benchmark of 625, indicating ability to make generalizations, draw conclusions and make a justification based upon the data. Of U.S. 8th graders, 92% scored at or above the low benchmark of 400 (higher than the international median of 75%) indicating a basic mathematics understanding of whole numbers, decimals, create a basic graph, and solve simplistic computations (Williams et al., 2009).

Statistical significance for the TIMSS data was set at the typically normed value of $p < .05$. When reviewing the data for comparative analysis of male/female performance, it indicated no statistical significant difference between males/females in 8th grade. However, when analyzing the content domains further, males outperform females on three of the four domains including number, geometry, and data and chance, while the females outperformed males in the algebra domain. In 4th grade there was a statistical significant difference between males/females, which favored males as their total performance exceeded that of the females. This higher average total score for males was only derived from one content domain of number, while the content domains of geometric shapes and measures and data display resulted in no statistical difference in performance between the sexes (Williams et al., 2009). Males and females in both fourth and eighth grade improved their total scores from 2003 to 2007 and both groups closed the score gap between male/female performance from 2003 to 2007, each by 2 points. Though males outperformed females in both fourth and eighth grade on the total score, the difference is statistically significant for fourth grade results only.

When analyzing TIMSS data to review disaggregated average scores based upon ethnicity, higher than U.S. average scores (529) are seen among White (550), Multiracial (534), and Asian (582) fourth graders; while Black (482) and Hispanic (504) fourth graders scored lower. In grade eight with a U.S. average score of 508, White (533) and Asian (549) eighth graders scored higher than the average, while Black (457) and Hispanic (475) scored lower. Though Multiracial eighth graders scored lower than the average with a score of 506, it was not a statistically significant difference. Gains have been shown over time with both fourth and eighth grade ethnicity total scores in all groups; however, statistically significant differences still remain in performance.

The given analysis and results of the 2007 TIMSS report suggests recommendations for improved mathematics with the need to more adequately prepare our students to use and apply mathematics to solve complex problems, continue to close the gap of achievement of students living in poverty and students of diverse ethnicities, and continue to strive to equalize the performance between males/females in mathematics. For the U.S. to make necessary gains in mathematics performance for all students, it is imperative that data provided through measures such as the TIMSS study be shared and understood by administrators, teachers, parents, and all stakeholders who share the joint mission of improving mathematics education.

Comparing international scores has proven to be beneficial as all countries strive to improve teaching and learning. Countries continue to learn more about teaching and learning from other countries as a means to improve education in their own country. For example, during the 2011-2012 school year, a team of twenty-five teachers from China visited the school where the researcher worked as part of an 8 week tour to learn about the U.S. educational system. In addition, as Singapore has risen to be among the top countries in mathematics performance worldwide in the TIMSS study, other countries are taking note of their achievement in an effort to emulate their success including the U.S. With this in mind, the researcher's school district adopted the K-8 mathematics program, Math in Focus, which is considered the U.S. version of the Singapore mathematics approach.

Standards to Support Teaching and Learning

In light of results from TIMMS, what should be done to improve teaching and learning of mathematics? An understanding of what we are doing that is not effective is an essential part of the improvement process. A willing abandonment of ineffective practices is needed to embrace the instructional methods to best prepare our students for their future. A common instructional method in classrooms throughout the U.S. is the teacher showing a procedure, having students practice the procedure, and closing the lesson by giving a homework assignment with procedural problems. In addition, teachers often present definitions and procedures for memorization and use in problem solving (Martin et al., 2007). Students typically retain this information for a short period of time, regurgitate it on a test and then it is gone. Instead, students need to have a deep, conceptual understanding of mathematics they view as a tool necessary for understanding and navigating the world around them. For students to realize the power of mathematics as a tool for understanding their world, reformers suggest math be taught and integrated within real world applications, in tandem with other content areas, to see connections and understand the relationship of math in social, political, economic, and other contextual arenas (Davidson & Mitchell, 2008).

NCTM's Mathematics Teaching Today (2007) outlines seven standards to support effective teaching and learning mathematics that promotes the vision of achieving reform recommendations. Though these standards were established prior to the adoption of CCSS, they provide instructional practices consistent with support of the current CCSS (Larson, 2011). *Standard 1: Knowledge of Mathematics and General Pedagogy* highlights the importance for teachers to have sound content knowledge of mathematics, understand the intellectual development of children, use a variety of modes of instruction, use assessment to guide instruction including student prior knowledge, create a motivational classroom environment that encourages academic risk taking, and establish communication with students that encourages them to share their thinking with others. *Standard 2: Knowledge of Student Mathematical Learning* sheds light on the importance of meeting the needs of each individual learner and providing the challenge and support needed to learn math concepts, ensuring students learn math in a connected manner, providing tools to allow students to represent their understanding in a concrete fashion, and allowing students to grapple with a problem for some time before intervening. *Standard 3: Worthwhile Mathematical Tasks* focuses on the importance of using math problems that connect mathematical thinking with mathematical skills allowing students the opportunity to justify their approach to problem solving or consider alternative approaches, providing problems that allow students to recognize the changing and evolutionary nature of mathematics, engaging learners in math lessons and tasks, and identifying student misconceptions. *Standard 4: Learning Environment* emphasizes the need for students to be in a classroom that will expect deep mathematical engagement to be the norm where students are able to justify their thinking, discuss with other students their reasoning in a non-defensive manner, show respect for each other as students collaborate and consult with one another, and where students are given time to process and think through problems encouraging perseverance with mathematics. *Standard 5: Discourse* explores the importance of expecting students to use multiple representations for discussing mathematical rationale, observing student participation in an effort to ensure all voices are heard, requiring students to clarify their reasoning, and deciding when to allow students to grapple with a problem and when to provide guidance to problem solving. *Standard 6: Reflecting on Student Learning* is essential to ensure students are learning rigorous mathematics while developing a positive disposition towards math, lessons are differentiated as needed, ongoing feedback is provided to parents and students, and student ideas are used to extend learning. *Standard 7: Reflecting on Teaching Practice* provides reflection on equitable learning for all students, reviewing discourse to confirm all students are active participants in discussions, analyzing what is taught and how it is taught, participating in ongoing professional development and peer collaboration to monitor effectiveness of instruction, and reviewing assessments and other data to inform future instruction and student interventions.

To fully sustain the transformation of math classes in schools, the improvement process should include ongoing administrative support. Ongoing observations of teaching within classrooms should reflect the quality characteristics of instruction included within the seven standards for effective teaching and learning established by NCTM's *Mathematics Teaching Today* discussed above. In addition, administrators must allocate funds in support of resources and/or experiences needed to support professional development to encourage building mathematical knowledge through attending conferences, purchasing teaching materials, professional books, and providing opportunities for collegial collaboration (Larson, 2011).

In terms of the future of mathematics instruction, the CCSS includes an overall focus and coherence for learning in all classrooms in all states that utilize CCSS. The K-5 standards focus on a foundation in whole numbers, addition, subtraction, multiplication, division, fractions, decimals, negative numbers, algebra, and geometry. Seventh and eighth grade should focus on algebra and preparation for high school mathematics, while high school mathematics should focus on using mathematics to solving real world problems with an emphasis on mathematical modeling. This rigorous focus K-12 allows students to tackle more demanding math problems and applications, which has been shown to be a deficit as noted in TIMSS reports (Larson, 2011).

The Mathematics Curriculum

When approaching mathematics instruction, one must consider the adopted curriculum, which would be understood as the intended or planned curriculum, the carried out curriculum or the enacted curriculum which is what is actually taught, the experienced curriculum including what influence the curriculum has and what students take away from lessons, and the hidden curriculum or the lessons and activities experienced that were unplanned (Marsh & Willis, 2003). Along with this intricate makeup are the influence of the individuals that are part of the curriculum adoption and instruction process and support each with their own philosophies and ideas of what should be taught and how. The decisions these individuals make has influence upon the dynamics of the curriculum itself (Marsh & Willis, 2003). These individuals include central office administration, principals, teachers, students, parents and the public. Since most individuals have experience with public school at some point in their life, many feel qualified to voice opinions and give advice on curriculum content and decisions, regardless of professional training and experience. The business community may make their opinions known as they communicate with educational leaders what they feel is necessary in curriculum to better prepare a workforce that matches the demands of the working world.

There is often a discrepancy between the planned, enacted, and experienced curriculums. Curriculum is consistently in a state of flux as our society changes. For instance, as technology continues to advance, its influence can be seen in new curriculum initiatives and assessments. Also, what is important to know, understand, and do in schools now may have little relevance on what is important to know, understand, and do 50 years from now. Though curriculum must include conscious planning and demonstrate what students will actually learn, by no means does this indicate that the students will actually learn all that is included, as there are unexpected and unplanned events that occur regularly in a classroom (Marsh & Willis, 2003).

As curriculum decisions are being made during reform efforts, those who are leading the initiative must be keenly aware of the historical evolution of curriculum. One must recognize that many of the initiatives of today are not novel ideas, rather most are founded upon historical perspectives revisited. For example, the curriculum reform effort, New Math, that took place in the 1950's was based upon concern of university professors that high school students were not well prepared for the rigor of post-secondary mathematics courses (Davidson & Mitchell, 2008). As a result, university mathematicians began to launch study groups to determine what the high school curriculum should encompass for students to be adequately prepared for college courses. Today's Common Core State Standards (CCSS) initiative is born of this same underlying goal that we must prepare our students for college and career readiness. However, lessons from the past are clearly reflected in this reform effort with the collaborative nature of the creation of the CCSS. The CCSS were established as a state-led initiative that included participation by teachers, administrators, parents, universities, and content experts. The complexity and rigor established through the CCSS will be reflected as it is used to guide the curriculum adopted by districts throughout the country. Though the overall goal is the same for New Math and CCSS initiatives, to better prepare our students for the rigor of college courses, the process in which the curriculum reform took place demonstrates the importance of using the history of curriculum planning and development to influence the decisions of future curriculum endeavors to be successful in reform efforts.

To improve curriculum we must include and consider skills that are essential to promoting success for students long after they leave the walls of U.S. schools. Curriculum framed by 21st century skills, for example, incorporates skills that promote college and career readiness for the life students will lead outside of our K-12 curriculum. The framework for 21st century teaching and learning includes a blend of skills, content knowledge, and expertise and literacies. The core subjects, including language arts, world languages, arts, mathematics, economics, science, geography, history, and government and civics serve as a foundation for 21st century skills along with innovation skills (creativity, collaboration, communication, and critical thinking), life and career skills (flexibility, adaptation to change, time management and goal setting, self-directed and independent learning, leadership ability, and interacting effectively with others) and information, media, and technology skills. The vision for 21st century skills emphasizes the importance of having curriculum connected with real-world examples and not an isolated set of skills and knowledge students view as not having relevance or impact beyond the school setting.

In an effort toward educational reform and improvement, we must strive to make connections of curriculum knowledge and skills as the tools necessary for success outside of school. CCSS has focused on the vision of adequate preparation for success in college and/or career paths. This vision will be guiding many curricular and instructional decisions made across the nation.

Need for Professional Development

There is a continued need for high quality professional development for teachers, which results in achievement for all students (Reeves, 2010; Sparks, 2005). Professional development must move beyond disjointed in-service days on unrelated topics, towards a sustained model that includes focus on teaching tasks. Teachers must know how to translate data, such as local, district, and state assessments or TIMSS results, to make a direct connection to their instruction, materials, lessons, and learning activities in order to meet the diverse needs of their students. Continuing to build a connection between research data and classroom instruction is imperative for improving instruction and learning (Brown & Clark, 2006). When educators fully understand research data and the implications for effective teaching and learning, shifts in practice begin to flourish. This knowledge and expertise will only come about with focused time allotted for professional development through collaboration with others in a continuous cycle of data analysis. Teachers must have the opportunity to continue to grow in content knowledge through professional development and discourse with peers (Loucks-Horsley et al., 2011; Joyce & Calhoun, 2010). The environment in which teachers learn is also critical to effective professional development, “collaboration is viewed as essential to promoting teacher learning” (Brownell, Adams, Sindelar, Waldron, & Vanhover, 2006, p. 169).

Effective Professional Development

The Status Report on Teacher Development in the U.S. and Abroad, noted that other professional fields, including the military and medicine, provide continuous learning opportunities that are far superior than is offered to educators (Darling-Hammond et al., 2009). The recommendation is that effective professional development for educators must emulate the learning from other fields to include professional development that is “continual, collaborative, and on the job” and that truly addresses the daily challenges that are faced by educators (Darling-Hammond et al., 2009, p. 2). Effective professional development must be supported by administrators who “work with staff members to create the culture, structures, and dispositions for continuous professional learning and create pressure and support to help teachers continuously improve by better understanding students’ learning needs, making data-driven decisions regarding content and pedagogy, and assessing students’ learning within a framework of high expectations” (Darling-Hammond et al., 2009, p. 3). This is a tall order and one which will take commitment over time and a determination to stay focused on this goal to move toward improvement.

Creating powerful professional development opportunities must be done through approaches that allow teachers to learn through their own teaching. Darling-Hammond purports that, “An effective teacher is one who learns from teaching rather than one who has finished learning how to teach” (1999, p. 3). Teachers must reflectively analyze the effectiveness of their instruction to systematically make change that will improve classroom instruction. This must done with approaches that equally take into account both content matter and pedagogy (Darling-Hammond, 1999, p. 3). Ensuring teachers are knowledgeable and skilled in their content area and pedagogy is accomplished through continued professional development opportunities that foster a rich learning environment that allows teachers to investigate teaching practices more in depth. Best practices for teaching points to active learning by students and the same holds true for teacher learners. Darling-Hammond provides additional context for teachers learning through, "studying, doing, and reflecting; by collaborating with other teachers, looking closely at students and their work, and by sharing what they see…plentiful opportunities for research and inquiry, for trying and testing, for talking about and evaluating the results of learning and teaching" (1999, p. 13). Professional development, generally a topic that may not have a tightly woven connection to the issues teachers are facing within their own classroom, should be designed as an "inquiry model" of continued learning (Darling-Hammond, 1999).

Darling-Hammond outlines three suggestions to enhance professional development to create a more meaningful connection to the specific teacher needs within their classroom setting. First, teachers should be afforded opportunities to engage in discourse with colleagues that focuses on the teaching and learning taking place within the classroom to analyze and examine the instruction more closely and suggest alternative approaches or improvements. Activities that would support this includes colleague classroom observations and videotaping lessons for deeper examination of teaching and bringing in additional educational experts who can provide insight into instructional practices. Secondly, Darling-Hammond supports a narrow focus on content material learning targeted for curriculum reform that grounds this new learning within the specific context of a classroom. Finally, she suggests that learning from practice through an analysis that bridges both theory and practice through action research on specific lessons will lead to improved instruction and student performance.

The National Staff Development Council's newly revised *Standards for Professional Learning* (2011) serve as a guide for effective professional development practices. The seven standards are equally important, as it is a holistic approach, and there is no hierarchical preference for one over another. The standards include: Learning Communities, Resources, Learning Designs, Outcomes, Leadership, Data, and Implementation. All seven standards should be implemented, with careful consideration of the four key components including educators (all stakeholders), effectiveness (building leadership capacity), results (evaluating from multiple perspectives), and all students (providing an equitable education with appropriate challenge for all learners). The standards bring about the necessity for the development of new knowledge and skills, with a thoughtful approach that takes into consideration the multiple perspectives crucial for effective professional learning. In addition, it is critical for teachers to have ample time for collaboration and reflection on their own teaching and learning (Hull, Miles & Balka, 2010). Time for quality collaboration and reflection is essential for success.

Building upon motivational learning theories, which highlight the importance for learners to have a sense of voice and choice in learning; this same phenomenon is vital for teachers throughout professional development. This allows teachers to have input in their professional learning journey. For example, allowing teachers to choose their partners for observations within each other's classrooms during professional development can help ease any anxiety and establishes a safe environment for collaboration and learning, especially if there is uneasiness among colleagues.

Lambert's work promotes the awareness that all people are capable of leadership (2003). When teachers come together, each taking on their own leadership responsibility in the process of professional development, whether that be by providing feedback to colleagues after an observation, sharing new knowledge, or analyzing CCSS and textbook alignment they are engaged in purposeful learning and leading together, which cannot be separated (Lambert, 2003).

Lesson Study

A high quality professional development practice that provides for growth in content knowledge, pedagogical knowledge, and discourse with peers through joint planning, teaching, reflecting, modifying, and evaluating lesson effectiveness is a model brought to the U.S. through the Japanese Lesson Study. The Japanese Lesson Study cycle embeds many of the National Staff Development Council's Standards for Professional Learning mentioned above (NSDC, 2011). The goal of lesson study professional development is to improve instruction and student learning by enhancing professional knowledge through collaboration. This model provides a significant degree of teacher collaboration with a focus on student learning, where teachers do not feel threatened by outside observers due to the nature of the collegiality and emphasis placed on student learning rather than the teacher's instruction. Though instruction is examined thoroughly to determine effectiveness, it is viewed in light of student response to instruction for making improvements rather than a lens focused on the teacher. Providing time for teachers to collaborate and continue professional development is essential for improved math instruction

(Reeves, 2010; Loucks-Horsley et al., 1998). Lesson study was the professional development method chosen for this research to provide such an opportunity.

Lesson study originated in Japan and has been part of the long history of continued educational improvement in the country for over a century (Lewis, Perry & Murata, 2006). Japanese lesson study was initiated by teachers and emerged through the Japanese educational system as a grassroots effort (Fernandez, 2002). Implementing lesson study professional development as a schoolwide effort promotes improvement on a continuous basis throughout all of the classrooms involved (Stepanek et al., 2007).

Stigler & Hiebert (1999) outline the cultural nature of teaching and the challenges that arise in creating change in education because of this cultural connection.

> Teaching is a cultural activity. We learn how to teach indirectly, through years of participation in classroom life, and we are largely unaware of some of the most widespread attributes of teaching in our own culture. The fact that teaching is a cultural activity explains why teaching has been so resistant to change. But recognizing the cultural nature of teaching gives us new insights into what we need to do if we wish to improve it. (p. 11)

Through the lesson study model of professional development, the nuances of teaching are examined by direct observation to reveal the impact specific components of teaching practice and lesson design have on student discovery, exploration, discussion, perseverance, and learning. This powerful collaboration and discussion amongst teacher colleagues allows a deeper understanding of the cultural nature of teaching to improve instruction through inquiry based professional development. Throughout the history of school improvement efforts within the United States, it is rare that teachers are utilized as the knowledgeable professionals in the process (Stepanek et al., 2007). Lesson study actively engages teachers through an inquiry process of investigating, observing, and revising their own practice with professional development that is meaningfully and tightly connected to their teaching with their own students. The steps of the lesson study process, as proposed by Stepanek et al., 2007, is included in Figure 2.2 below. This professional development opportunity allows teachers to learn through their daily teaching. Much professional development in the United States consists of learning about teaching methods, but does not provide a tight link between the professional development topic and what the teacher is doing in his/her classroom. This results in disjointed professional development that leaves teachers preferring not to participate (Stewart, 2011).

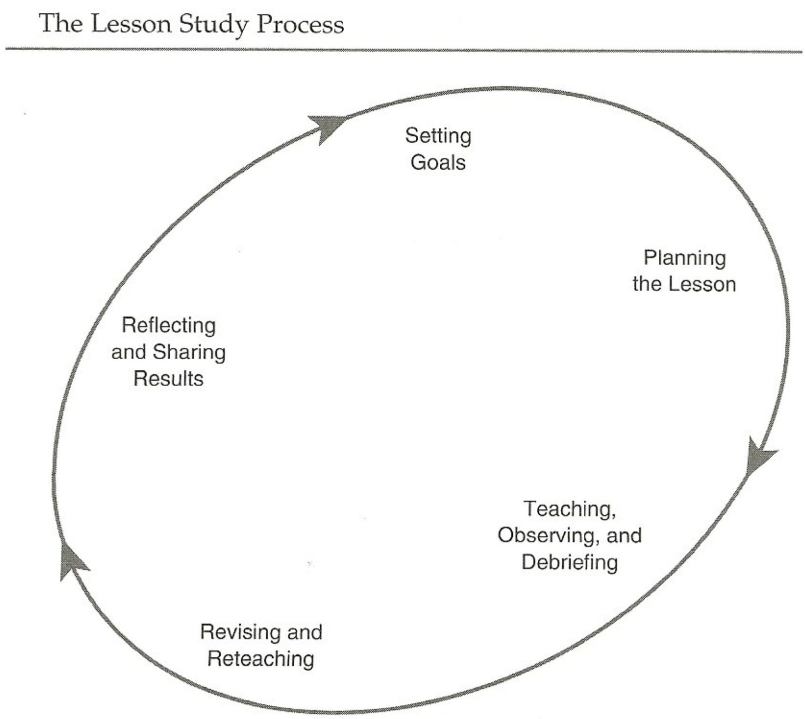

Figure 2.2: Lesson Study Cycle (Stepanek et al., 2007)

The beauty of the lesson study is it can be modified to meet the needs of an individual school, without compromising the integrity of the experience, so long as the core elements are retained in the iteration of the lesson study implemented. Stepanek et al., (2007) refer to these core elements as "Big Ideas," which include instruction, students, goals, and content. Focusing on the big ideas of lesson study permeates knowledge that will supersede beyond the lesson study into other lessons and teaching episodes. The big ideas must be continuously reflected upon throughout the process. It is important to consider how the students learn best, their prior knowledge and possible misconceptions they bring to the lesson in an attempt to predict student responses. This detailed consideration allows teachers to design an informed lesson that will engage students more fully in a lesson that is meaningfully connected to student readiness. In addition, this knowledge helps drive short-term and long-term goals for learning both in content and process. When considering content within the lesson study, teachers are driven to craft high quality questions that get at a deeper knowledge of content from a conceptual understanding instead of fact gathering. Careful consideration is given to the sequence of the lesson and how to initially engage students and provide important learning experiences, based upon best practices, where students can explore and discover throughout the lesson. Peer observation and collaboration throughout the process are also crucial components of the lesson study model that must be included (Stepanek et al., 2007).

In the lesson study process there are characteristics that teachers form and enhance throughout the process by application, which results in professional growth. These characteristics are referred to as "Habits of Mind" (Stepanek et al., 2007, p. 5). The first habit of mind is employing a research stance. Looking at a lesson from a research stance means that the lesson is informed through, "…posing questions and problems, researching possible solutions, trying out ideas, collecting data, and analyzing findings. Teachers engage in inquiry, reflection, and critical examination of their practice. They look at the classroom as a place in which to investigate teaching and learning" (Stepanek et al., 2007, p. 6). The research stance provides a specific purpose and focus that drives the lesson study.

The second habit of mind is learning together. Lesson study provides a highly collaborative environment that requires a safe haven for teachers to share their ideas with a respectful team that is open to innovative thinking that spurs new approaches (Stepanek et al., 2007). Continuous clear and effective communication is essential to supporting the process of learning together. This communication must seek to confirm what participants hear others saying and to clarify any misunderstandings.

Self-Efficacy is the third habit of mind. Stepanek et al. (2007) describe self-efficacy in relation to lesson study as, "Teachers are motivated and persistent in improving their craft. They take responsibility and believe that they can make a difference in student learning" (p. 6).

Stepanek et al., (2007) caution about a critical issue, "If teachers do not ground their work in important ideas and adopt the necessary habits of mind, lesson study is not likely to bring about significant improvements in teaching and learning" (p. 7). This note of caution serves as an important reminder to ensure the core elements of lesson study are embedded during the professional development experience to support change and improvement of educational reform.

Lesson study can be carried out in various formats. Lesson study can be conducted at any stage of teacher preparation or training, including preservice and inservice experiences. Lesson study can be completed by same grade level colleagues for a horizontal collaboration with a common subject matter, as was done in this research. In addition, lesson study can be implemented in more of a public forum in which educators from other schools, districts, or universities are invited to participate. This research in this study was done in collaboration with a university professor.

A plethora of support of the impact of lesson study on student learning and instruction comes from Japan, where it has been a long customary practice where all teachers participate in the professional development on a regular basis (Stewart, 2011). Japanese teachers report increased content knowledge, improved instruction, an alignment between long-term student learning goals and a teacher's daily work, and an enhanced capacity for "seeing children" (Lewis, 2000; Lewis & Tsuchida, 1997). Similar support is emerging from the United States as the use of lesson study has been gaining momentum over the last decade (Stepanek et al., 2007).

Supporting Successful Educational Change

All individuals tend to view change through their own lens shaped by prior experiences, albeit good or bad. As a result, some teachers see change as an exciting opportunity for a new journey, while others see change as an unappreciated stress inducing experience. Change often poses a challenge for leaders, especially when it is a top-down initiative that must be implemented. The Common Core State Standards (CCSS) is an initiative that must be implemented, without exception, in states that have adopted the new standards. The challenge for administrators, academic coaches, and others leading the reform lies in helping teachers value and believe in the reform effort to enhance full implementation in schools (Fullan, 2007).

Fullan's work (2007) highlights the importance of moving beyond surface level change by tapping a deeper level, which includes individual beliefs. Thus, it is imperative that teachers have a clear conceptual understanding of what the change is and why it is important (Fullan, 2007). When teachers understand the what and the why of change and reform, they are more likely to believe in the change, take ownership, and be on board with implementing the change in their own instruction and in collaboration with peers to assist in the effort. According to Fullan, solid lasting reform is built upon the foundation of beliefs and understanding (2007). To successfully bring CCSS implementation to any school, it is imperative to tap into the deep understanding and beliefs of teachers and stakeholders. They must know and understand the mission and goals of CCSS to build acceptance. To do this most effectively, working from a perspective of connecting beliefs and understandings that teachers already hold with the purpose of CCSS is crucial. As educators, we must ensure stakeholders see a connection between what they believe and what CCSS is trying to accomplish. The CCSS were adopted to provide a vision for students to have the ability to be college and/or career ready when all students leave high school, providing learning to meet the needs of the diverse students within the U.S. pluralistic society. This researcher believes this supports the expectations and visions of educators as well. All educators want students to succeed, to be well prepared for the life they will live outside of school, college and career ready, and to provide the best instruction possible to our students. Teaching for understanding is the heart of teaching and it is the heart of the vision of CCSS. In order to bring about a successful implementation of CCSS in schools across the U.S., teachers must begin to see how their own beliefs fit within the goals of CCSS. It is an important job for leaders to ensure teachers find connections to the CCSS and their beliefs. Collegial support, along with a blend of "positive pressure that motivates" is important as we build individual, school, district, and state vision for successfully implementing the CCSS (Fullan, 2007, p. 132). It is only when teachers come to realize their own common ideas and beliefs are tied directly to the CCSS mission that they will view CCSS as something other than simply a new mandate being imposed upon them. When teachers see a strong connection of their beliefs to this reform initiative, they are more likely to support and move along with successful implementation in their classroom because it reflects a moral obligation based on what they already believe (Sergiovanni, 2009).

Furthermore, Fullan, stresses the importance of having teachers directly involved in the change process. Since the CCSS reform initiative is a top down tri-level change stemming from state, district, and school level, it is even more essential to bring about a plan that incorporates a grassroots, bottom-up initiative within individual schools. The implementation of CCSS must stem from a collective vision and the building stakeholders need to play a vital role to bring about acceptance and ownership. In addition, teachers often learn best from other teachers, so involving teacher leaders in planning and delivering professional development to their peers is essential (Fullan, 2007; Loucks-Horsley et al., 1998; NCTM, 2001). Fullan's research serves as an underpinning that must guide our efforts for mathematics reform, as we recognize understanding, beliefs, and participation are imperative keys for successful educational reform.

Leaders of reform initiatives, such as the CCSS implementation, must be reminded that change takes time and patience. Change that is to be maintained over time requires much energy which is cyclical in nature (Fullan, 2005). To maintain sustainability, continuous evaluation of the energy and morale of teachers is critical. Change of a large magnitude, such as CCSS implementation, is hard work that is often physically and mentally draining. As we strive for change in education we expend greater levels of energy in learning new skills and implementing that change in classrooms and schools as a whole. When energy for the change begins to decline, so does performance (Fullan, 2005). During the years of implementation, it is important for administrators to recognize the consequences of pushing too hard too fast. If leaders are not cognizant of this, change can move so quickly that burn out is a result of the efforts. Continuous monitoring of effort is important to determine the need for modification, to some degree, to take into account the efforts put forth with the change in light of all the other continual stresses that are upon the shoulders of educators.

Fullan's work suggests that "sustainability is cyclical" and leaders of reform must expect that a temporary plateau during the process before more growth is experienced is likely (2005, p. 26). A strong collaborative effort will help sustain positive collective synergy for the change, opening a door for greater accomplishments together as a team (Fullan, 2010). Including energizers throughout the implementation years to sustain positive efforts is advantageous. This could include sending teachers to conferences, maintaining a positive climate, ensuring good working conditions, and reminders of a collective moral purpose (Fullan, 2010).

Hull, Miles and Balka (2010) suggested ramifications for change could likely include initial disengagement from some teachers who are not supportive of the reform. Providing individual assistance to teachers might need to be an option for those who are struggling to understand the change. It should be understood that thrusting a top-down vision upon teachers is not an ideal situation. However, when deep understanding has been established and connections between personal belief systems are made, the initiative is more likely to be a success. Change can be overwhelming for some teachers and pairing that along with personal stress they might already be experiencing outside of school just might be the breaking point. Resistance to the change must be understood to help move the teacher along (Hull, Miles, Balka, 2010).

Throughout any change process, relational trust must be present and the change must be deeply embedded in beliefs. Joining teacher vision and beliefs with the mission of reform will bring about the clarity and understanding needed for realizing the benefits of an initiative. Teachers must be bonded in supporting and following a collective vision and moral purpose that are guided by high expectations, which will sustain the intensive efforts that will be necessary for full implementation of reform initiatives (Fullan, 2010).

Mathematical proficiency must be viewed as a goal for all students to make reform efforts a reality. Historically, some have held the belief that mathematics is a content area that only some students could master (Larson, 2011). We need to hold high expectations for all students, providing the instruction needed to ensure mathematical proficiency is attained. Tracking is a practice that has held some groups of students back because of low expectations with a focus on remediation and less effective practices (Oakes, 2005; Mirra, 2003). We must ensure that all students including minority groups, females, students of low SES, ELL students, and students with disabilities are expected to reach mathematical proficiency and are provided with any accommodation or modification needed to allow them to succeed in learning mathematics (Larson, 2011).

Summary

This literature review provided an overview of Albert Bandura's Social Cognitive Theory as it was utilized as the framework for grounding this study. Self-efficacy and teacher self-efficacy were defined as important components integral to Bandura's theory and this study. A brief historical description of the mathematics educational reform was described including the three major mathematics reform efforts that have taken place over the last century: the Chicago Movement, New Math, and Standards-Based Mathematics Reform. The CCSS initiative was discussed, along with the need for effective professional development guided by The National Development Council's newly revised *Standards for Professional Learning* (2011) to fully implement the new standards. Japanese Lesson Study, the professional development experience utilized in this research, was outlined as a way to provide collaborative support for teachers through their learning and improving instruction.

Support for teachers was evidenced throughout the literature review as an essential component when significant change is in progress and more specifically in light of the shifts in mathematics instruction mandated through the CCSS initiative. According to Fullan (2007), "…change will always fail until we find some way of developing infrastructures and processes that engage teachers in developing new knowledge, skills, and understandings" (p. 29). As a result, the critical ideas presented in the literature review discussed were used as the foundation for creating the lesson study professional development experience for this research that allows teachers to develop new knowledge, skills, and understandings in an effort to bolster teacher self-efficacy and outcome expectancy.

Chapter 3 - Methodology

Research Design

A case study methodology was utilized in this study to ascertain the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, the case study examined a lesson study professional development and focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy. This case study was viewed through an indepth examination of the entire process, including direct classroom observations by the researcher to study teacher efficacy in a natural setting revealing teacher beliefs and practices in action, rather than relying solely upon teacher self-reporting.

Yin (2009) describes that a case study is appropriate for research when the questions to be answered are based upon how or why, there is not a need to control behavioral events, and there is a focus on contemporary events. All of these factors are congruent with this research study. Yin (2009) further explains that a case study is necessary when, "you wanted to understand a real-life phenomenon in depth, but such understanding encompassed important contextual conditions" (p. 18). This real-life phenomenon of lesson study professional development, embedded within a unique setting, needed to be understood from a perspective that allowed the events to take place without interference of the authentic experience. For this reason, a case study was determined as the best approach to allow the lesson study professional development cycle to take place without imposition of other factors outside of seeking to understand the complex contemporary event.

Both qualitative and quantitative data were gathered through this process to obtain a broad perspective and deeper understanding of the impact of the lesson study. The professional development studied and how it impacted self-efficacy and outcome expectancy was embedded within a rich contextual condition which was uncovered through the use of qualitative data including observations and journaling. In addition, quantitative data was gathered through collection of a pre and post MTEEBI survey results. Woolfolk Hoy offers support for research of self-efficacy methodology that employs both qualitative and quantitative measures (Shaughnessy, 2004).

Creswell (2007), further defines a case study as a “bounded system” (p. 73) which is contained in a setting, which may include a specified time period, events, or process. This study was bounded within a single setting, which was a K-6 elementary school in northeastern Kansas. The study was bounded by a time period as well, which was fixed within the spring semester of the 2012-2013 school year, more specifically January through May of 2013. This study was not only bounded within a single setting and within a timeframe, the study was also bounded by events, namely the lesson study professional development focused on mathematics CCSS that took place.

In addition, Creswell (2007) notes the importance of gathering multiple sources of data throughout the inquiry of a case study. This study incorporated triangulation by gathering three main sources of data: pre and post MTEEBI surveys, direct teaching observations including audiovisual recordings of the lessons taught, and journaling prompts before, during and after the professional development. Triangulation not only strengthened the validity and credibility of this study, it also provided for multiple perspectives of the professional development to be revealed to better understand the experiences of the participants. In addition, incorporating both qualitative and quantitative data helped provide a more holistic understanding of the impact of the professional development on teacher self-efficacy and outcome expectancy.

Researchers have delineated case study methodology into variations based upon intent. Creswell (2007), identified three variations including the single instrumental case study, the collective or multiple case study, and the intrinsic case study. The intrinsic case study is of particular interest and most applicable to this study. Stake (1995) identified people and innovative programs as plausible potential cases for an intrinsic case study. Further, Stake articulates when a researcher has a specific need to know about or an intrinsic interest in a particular program, which is not driven by a desire to learn more about other cases, then the research on this given intrinsic interest can be deemed an intrinsic case study. Because the researcher was most interested in the impact of lesson study professional development on teacher self-efficacy and outcome expectancy, the study is an intrinsic case study. The researcher was mindful of Stake’s guidance with undertaking an intrinsic case study, “The more the intrinsic interest in the case, the more we will restrain our curiosities and special interests and the more we will try to discern and pursue issues critical to Θ” (p. 4), where the Greek symbol Θ (theta) represents the case.

Hence, the researcher focused intensely on the unit, or Θ, of this intrinsic case study. More specifically, the researcher focused on the self-efficacy and outcome expectancy of the fourteen K-6 elementary teachers who participated in the professional development that embedded lesson study to incorporate Common Core State Standards into mathematics instruction.

Setting

The School District

The setting for the case study was an elementary school within a school district located in a college town in northeastern Kansas, nearly 20 miles from a military base. The school district was established as a Professional Development School (PDS) district in partnership with Kansas State University's College of Education in 1989. The population of the town is approximately 52,000, while the enrollment of the university is approximately 23,000, including both undergraduate and graduate students. The school district has nine elementary schools, two middle schools, a ninth grade center, a high school for students in 10-12 grades, a virtual school for students in 7-12 grades, and an alternative high school for students ages 16-23. The district offers infant/toddler services, pre-school services, before/after school services, and summer school camps. The school district had a total enrollment of 6, 319 students, K-12, at the time of this study. The ethnic demographic make-up of the school district was 67.3% White and 32.8% Minority: 11.8% Hispanic; 8.3% Multi-Ethnic; 8.2% African American; 3.9% Asian; and 0.6% American Indian or Alaska Native. District-wide there were a total of 270 students that received English for Speakers of Other Languages (ESOL) services during the 2012-13 school year. The socioeconomic status (SES) makeup of the district was 27.9% Free and 11.2% Reduced lunch fees for a total Low SES of 39.1% and 60.9% Full Cost lunch fees, when based upon school lunch fee records. The district's total special education population was 18.1% with 13.4% students having a categorical disability and 4.7% identified as gifted. Of the district's student population, 48.1% were female and 51.9% male. Given the close proximity of the district to a military base, the student diversity was enriched with 20% military population.

The Elementary School

The research took place in a public K-6 elementary school that was built in 1923 with a limestone structure, indigenous to Kansas. This elementary school is a Professional Development School (PDS) in partnership with Kansas State University and was one of the first schools in the district to be recognized as a PDS partner with the university in 1989. This partnership has afforded the opportunity for professional development learning for teachers, such as the one outlined in this research. The USRG grant to support this research is inclusive in the university's efforts, "These smaller projects have continued to provide ongoing professional development and opportunities to communicate and collaborate across institutions and jointly enact improvement efforts" (Shroyer, Yahnke, Miller, Dunn & Bridges, 2014, p. 8). In addition, the school hosts students in various stages of their educational preparation including teacher aiding, block class experiences, and student teaching. Together, the school and the university support the up and coming teachers in quality teaching experiences through professional development, feedback, and shared resources. As evident in this study, this is a symbiotic relationship as the university also positively impacts not only pre-service teachers, but also has a positive impact on in-service teachers as well. Both the school and university work together toward a mutual goal of preparing the future of education, while embracing practicing teachers who are challenged with the demands of carrying out educational reform for continued improvement in teaching and learning.

This elementary school PDS site was recognized nationally for its outstanding professional development program. In 1997-98, the US Department of Education's National Awards Program for Model Professional Development honored this school not only with an award, but also by including it in the Johnson and Murphy (2000) publication, *Teachers Who Learn Kids Who Achieve,* which highlighted eight schools that were recognized across the nation for their success. In addition, this school's professional development program was recognized as one of seven Successful Programs in *Ideas that Work: Mathematics, Professional Development (ENC, n.d.).* A parallel can be drawn with the mission of the school's relationship with the university then and now. "When a new state math assessment left [name of school] students in the dust, the staff involved the university and looked to professional development to turn things around" (Johnson & Murphy, 2000, p. 7). Fast forward to the fall of 2012, with the adoption of CCSS and new assessments on the horizon, change and educational reform were once again eminent. The new principal, also the researcher, took a proactive approach before the assessments and once again collaborated with the university to prepare the teachers and students for the rigor of the new standards and to make shifts in instruction a reality in order to prepare the students for college and career readiness. This was done through lesson study professional development described previously. The positive results of this collaboration are revealed in this research. In addition, under the leadership of the researcher, this school earned the distinction of being a Governor's Achievement school for academic excellence. Kansas Governor, Sam Brownback, personally visited the school in March of 2014, to present the award.

This school has had several additions, including a most recent renovation and addition that was completed in 2012. All renovations, including the 2012 addition, continued with a limestone exterior to maintain the historic look of the school. A total of $3,498,016.00 was spent on this most recent construction project. The much needed enhancements to this school were of necessity, including safety features such as a fire suppression system throughout the building, new plumbing, new locks for security and a secured main entrance, which ensures anyone who enters the building must pass through the office first. The new windows replaced the dilapidated windows and now protect faculty, staff, and students from weather elements such as extreme temperatures and moisture. The new HVAC system brought an end to the old window units that were so loud teachers had to choose between the comfort of AC or being able to hear their own voice when teaching. The remodeling has made this school ADA accessible with an elevator. The 2012 addition included three classrooms and a computer lab.

The school had a total enrollment of approximately 258 students during the research project in grades K-6. The ethnic demographic make-up of the school included 77.1% White and 23.3% Minority: 9.3% Hispanic; 7.0% African American; 4.7% Multi-Ethnic; 1.9% Asian; and 0.4% American Indian or Alaska Native. There were a total of 5 students that received English for Speakers of Other Languages (ESOL) services. The socioeconomic status (SES) profile for the school was 18.2% Free lunch and 7.4% Reduced lunch for a total Low SES of 25.6% and 74.4% Full Cost, when based upon school lunch fees. The school's total special education population was 15% with 9.7% students having a categorical disability and 5.3% identified as gifted. Of the school's total population, 52% of the students were female, while 48% were male. Due to the close nature of a military base, 38% of the school's population included active military families. The transient nature of the school's population, including the active military families, caused the enrollment to fluctuate throughout the year. For this reason, the total student population reported is given as an approximation. The overall average class size was 21 students, with class size ranging from the smallest class of 18 students to the largest class of 28 students. Given the demographics of the school, it did not qualify for any additional funding through special programs including Title I Funding.

The Participants

The participants of the case study included fourteen kindergarten through sixth grade teachers from an elementary school in northeastern Kansas who were actively involved in the semester long lesson study professional development process. The teachers within this school are viewed as a close knit “family” that are very supportive of one another. This “family” feel is often referred to by stakeholders who enter the building and interact with faculty and staff, including parents, community members, substitute teachers, and other district employees. The teachers are eager learners who embraced the lesson study professional development. Participation in the lesson study professional development and completion of the data instruments was on a voluntary basis. Participants who completed all data instruments received a gift card funded through the University Small Research Grant (USRG) from Kansas State University that supported this project.

Teachers self-reported their years of teaching experience, which included the current school year this research took place, and their level of education. The teaching experience among the fourteen participants ranged from two years to thirty years of teaching. Education earned by the participants ranged from a Bachelor’s Degree to a Master’s Degree plus thirty hours. Table 3.1 specifies the number of teachers within each band of teaching experience, while Table 3.2 specifies the amount of education earned by the teachers.

Table 3.1: Participants' Years of Teaching

Years of Teaching Experience				
	0-5 Years	6-10 Years	11-20 Years	21-30 Years
Number of Teachers	4	3	4	3

Table 3.2: Participants' Level of Education

Degree Earned				
	Bachelor's (BS)	BS +15-30 hours	Master's (MS)	MS +15-30 hours
Number of Teachers	5	4	4	1

The Researcher

This discussion of the researcher in this dissertation has been written with first person style using the pronouns: "I," "me," and "my." This was done because I, the researcher, felt first person was most appropriate to articulate and share a personal perspective written from my own point of view.

I am embarking upon this research study with nearly 20 years of experience in education. My wide range of experiences in education stem from my willingness to be open to where the journey may lead. My career started in a middle school, 6-8th grade, science classroom and shifted to teaching special education, more specifically I taught both ends of the special education spectrum including teaching in a learning resources classroom and then transitioning to a gifted education classroom. My teaching experience as a resource room teacher was at the K-6 level, while my gifted education experience spanned grades K-12. I also was employed, for three years, as a Clinical Instructor with Kansas State University to support the distinctive Professional Development School (PDS) partnership between Kansas State University and area districts to provide regular on-site supervision and support for the building's cooperating teachers and KSU's teacher aides, block students, and teacher interns (student teachers) doing field placements within the school I served. This liaison position opened opportunities for me to collaborate with university instructors and professors, who graciously invited me as a guest to teach in their university classes. I am in my third year of administration, currently serving as an elementary principal in the school where this study was conducted. Interestingly, as a child, I attended this same school when I was in third through sixth grades. I have a strong vested interest in the success and learning of the students, faculty, and staff. It is my hope to provide meaningful learning opportunities for all, as research shows when teachers are learning, students are thriving in their learning as well.

My own self-efficacy has been enhanced throughout my career, in part, because I have been fortunate enough to be surrounded by some of the most renowned educators, professors, and researchers in Kansas. My training in education through a Kansas State University (KSU) Professional Development School (PDS) partnership in the same school where I am the principal today, allowed me to have close supervision and support through a strong partnership between the school and university. This partnership included my cooperating teachers, Clinical Instructor (school supervisor) and university supervisor. This partnership provided support with professional development learning opportunities and teaching resources that allowed me to experience immediate success with my instruction. However, this partnership stretched well beyond my student teaching and is a support I value still today.

As a first year teacher in 1996, feeling a bit overwhelmed due to the lack of specified curriculum, the influence of my university mentors was immediately evident as they embraced me, supported me, and challenged me to be the very best teacher I could be. They provided resources to allow me to create high quality, hands-on inquiry learning experiences for my students. The energy and excitement this meaningful learning brought to me and my students served as the catalyst I needed to work hard and give my best, further flourishing my love and deep passion for teaching that had been there all along, albeit initially cloaked by fear.

Through hard work, dedication and a commitment to being a life-long learner after nearly ten years of teaching, my efforts resulted in recognition in the field of education. During the 2005/2006 school year I was nominated as an elementary building level Kansas Teacher of the Year representative. In both 2005/2006 and 2006/2007, I was a district level nominee for the Bob Srack Excellence in Teaching Award. In 2006, I earned the status of National Board Certified Teacher certified as a Middle Childhood Generalist. I was nominated as a Kansas Master Teacher by my colleagues at one elementary school in 2005/2006 and 2006/2007. I was once again nominated at another elementary school in 2007/2008 as the school's Kansas Master Teacher. In 2007, I went on to be selected as the district's elementary Kansas Master Teacher nominee. At the state level, I was honored as a Kansas Master Teacher in 2008. Following this experience, I was selected as a 2009 Black Endowed Kansas Master Teacher and was invited to teach for a week on the Emporia State University campus. In 2011, I was among the first teachers in Kansas to earn the distinction as a Kansas Teacher Leader through the newly developed portfolio assessment and licensure program. In 2013, I was selected by the Kansas State University's College of Education (COE) to participate in a Circles of Influence documentary, which allowed me to reflect on the people instrumental in my career and journey in education. In December of 2013, I was honored with the great privilege of being selected as the KSU COE commencement speaker. Learning truly is a joyful journey with many rewards along the way. I'm excited to see where the adventure leads next.

Providing an engaging learning environment that challenged my students to step outside of their comfort zone and to take risks is always important to me as a teacher. In addition, finding ways to bond with students by learning about their interests, passions, and perspectives is something I always try to accomplish, whether I am the teacher or principal. As a young learner, I always valued, respected and appreciated the teachers who challenged me beyond what I believed I was capable of and I gave my best effort to rise to their challenge that was set before me. I enjoyed the teachers who took special interest to know me outside of just being a student. These same ideals continue to be the foundation I use as a leader. My goal is to provide meaningful learning opportunities for teachers to try new strategies and techniques, collaborate with peers, embrace challenge, and become the best teacher they can be through being open to lifelong learning and change. This journey invites me as the leader to walk beside my teachers as we all grow together, striving to enhance our teaching practices. The process of completing a dissertation is one that has pushed me far from my comfort zone, fulfilling my drive and desire to be a lifelong learner. I am honored the faculty of my school were open and willing to allow us this challenging learning opportunity within the safe haven we consider our "home."

My role as the researcher is one where I had to continuously and consciously separate myself as the principal of the school and focus on the research aspect of the study. I participated in nearly all phases of the lesson study in each grade level. The infrequent times I was absent from a session were when urgent situations arose that required my attention and were not appropriate times for another faculty member to step in to assist. Throughout the research, I was both an observer and participant. Being directly involved in the lesson study cycles and professional development was important for me to gain a deeper understanding of the interactions and implications of lesson study on teacher self-efficacy and outcome expectancy. This close interaction also allowed me to observe the meaningful collaboration, supportive environment, and collegial bonding that was created throughout the lesson study, as well as experience firsthand the synergy that existed when teachers reflected on the success of their lessons.

The Lesson Study Process

This case study research was conducted within a single K-6 public elementary school in northeastern Kansas. The teacher participants included fourteen K-6 teachers. Permission was granted to the researcher from the district's Executive Director of Teaching and Learning and the Grant Coordinator through the district's educational research approval process. A formal written research proposal, which included a full description of the research, documentation of teacher, parent, and student consents (see Appendix B & C), a copy of the data collection instruments, including the MTEEBI and journal questions, and the Kansas State University Institutional Review Board (IRB) approval were all presented for the district's approval process.

This research was a collaboration with Dr. Chepina Rumsey from Kansas State University. The researcher and Dr. Rumsey planned and collaborated from August to December of 2012 to prepare for the professional development and research that took place from January to May of 2013. Much time was devoted to creating a five month calendar that allowed for each grade level team, which included at least two classroom teachers, a week in which to complete the lesson study cycle. This calendar can be viewed in Appendix D.

A consideration that was essential to implementation was convenient scheduling of the professional development and location for easy access by participants. The professional development was scheduled during the typical professional development time built into the school's professional development calendar and/or during the school day within the school. This allowed easy access for participation for teachers, on site. Because implementation of the CCSS is a state and district requirement, the professional development provided reciprocity to the teachers in helping them grow in their understanding of the new standards, math content knowledge, pedagogy, and implementation of these standards into their instruction with the benefit of support and guidance from Dr. Rumsey's expertise and knowledge.

This professional development was centered around mathematics instruction that embedded student argumentation as set forth in the Common Core State Standards for Mathematical Practice 3: *Construct viable arguments and critique the reasoning of others*. A common theme was woven through each of the K-6 lesson studies by focusing on the overarching Domain of Number and Operations. The professional development incorporated the lesson study model to provide a team-centered approach to support teachers as they align their instruction with Common Core Standards.

Prior to the start of the lesson study professional development, all participants took a pre-MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument) survey to obtain a quantitative measure of teachers' self-efficacy and outcome expectations (see Appendix E). At the culmination of the lesson study professional development, all participants took the post-MTEEBI. In both instances though time was allotted for completion, the participants were given the opportunity to take the MTEEBI with them to allow additional time to complete it at their choosing.

As an expert math educator, Dr. Rumsey brought her knowledge to present three one-hour professional development sessions that focused on mathematical argumentation in the classroom and an overview of the Japanese Lesson Study model. During this time, teachers who had completed their lesson study cycle shared their interesting discoveries and perspectives from their experience.

This research project utilized a modified version of the Japanese Lesson Study model for professional development. Figure 2.2, presented in Chapter 2, outlined the process that was used for lesson study in this research project. The lesson study cycle presented in this figure was modified from the Stepanek et al., 2007, model. The primary modifications made, as represented in Figure 2.2, included the goal setting and planning phases were combined into one step; teaching of the initial lesson and debriefing were separated into two distinct steps; debriefing was combined with revising the lesson into one step; and reteaching was isolated into a single step. Though this model shows five distinct steps in the process, only three 90 minute sessions were utilized to complete the lesson study cycle. Step one was a single session, steps two and three were combined into one session, and steps four and five were combined into the final session.

Each lesson study cycle was planned with three 90 minute sessions per grade level for a total of 270 minutes of collaboration time. This calculation does not, however, include the extensive amounts of time that teachers worked on their lesson in addition to this allotted time. The lesson study cycle steps, as modified and implemented in this research, are outlined in a visual format in Figure 3.1 below.

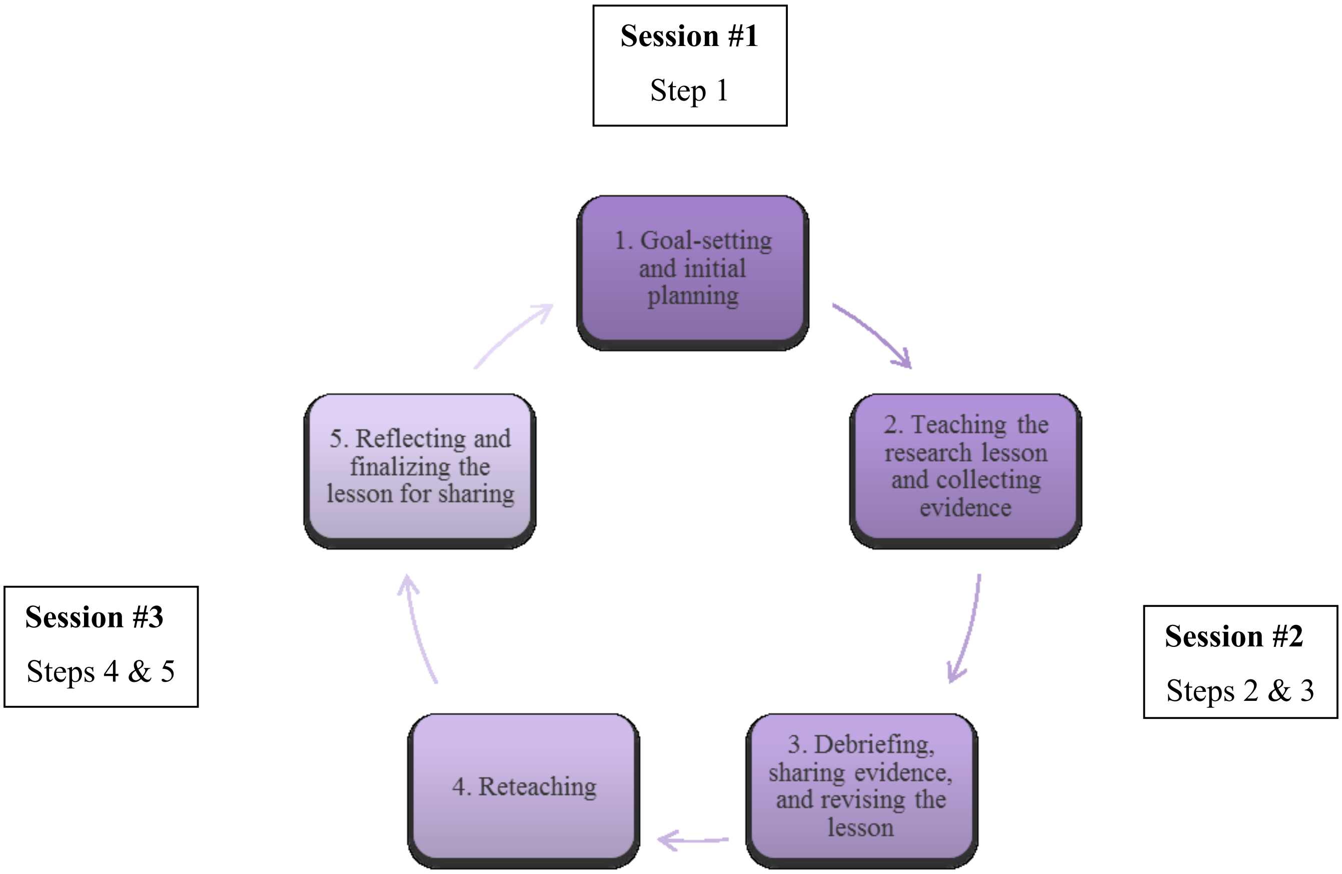

Figure 3.1: Lesson Study Cycle (modified from Stepanek et al., 2007) by Dr. Chepina Rumsey (professional development documents)

Step one was a 90 minute session devoted to goal setting and planning the lesson. After teachers initially selected the CCSS of focus for the lesson, Dr. Rumsey provided additional resources on the math concept for the teachers to consider during the planning session. The teachers, Dr. Rumsey, and the researcher all collaborated during this planning meeting to create a math lesson utilizing the 5-E lesson planning model, to include a constructivist learning experience that allowed the students to begin creating their own understandings from the lesson activities and new ideas presented. The 5-E lesson plan was an efficient way to organize and structure all the lessons K-6 based upon core lesson components including: Engage, Explore, Explain, Elaborate and Evaluate. The 5-E lesson plan template can be viewed in full detail in Appendix F.

After the initial planning meeting, there was a gap in time of several weeks until the lesson was taught. This allowed teachers ample time to gather or create any additional materials needed and to finalize the lesson plan. It should be noted that during this time, other lesson studies were ongoing and being taught by other teachers and the building wide lesson study cycle was continuously fluid during this time.

Each lesson in the lesson study cycle was initially taught by one of the grade level teachers for approximately 45 minutes. This lesson was video recorded and was observed live by the grade level teaching partner, Dr. Rumsey, the researcher, and any other participants (see Appendix G for Lesson Study Observation Protocol). Immediately following this initial lesson, the team met for a debriefing session. The teacher who taught the lesson always began the debriefing discussion to share how effective he/she thought the lesson was, note any interesting discoveries, and to share any recommendations for changes. Other team members then shared their observations of student responses and understanding, offering suggestions for modifications to improve student learning (see Appendix H for Lesson Study Follow-Up Discussion Protocol). The debriefing sessions lasted approximately 45 minutes to one hour. The teachers then modified the lesson as suggested and gathered or created any additional materials needed to prepare for the next teaching cycle of the lesson. Both the initial teaching of the lesson and the first debriefing session were combined into one day for a total combined meeting time of approximately 90-120 minutes.

During the second teaching cycle, the lesson was retaught by the grade level partner that observed the original lesson once again using the Lesson Study Observation Protocol. The lesson was taught for approximately 45 minutes, incorporating the changes and modifications suggested from the debriefing session following the initial teach. The second lesson was observed by all participants and video recorded. Immediately following this lesson reteach, the team met once again to have a final reflection meeting to discuss the lesson and how effective the modifications were using the Lesson Study Follow-Up Discussion Protocol. The final reflection meeting lasted approximately 45 minutes to one hour. Both the reteach of the lesson and final reflection session were combined into one day for a total combined meeting time of approximately 90-120 minutes. Each lesson was taught twice, with the exception of the $5^{th}/6^{th}$ grade team. Since there were two 5^{th} grade teachers and one 6^{th} grade teacher on this team, this lesson was taught a total of three times. Throughout the lesson study cycle, participants completed the journaling prompts as seen in Appendix I. Technology was used as the journaling prompts were emailed to participants by the researcher. The prompt responses were sent to Dr. Rumsey and organized until the end of the research. The prompts were then sent on to the researcher for analysis.

Data Collection

This case study integrated both qualitative and quantitative data collection methods to examine the impact of the professional development on teacher self-efficacy and outcome expectancy and to provide a broad understanding and examination of the impact of the professional development on these two constructs. The quantitative data collection included the completion of the MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument) before and after the professional development for pre and post measures. The qualitative data collection included observations of planning meetings, teaching episodes and debriefing/reflection meetings (these were also videotapes) and participant journal entries. The journaling took place before the lesson study cycle began, during the lesson study but after the teacher had taught his/her lesson, and after the lesson study cycle was completed. Both the journals and the videotaping were completed before, during, and after the professional development. The qualitative data supports the quantitative through triangulation of data.
As noted by Stake (1995), the researcher carefully selected data collection methods that would cause least disruption to the natural setting in an effort to, “preserve the multiple realities, the different and even contradictory views of what is happening” (p. 12).

The data collection for this study was narrowly focused on gathering information that addressed the following research questions and hypotheses:

1. In what ways does lesson study professional development impact teachers’ self-efficacy and outcome expectancy?

This overarching question was explored through two more specific subquestions.

A. In what ways does the lesson study process impact teachers' personal mathematical teaching efficacy?

B. In what ways does the lesson study process impact teachers' mathematical outcome expectancy?

The quantitative data, pre and post MTEEBI scores, were tested against the following Null Hypotheses:

Null Hypothesis 1: There will not be a difference in the MTEEBI pre and post self-efficacy mean scores collected before after the lesson study professional development.

Null Hypothesis 2: There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores collected before after the lesson study professional development.

Table 3.3, below, serves as a guide to demonstrate the alignment of data sources to the research questions. Both qualitative and quantitative data were collected to better inform this research project.

Table 3.3: Data Source Alignment to Research Questions

Data Sources			
In what ways does lesson study professional development impact teachers' self-efficacy and outcome expectancy?			
	MTEEBI	**Video Observations**	**Journal Reflections**
Question A: In what ways does the lesson study process impact teachers' personal mathematical self-efficacy?	**Pre/Post**	**Planning Session** **Lessons** **Reflection Session**	**●Planning Phase Questions** **●Lesson Study Reflection Questions** **●Final Reflection Questions**
Question B: In what ways does the lesson study process impact teachers' mathematical outcome expectancy?	**Pre/Post**	**Planning Session** **Lessons** **Reflection Session**	**●Planning Phase Questions** **●Lesson Study Reflection Questions** **●Final Reflection Questions**

The pre and post MTEEBI were used to answer questions A and B, pertaining to personal mathematics teaching efficacy and outcome expectancy. As noted in table 3.4, all journaling prompts for the three phases: Planning Phase, Lesson Study Reflection, and Final Reflection were used as data sources to answer sub questions A and B. In addition, the planning sessions, lessons before, during and after the study cycle and reflection sessions were observed, recorded, and reviewed to further triangulate the findings of the MTEEBI and the journals to more fully answer questions A and B.

In an effort to ensure accuracy and privacy in the data collection process, the pre and post MTEEBI surveys were distributed and returned in sealed envelopes. The reflective journal prompts were emailed directly to the participants by the researcher and were emailed back directly from the participants to Dr. Rumsey. These secured measures allowed for the teacher participants to share their open and honest perceptions with assured confidentiality.

Primary Sources of Evidence

Classroom Teaching Observations and Videotaped Documentation

First-hand observations and videotaped sessions were used to document the lesson study process. As previously mentioned, the entire lesson study professional development process was videotaped with teacher, parent, and student consents (as documented in Appendices B & C). The introduction session and professional development on mathematics argumentation with Dr. Rumsey was also videotaped. All team planning sessions were videotaped, along with a classroom lesson taught before, during, and after the lesson study cycle. All debriefing meetings and reflection meetings were recorded. The final whole group reflection and debriefing session with all grade level teams together was also recorded. This resulted in the teachers being videotaped at least three times during instruction of math lessons throughout the entire lesson study process. All video was collected and stored by Dr. Rumsey. To assist with participant teachers feeling more comfortable with the videotaping process, teachers were allowed to videotape their own lesson initially with an iPad without additional observers in the classroom. During the actual lesson study lesson, the math instruction was both videotaped and observed by peers, Dr. Rumsey, and the researcher. For each team, one lesson study lesson was videotaped by a videographer from the university to provide better quality audio and visual documentation.

MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument) Survey

The MTEEBI survey was used to quantify and analyze self-reported changes in the teachers' self-efficacy and outcome expectancy during the lesson study professional development. All participants completed a pre and post MTEEBI survey, which provided quantitative data relevant to answering the research questions and null hypotheses presented for the study. This survey was previously noted in Appendix E and its progression over time will be described in detail below. The MTEEBI survey was used for this study with permission granted by Dr. Iris Riggs through communications initiated by Dr. Gail Shroyer, the major professor of the researcher.

This Mathematics Teaching Efficacy and Expectancy Beliefs Instrument was intended to measure mathematics self- efficacy beliefs and outcome expectancy beliefs of inservice teachers.

These two subscales are based upon Bandura's construct of self-efficacy. The MTEEBI was generated from a modification of the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI), which was designed for preservice teachers (Enochs, Smith & Huinker, 2000). The MTEBI was created from adaptations of the Science Teaching Efficacy Belief Instrument (STEBI) (Riggs & Enochs, 1990). The creation of the MTEBI was initially established by only slightly modifying the items' reference to science in the STEBI to include a reference to mathematics in the MTEBI, maintaining the original construct validity. Due to the slight modification of the STEBI, the MTEBI only had general references to mathematics teaching and learning.

The MTEEBI is a self-report instrument that originally included 59 items, at the time the participants were surveyed. The MTEEBI items have been crafted to incorporate the Common Core State Standards and CCSS Mathematical Practices, examining teacher agreement with items pertaining to teachers' beliefs in their ability to teach mathematics (self-efficacy) and their beliefs in their students' ability to learn mathematics, when provided effective teaching (outcome expectancy). The MTEEBI contains a five point likert scale with a teacher response that ranges from strongly agree to strongly disagree, with a neutral response of uncertain. Appendix J includes a copy of the MTEEBI with scoring coding of outcome expectancy and self-efficacy items, positively and negatively coded items, and the likert scale. This instrument was selected not only because of its anticipated validity and reliability, but also because of the context specificity of the instrument to measure self-efficacy and outcome expectancy related to the CCSS which tightly aligns with the focus of this research project and the ease of use of the instrument (I. Riggs, personal communication, November 10, 2012; Fischman et al., 2014).

MTEEBI Instrument Validity & Reliability

The original MTEBI was created by Drs. Enochs, Smith, and Huinker (2000) out of modification to the Science Teaching Efficacy Belief Instrument (STEBI), which was created by Riggs and Enochs (1990). The MTEBI and STEBI surveys were both designed to be used with preservice teachers. However, Fischman, Lewis, Riggs and Riggs (2014) adapted the MTEBI to create the MTEEBI over an extensive five year process to allow the instrument to be used with inservice teachers with questions tailored to address CCSS and teachers' beliefs in their ability to implement CCSS Standards for Mathematical Practice and teachers' beliefs in their students' ability to learn the CCSS Standards for Mathematical Practice, regardless of student background.

During the adaptation of the MTEBI into the MTEEBI, construct validity was established as a professor of mathematics designed pilot questions, based upon extensive knowledge of the CCSS Standards for Mathematical Practice. In addition, a team including mathematics professors and teacher educators was identified to review the CCSS items in terms of "jargon or awkward wording," clarify meaning, and to create additional items so all 8 of the Standards for Mathematical Practice were addressed with both positively and negatively worded items that included both self-efficacy and outcome expectancy constructs. Rasch analysis was used throughout this process to determine "fit of individual items" and to eliminate weak performing items.

As a result of this development process, the MTEEBI instrument included 59 items with 13 items that remained from the MTEBI and 15 items that were eliminated. A total of 46 items were created and added to address the CCSS. This 59 item MTEEBI was administered in the summer of 2013 to a group of teachers participating in a professional development event at California State University, San Bernardino and also to a group of Kansas teachers during a district wide professional development led, in part, by the researcher in November of 2013.

Using this pilot data, the MTEEBI instrument went through a rigorous process of refinement in July of 2014 to determine which items performed well and which items did not perform as well. Through a process of confirmatory factor analysis, the poorer performing items that were not consistent with either construct of self-efficacy or outcome expectancy were ultimately removed from the MTEEBI. Construct validity was further established through this process of item enhancement and confirmatory factor analysis (I. Riggs, personal communication, July 3, 2014). The confirmatory factor analysis was completed with a sample of 388 participants. Any item with a value equal to or less than .30 or any item that was cross loaded was removed from the instrument. See Appendix K to view the results of the confirmatory factor analysis item removal. As a result of this fine-tuning to ensure the soundest instrument possible, 12 of the self-efficacy items were removed and 14 of the outcome expectancy items were removed, leaving a total of 33 items in the final MTEEBI instrument (Appendix J highlights the items retained in the final MTEEBI instrument).

MTEEBI instrumentation reliability for the items' internal consistency was established through determining the Cronbach's Alpha with a sample of 430 teachers, which included the participants in this study. The additional K-6 teachers were from the same school district where this study took place. For the self-efficacy scale, 42 cases were excluded for a total N=388 and for the outcome expectancy scale, 40 of the original 430 cases were excluded for N=390. The Cronbach's Alpha value ranges between 0 – 1.0 and the closer the value is to 1.0, the greater the internal consistency of the instrument items. According to George and Mallery (2003), the Cronbach's Alpha value can be evaluated as: "≥.9 = excellent; ≥.8 = good; ≥.7 = acceptable; ≥.6 = questionable; ≥.5 = poor; <.5 = unacceptable" (p 231). Table 3.3 below indicates the Cronbach's Alpha ratings derived from the self-efficacy and outcome expectancy items. The MTEEBI results revealed an excellent Cronbach's Alpha value of .932 on the 33 self-efficacy items and a good Cronbach's Alpha value of .841 was yielded from the 26 outcome expectancy items (I. Riggs, personal communication, July 3, 2014). Both alphas are indicative of acceptable values and indicate a high internal consistency reliability (Cronbach, 1951).

Table 3.4: Cronbach's Alpha

Construct	Number of Items	Cronbach's Alpha	Alpha Rating
Self-Efficacy	33	.932	Excellent
Outcome Expectancy	26	.841	Good

An Item-Total Correlation of .348 or higher was reported for all 33 self-efficacy items, with the exception of item #30 that had a -.179 item-total correlation. This item was removed during the refinement process and was not included in the final 33 MTEEBI items. An Item-Total Correlation of .355 or higher was reported for all 26 outcome expectancy items, with the exception of 5 items that had a .255 or lower item-total correlation. These items, #1, 2, 16, 26, and 41, were all removed during the refinement process and were not included in the final MTEEBI. The pre and post MTEEBI administered for this research will be maintained with the larger group of piloting to assist in further development of reliability.

Figure 3.2 below shows the self-efficacy and outcomes expectancy items and the scoring coding for each item. The self-efficacy items and outcomes expectancy items were either positively or negatively worded and therefore some items were negatively or reverse scored.

When the items were positively scored, strongly agree = 5, agree = 4, uncertain = 3, disagree = 2, and strongly disagree = 1. When the items were negatively scored, reverse scoring was used, resulting in strongly agree = 1, agree = 2, uncertain = 3, disagree = 4, and strongly disagree = 5. There were 23 items written with positive/affirmative word formatting, while 10 items were written with negative word formatting that remained. The items written with negative word formatting were reverse scored to produce consistent values between the positively and negatively worded items. The highlighted items in Appendix J are the items that were retained in the final MTEEBI and these items were used in the final analysis of data in this study. The revised MTEEBI currently has a total of 33 items, 21 self-efficacy items and 12 outcome expectancy items.

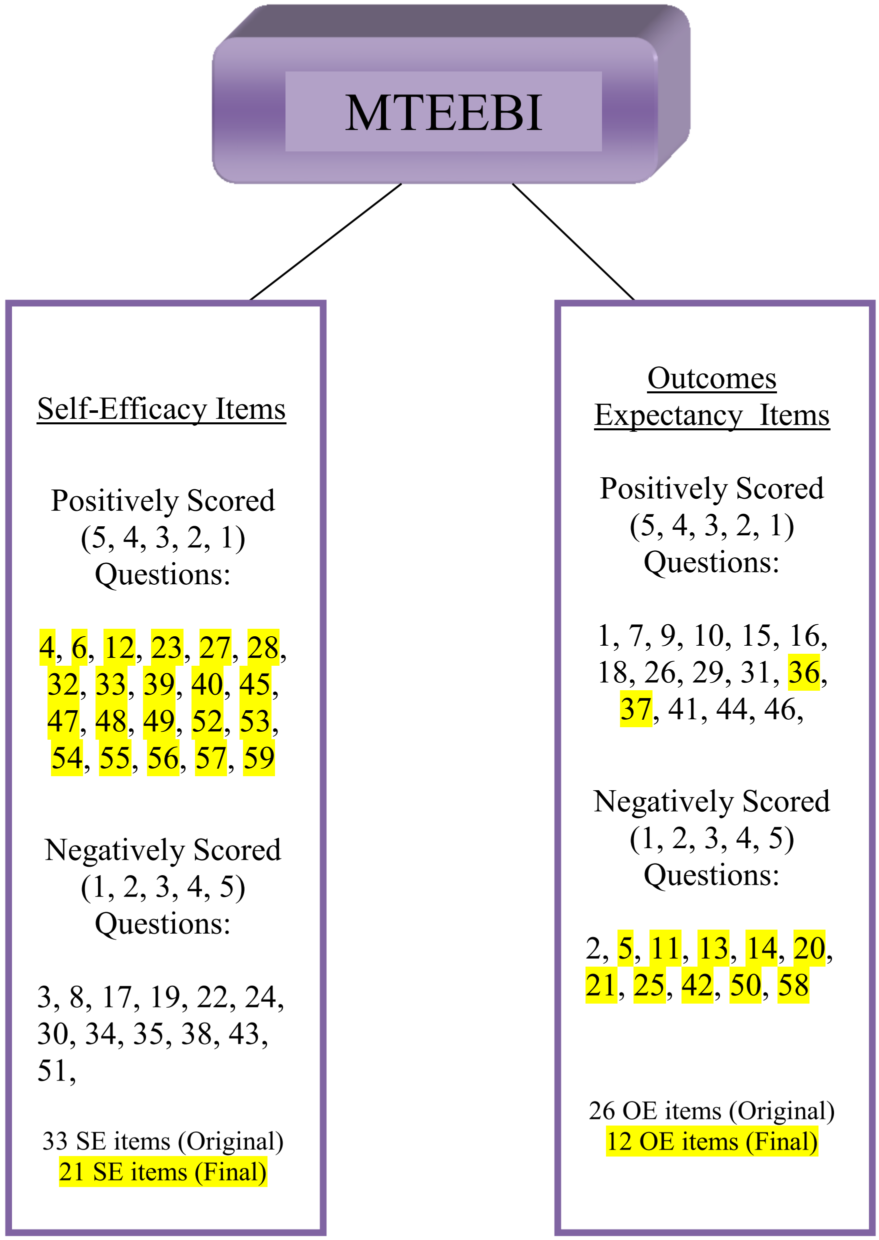

Figure 3.2: Structure of MTEEBI, Self-Efficacy and Outcome Expectancy Items with Positive/Negative Scoring and Final Items Retained Highlighted in Yellow

Because of this continuous refinement process of the instrument to establish heightened construct validity, the pre and post MTEEBI surveys the teacher participants completed in this study had some items with minor word changes that happened after the administration of the MTEEBI in this research. Therefore, the MTEEBI items the teacher participants were given have since been changed in the newly revised MTEEBI. For example, the words “elementary school” were removed from item #12, The item #12 given in this study read, “I understand math concepts well enough to be effective in teaching elementary school math.” However, the newly revised item #12 now reads, “I understand math concepts well enough to be effective in teaching math.” Item #15 was modified as the word “skills” was replaced with the word “effectiveness” and item #36, “environment” was replaced by the word “background.” These changes to each of these items can be viewed fully in Appendix L.

The MTEEBI survey was used as a pre/post measure to determine teacher self-reported growth of the two constructs of Self-Efficacy (SE) and Outcomes Expectancy (OE). The original MTEEBI had a total of 59 items, 33 SE items and 26 OE items. Teachers in this study were given the original MTEEBI with all 59 items. The final selection of the 33 items were extracted from the total 59 item pre and post MTEEBI administered to the teacher participants in this research project and used for final analysis. The researcher had statistics run on the full 59-item MTEEBI, prior to knowing the results of the refinement of the confirmatory factor analysis process. However, when these results became available to the researcher, the results were run again using only the final 33 items that remained after the confirmatory factor analysis. The researcher used this final statistical analysis to report on the data in this study because the final 33 items represented an enhanced instrument.

Journaling Reflections

Journal prompts were used to triangulate with the MTEEBI and to explore sources of changes in self-efficacy and outcome expectancy. Journaling was selected as a means of qualitative data collection because this method provided a less formal, non-threatening outlet of communication to allow participants to share their thoughts and feelings more openly about their experiences. Given the private nature of the forum, it allowed for authentic diverse perspectives to be shared by promoting individual self-expression resulting from the lesson study professional development experience. This form of communication was not intended to replace traditional discussions, rather the hope was that it would provide a deeper understanding of the introspective reflection of teachers through a more secured venue as they documented their experiences throughout the lesson study professional development process.

The researcher requested all participants complete journal reflection prompts throughout the professional development and lesson study process (as previously noted in Appendix I). Prompts were written to gain a rich perspective of the participants' experiences. Specifically, the researcher wrote prompts to gain an understanding of how the professional development impacted the beliefs and behaviors of the teachers as related to the sources of self-efficacy including: mastery experiences, modeling, verbal/social persuasion, and physiological response. Participants journaled during the planning phase, during the actual lesson study but after teaching the lesson, and following the lesson study experience.

Data Analysis

Though there were a total of fourteen participants initially, not all fourteen completed each of the data collection instruments or processes. Since this was a voluntary process, attempts were made to encourage full completion of data collection methods, though 100% participation was not accomplished. The researcher determined that only participants who completed the lesson study process would be included in the study to determine impact of the lesson study on self-efficacy and outcome expectancy. One participant needed to be removed from the sample because this teacher did not participate fully in the lesson study cycle with colleagues. Though some participants did not submit all of the data requested, they were still included in the study because they participated fully in the lesson study cycle process.

This mixed methods case study utilized both qualitative and quantitative data sources to more fully understand the impact of lesson study professional development on self-efficacy and outcome expectancy. At the culmination of the study, the researcher examined all of the data holistically as well as individually (Yin, 2003). This examination included the videotaped documentation of the entire lesson study cycle with planning sessions, teaching episodes, debriefing/reflection meetings; pre and post MTEEBI survey results; and journal entries.

Patton (2002) delineated there is not a clear and distinct difference between data collection and data analysis in qualitative research. He further clarified that at the culmination of data collection, a process of analysis can be completed through organization of the data. The researcher approached the qualitative data analysis in this manner.

The data was analyzed with the specific methodology described in detail below.

Observations and Videotaped Documentation Analysis

Field notes the researcher recorded during observations, along with the videotaped episodes were reviewed and used to provide the thick, rich description of the lesson study process in Chapter 4. The observational data was then categorized into the main events of the lesson study process including planning session, first teaching episode, debriefing session, reteach episode, and final reflection meeting. Quotes were extracted verbatim from notes and videotape review, when possible, and applied as support for emerging themes when there were repeated and overlapping patterns present.

While the text data was reviewed from a holistic perspective, the researcher took notes on potential patterns and categories that began to emerge through repetition and correspondence between the multiple data sources collected. A coding system was used to track similar participant responses, which were then coded and later became themes. Items were coded initially based upon their congruence with self-efficacy or outcome expectancy. Codes that seemed to overlap were refined and combined into a singular theme. Open coding was implemented throughout this process, continually adding to codes as they became evident and analyzing previously coded data with respect to the new codes that emerged. New codes were merged into the priori codes of Bandura's four sources (i.e., collaboration was merged under modeling). In other cases, open codes were not aligned with the scope of the research questions and were not included (i.e., teaching practices). This cyclical analysis continued until all textual data had been coded. Deductive coding was implemented as all codes were applied based upon the theoretical framework of Bandura, including priori codes of sources of self-efficacy including mastery experiences, modeling, verbal/social persuasion and physiological response. In vivo coding was applied when possible to utilize the specific language of participants to more closely represent their experiences. The researcher used memoing throughout the analysis process to record insights or reflections on the data as they occurred.

MTEEBI Analysis

The MTEEBI was analyzed using a Paired-Samples t-test to determine the significance of the pre and post self-efficacy and outcome expectancy shifts in relation to the lesson study professional development experience. This analysis is the recommendation given from the instrument developer and is traditionally the most commonly used in the field with the MTEEBI and related instruments (STEBI & MTEBI). Given the small sample size of this research, N=13, and likert scale responses not representing true interval data, the researcher chose to include a Wilcoxon Signed Rank Test as a non-parametric comparison. In addition, Cohen's d was calculated to interpret the level of significance of the t-test results, which is discussed further in

Chapter 4. The SPSS Predictive Analytics SoftWare statistics program was utilized to run the statistical analysis of the MTEEBI used in this study.

The researcher also analyzed the MTEEBI results in terms of differences of groups including examining the number of years the participants taught by career clusters. The MTEEBI results were also analyzed in terms of differences by individual teachers. Finally, the MTEEBI results were analyzed by individual self-efficacy and outcome expectancy items with the highest three gain scores and the lowest three loss scores for each construct respectively.

Journal Analysis

The journaling entries completed by participants were used to triangulate and support the results from the MTEEBI and the observations. The researcher purposefully created journaling prompts that connected to the theoretical framework of the study with questions that contributed to better understanding both self-efficacy and outcome expectancy factors. Further, the responses were analyzed in respect to connection to the four sources that contribute to self-efficacy: mastery experiences, modeling, verbal/social persuasion and physiological responses.

While the text data was reviewed from a holistic perspective, the researcher took notes on potential patterns and categories that began to emerge through repetition and correspondence between the multiple data sources collected, specifically considering the four sources that contribute to enhancing self-efficacy. Priori codes were established initially using self-efficacy and outcome expectancy as overriding themes. Codes that seemed to overlap were refined, combined, and condensed into a singular theme. Open coding was implemented throughout this process, continually adding to codes as they became evident and analyzing previously coded data with respect to the new codes that emerged. This cyclical analysis continued until all textual data had been coded (Creswell, 2007). Priori coding was applied as all codes were identified by the researcher during the analysis to align with the four sources of efficacy outlined by Bandura. In vivo coding was applied when possible to utilize the specific language of participants to more closely represent their experiences (Creswell, 2007). These codes were then aligned to the theoretical framework with the four sources of efficacy. The researcher used memoing throughout the analysis process to record insights or reflections on the data as they occurred.

Finally, the researcher considered all the pieces of data collected and identified the themes that were relevant in answering the research questions. This included analysis to determine responses "repeatedly being present" (Corbin & Strauss, 1990, p. 7). This data was then represented in written discussion and visual formats including figures and tables, when possible.

Trustworthiness and Ethical Standards

A wide variety of perspectives exist in terms of trustworthiness of research. The researcher opted to use the following four criteria to establish trustworthiness: 1) Truth value and credibility for internal validity; 2) Applicability and transferability for external validity; 3) Consistency and dependability for reliability; and 4) Neutrality and confirmability for objectivity.

In qualitative research, validity can be described as the assessment of accuracy of the research, while reliability can be viewed in terms of consistency within a study (Creswell, 2007). Whittenmore, Chase, and Mandle (2001) identified 29 techniques for demonstrating validity within a study. The researcher has chosen to employ nine methods to highlight specifically in this chapter, though even more techniques were embedded within this research. The nine techniques included are: triangulation, member checking, peer debriefing, peer auditing, prolonged engagement, persistent observation within the field, rich, thick description, high quality tape recording and direct quotes from participants. The researcher has described these nine techniques aligned with the four criteria of trustworthiness selected for this study (see Table 3.5).

Creswell (2007) recommends that researchers employ at least two methods of validation strategies within a study. The researcher amply surpassed this recommendation as outlined above. In addition, Creswell asserts his support of these techniques used by the researcher, "I also view validation as a distinct strength to qualitative research in that the account made through extensive time spent in the field, the detailed thick description, and the closeness of the researcher to the participants in the study all add to the value or accuracy of the study" (p. 207). The researcher was close to the participants with a professional, yet warm relationship as the principal of the school where the research took place.

Table 3.5: Criteria of Soundness & Evidence within this Research Study

Trustworthiness Criterion	Qualitative Research	Quantitative Research
Truth Value	Credibility	Internal validity
Established through structural corroboration of utilization of multiple data sources to include triangulation of data, including Pre/Post MTEEBI, observations, and journal responses to seek confluence of evidence. In addition, the researcher employed member checking to ensure the experience was captured accurately from the participants' perspectives. Peer debriefing and peer auditing with the Major Professor, Dr. Gail Shroyer ensured agreement on codes and themes that emerged. Prolonged engagement and persistent observation in the field also contributed to the credibility of the study.		
Applicability	Transferability	External validity
Established through providing a rich, thick description of the setting, participants, background, data collection methodology and analysis, findings and conclusions to allow readers to determine the potential transferability of findings of this study to their own setting by determining any shared characteristics.		
Consistency	Dependability/Replicability	Reliability
Established through observation and video recording of all lesson studies to prepare a thick, rich description of the data collection and analysis process which was established, in part, through the audit trail maintained throughout the process. Triangulation of both qualitative and quantitative data served to provide a primary means of dependability through using multiple data sources with varying data collection methods. Prolonged engagement and persistent observation with the researcher spending a full year on the study with one semester of planning with Dr. Rumsey and one semester of conducting the research contributed to the overall dependability. In addition high quality tape recording and direct quotes from participants were utilized.		
Neutrality	Confirmability/Unbiased	Objectivity
Established with peer auditing and peer debriefing by the Major Profession, Dr. Gail Shroyer, throughout the entire research process. The researcher also created an audit trail during the research process.		

Truth Value/Credibility/Internal Validity

Credibility can be viewed as an indicator of the trustworthiness of the measures or strategies utilized within a research. Credibility of this study was enhanced with structural corroboration of multiple data sources to include triangulation of data, member checking, peer debriefing and auditing, and prolonged engagement. Each of these strategies are discussed in full detail to give the reader a clear understanding of these methods employed.

The researcher created credibility by implementing structural corroboration by utilizing varying types of data to confirm or contradict the interpretation of data (Eisner, 1991). This study incorporated triangulation by gathering three main sources of data: pre and post MTEEBI surveys; direct teaching observations including audiovisual recordings of the lessons taught, debriefing and reflection sessions; and journaling prompts before, during and after the professional development. In this process, the researcher pursued a way in which to, "…seek a confluence of evidence that breeds credibility, that allows us to feel confident about our observations, interpretations, and conclusions" (Eisner, 1991, p. 110). Continual comparison of the varying data sources provided a way in which triangulation not only strengthened the validity and credibility of this study, it also provided for multiple perspectives of the professional development to be revealed to better understand and affirm the accuracy of the experiences of the participants. In addition, incorporating both qualitative and quantitative data helped provide a more holistic understanding of the impact of the professional development on teacher self-efficacy and outcome expectancy.

Member checking was incorporated at multiple points throughout the research and writing process. The researcher provided drafts of chapters for participants to review and make comments and suggestions on the truthfulness of the accounts. After the researcher analyzed data including the MTEEBI, teaching observations, debriefing/reflection sessions, journal entries, and written accounts of the data analysis were presented to the participants for confirmation or denial of the accuracy of the written summary initially presented by the researcher. Based upon the participant input, modifications were made if needed. The process of member checking was utilized to ensure the accuracy of the participants' voices were relayed in a sound manner through the research. Furthermore, Johnson, 1997, asserts that the use of verbatim descriptions in the way of direct quotes from participants further enhances reliability due the nature of their low inference descriptive nature. The researcher embedded direct quotes when possible to promote authenticity in the analysis and reporting of findings in this study.

Throughout the entire study, the researcher debriefed continuously with her Major Professor, Dr. Gail Shroyer and doctoral committee member, Dr. Chepina Rumsey. This continuous dialogue regarding the research design, lesson study professional development, and analysis provided peer review, debriefing, and auditing that supported the researcher's continued efforts in completing a meaningful, quality study. During the qualitative coding process, the researcher worked closely with Dr. Shroyer to determine intercoder agreement on codes and themes that emerged throughout the data analysis. Furthermore, the researcher consulted with this expert reviewer to establish inter-rater reliability of the coded transcripts. This goal was achieved by coding transcripts independently and then meeting to examine the code names and the text of the transcripts that were coded to examine the consistency of the coding process. Patton (2002) provides confirmation that when the doctoral committee serves as expert reviewers, the credibility of the study increases.

Prolonged engagement and persistent observation within the field were both established and enhanced the credibility of the study as the researcher worked in the environment and participated in planning and/or observation throughout the entire 2012/13 school year. The researcher spent August through December observing and participating in ongoing professional development within the school where the research was conducted. In addition, the researcher planned with Dr. Rumsey the lesson study professional development and calendar of implementation during this time period as well. The actual research took place from January through May of 2013. During this time, the researcher was both participant and observer of the lesson study professional development process. Throughout this year of prolonged engagement and persistent observation, the researcher was able to better understand the learning culture of the school and build a trusting relationship with the participants.

Applicability/Transferability/External Validity

Transferability of research can be viewed as a determination if the findings and results of one study are applicable or transferable to outside settings. The transferability of this research was established in the way of the researcher's attention to detail in providing dense description of the setting, participants, background, data collection methodology and analysis, findings and conclusions. Rich, thick description was provided from the researcher about the school setting context of the study, as well as the participants in the study.

This rich description will help readers determine transferability of findings of this study to their own setting by determining if there are any characteristics that are shared with their own scenario (Guba & Lincoln, 1989). In addition, throughout the study the researcher used thick description of all data collection methods and analysis to fully describe all aspects of the research.

Consistency/Dependability/Reliability

Dependability refers to the likelihood that findings from one study will yield similar results across time or in a different setting or context. Triangulation of both qualitative and quantitative data served to provide a primary means of dependability through using multiple data sources with varying data collection methods. Prolonged engagement with the researcher spending a full year on the study with one semester of planning with Dr. Rumsey and one semester of conducting the research also contributed to the overall dependability of this study. Dependability in this research also was established through the observation and video recording of all lesson studies to prepare a thick, rich description of the data collection and analysis process which supported the establishment of the audit trail.

Creswell outlines one reliability perspective, "Reliability can be enhanced if the researcher obtains detailed fieldnotes by employing a good-quality tape for recording and by transcribing the tape" (p. 209). Reliability was enhanced through high quality videotaping and the transcription of the videotaped lessons and debriefing/reflection sessions, to provide a consistent record of the study's events and outcomes.

Given that qualitative research relies upon the interpretation of the researcher, direct quotes from participants were used. Johnson (1997) asserts that the use of verbatim descriptions in the way of direct quotes from participants further enhances reliability due to their low inference descriptive nature. The researcher embedded direct quotes when possible to promote authenticity in the analysis and reporting of findings in this study.

Neutrality/Confirmability (Unbiased)/Objectivity

Confirmability can be understood as the unbiased, objective, and impartial collection, analysis and interpretation of data. Confirmability in this study was established through peer review, auditing and debriefing with the Major Professor, Dr. Gail Shroyer, as discussed previously. In addition, the researcher created an audit trail through the process including field notes and analysis coding.

Ethical Standards

Throughout this study, the researcher took precaution to ensure the strictest of ethical standards with human subjects was upheld. The researcher initially took into consideration the voice of the participants to establish their willingness to participate through a survey which can be viewed in Appendix A. The Kansas State University's Institutional Review Board (IRB) process and expectations were adhered to, resulting in permission granted for the study. In addition, the researcher adhered to the process and protocol established by the USD #383 School District to conduct research with teachers and students within a district school. The identity of the teacher participants and their students has been protected. However, the professor that lead the professional development, the university, school district, and the school are mentioned by name.

Summary

In this chapter, the researcher outlined the setting, participants, researcher's role, research design, data collection and data analysis that were applied to this study. The multiple strategies employed for ensuring trustworthiness and ethical standards were discussed. The trustworthiness of this study has been enhanced through the variety of data that was collected, qualitative and quantitative, in varying methodology. All of the methods discussed and employed in this research established a solid foundation for the trustworthiness of this study. This intrinsic case study was designed to examine the complex nature of the impact of lesson study professional development on self-efficacy and outcome expectancy of 14 elementary teachers.

Chapter 4 - Results

Introduction

The central purpose of this mixed methods case study research was to ascertain the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, the study focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy viewed through an indepth examination of the entire process. The data was grounded in actual teaching practice through observations by the researcher to effectively capture and study teacher efficacy in a natural setting revealing teacher beliefs and outcome expectancy in action, rather than relying solely upon teacher self-reporting.

The setting for this study was an elementary school with a total enrollment of 258 students in grades K-6. The school was located in a college town in northeastern Kansas. Data was initially collected from 14 teachers. However, one teacher was not able to fully participate in the lesson study process due to the part-time nature of her teaching position. Therefore, final analysis of data was based on 13 teacher participants.

The professional development was completed in collaboration with the local university's College of Education with a math education professor that conducted the professional development sessions and led the lesson studies. Each grade level completed a lesson study with at least two teachers per team and the 5th and 6th grades combined with three teachers on the team because there was only one 6th grade teacher.

All planning sessions began with an overview of the Common Core Standard(s) that was the focus of the lesson, the lesson objectives, and additional resources Dr. Rumsey, the university professor, provided for the teachers to consider. These resources included websites, books, and research articles. Discussion also included the parental consents gathered by the teacher and the strategic grouping of students to ensure any child that did not have a parental consent for participation in the project was placed in a group together that did not appear in the videotaping.

The lesson studies comprised of the following phases: planning session, first teaching, debriefing, reteaching, and final reflection which will be discussed in further detail in this chapter. A joint planning session with the teachers, professor and researcher allowed for the team to discuss goals and objectives of the lesson and materials to be used. The lesson that was designed in the planning session, guided by the Lesson Study Plan Template in Appendix F, was then taught by one teacher to his/her students as the other team members completed observations and made notations, recorded on the Lesson Study Observation Protocol as seen in Appendix G. Following the initial teach, a debriefing session was completed immediately following to discuss and identify strengths and weaknesses of the lesson and modifications needed to improve the lesson. This discussion focused primarily on the students' learning response to the lesson and ways to improve student learning and understanding. Following the debriefing session, the modified lesson was retaught by the partner teacher to his/her students. Following the reteach, a final reflection meeting was held to discuss the impact of the modifications on the lesson effectiveness and discuss future instruction.

Data was collected from a variety of sources, which included both qualitative and quantitative measures to obtain a broad perspective and deeper understanding of the impact of the lesson study professional development on self-efficacy. The qualitative data was gathered through observations and videotaped recordings of all phases of the lesson study (planning, teaching, debriefing, reteaching, and reflecting) and participant journaling throughout the entire process. The quantitative data was gathered through a pre and post MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument) survey. This study used the theoretical framework of Albert Bandura's Social Cognitive Theory as a means of grounding (1986).

The impact of lesson study professional development on self-efficacy and outcome expectancy was examined through the following overarching research question:

1. In what ways does lesson study professional development impact teachers' self-efficacy and outcome expectancy?

This overarching question was explored through two more specific subquestions.

A. In what ways does the lesson study process impact teachers' personal mathematical self-efficacy?

B. In what ways does the lesson study process impact teachers' mathematical outcome expectancy?

These questions were answered through the data collected and analyzed as outlined in Table 3.4.

This chapter will continue with an overview of the observations of the lesson study process and a thick, rich discussion of the phases of the lesson study including: planning session, first teaching, debriefing, reteach and final reflection. These observations will be related to Bandura's four sources of efficacy: Mastery Experiences, Modeling, Verbal/Social Persuasion, Physiological Response. Bandura (1977) identified four contributing sources that influence one's self-efficacy beliefs. These sources are: 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions. The MTEEBI results will follow. The MTEEBI data were analyzed using the paired t-Tests in relationship to the Null hypothesis. This research tested the following hypotheses: Null Hypothesis 1: There will not be a difference in the MTEEBI pre and post self-efficacy mean scores collected before after the lesson study professional development. Null Hypothesis 2: There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores collected before after the lesson study professional development. The results from the journal analysis will be presented last, showing impact on self-efficacy and outcome expectancy, once again related to Bandura's four sources of self-efficacy.

Observations of the Lesson Study Process

The researcher will begin with a rich, thick description of the lesson study process and the lesson study itself. This section will be organized by the major events that took place throughout the lesson study process including planning sessions, teaching episodes with observations, and debriefing/reflection meetings. The videotaped documentation of the entire lesson study process, including the planning sessions, teaching episodes, and reflection meetings, as well as first hand observations conducted by the researcher as a result of being a participant in the process, were used as a foundation for the thick, rich description captured here. The researchers will connect the observations, including discussions and experiences, to Bandura's four sources of efficacy and highlight evidence of self-efficacy and outcome expectancy.

This research was planned from August to December of 2012 to prepare for the professional development and research that took place from January to May of 2013. Much time was devoted to creating a five month calendar that allowed for each grade level team, that included at least two classroom teachers, a week in which to complete the lesson study cycle. This calendar can be viewed in Appendix D.

Prior to the start of the lesson study professional development, all participants took a pre-MTEEBI to obtain a quantitative measure of teachers' reported self-efficacy and outcome expectancy. At the culmination and conclusion of the lesson study professional development, all participants took a post-MTEEBI. In both instances though time was allotted for completion in the meeting, the participants were given the opportunity to take the MTEEBI with them to allow additional time to complete it at their choosing.

As an expert math educator, Dr. Rumsey brought her knowledge to present three one-hour professional development sessions that focused on mathematical argumentation in the classroom and an overview of the Japanese Lesson Study model. Teachers who had completed their lesson study cycle shared their interesting discoveries and perspectives from their experience during professional development sessions that took place toward the latter part of this study.

This research project utilized a modified version of the Japanese Lesson Study model for professional development. Though the model in Figure 4.1 shows five distinct steps in the process, this was modified and only three sessions were utilized to complete the lesson study cycle. Step one, goal setting and planning, was a single session; steps two and three, teaching/data collection and debriefing/revising, were combined into one session; and steps four and five, reteach and reflecting, were combined into the final session. Each lesson study cycle was planned with three 90 minute sessions per grade level for a total of 270 minutes of collaboration time to complete the lesson study. This calculation does not, however, include the additional amounts of time that teachers worked on their lesson in addition to this time allotted.

The lesson study cycle process, as modified and implemented in this research, is outlined in a visual format in Figure 4.1.

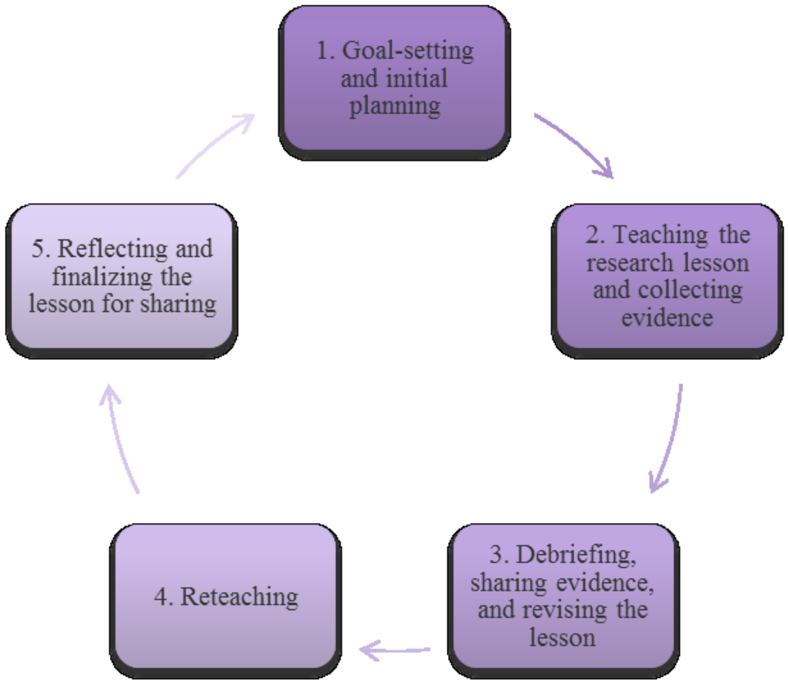

Figure 4.1: Lesson Study Cycle (modified from Stepanek et al., 2007) by Dr. Chepina Rumsey (professional development documents)

Throughout the lesson study process outlined here, it should be recognized there was an understanding that each member of the team was considered an equal member with an important perspective and contribution to bring to the experience. Observations and teacher comments provided evidence that the collaborative nature of the lesson study itself, combined with the evident respect for one another by the grade level team members helped everyone feel as though they were part of the team. As Teacher #52 explained it, "Working with a team enhanced my belief that we are in this together. Working together can help us do better." This attitude, as observed by the researcher from working firsthand with each team, brought about a shared vision and ownership for the lessons that were created by each grade level team. This shared responsibility for carrying out the lesson study process to completion provided further evidence of the impact of shared mastery experiences, modeling, verbal/social persuasion and physiological response. Each team was open to the ideas shared by various team members and the continuous mention of the positive impact of collective brainstorming served as evidence the value teachers placed on this collaborative experience.

Initial Orientation and Professional Development Session

Prior to the start of any of the lesson study cycles, Dr. Rumsey led a professional development session on January 14, 2013, in the school library where this research took place. The purpose of this initial session was to set the stage for the professional development which provided an orientation overview of goals, the teacher, parent, and student consents (see Appendices B & C), the building calendar and schedule for the lesson study lessons at each grade level (see Appendix D), the MTEEBI (Appendix E), journaling prompts (Appendix I), videotaping expectations, lesson study process, review of the collaborative environment of the lesson study and expectations, and the overriding focus themes of the Standard Domain of Numbers/Operations and the Standards of Mathematical Practice #3 (SMP): Construct arguments and critique the reasoning of others. In addition, the 5E lesson plan format was introduced (see Appendix F). Also, Language Frames by Ross, Fisher & Frey, 2009, were introduced including:

Based on _____, I think ______.

I agree with _______ because _________.

I observed ______ when _______.

I disagree with _________ because ________.

Dr. Rumsey shared ideas for how to modify a given lesson from a text, reviewed supporting research articles, and explained that the district's current mathematics textbook would be used as the foundation for the lessons and the lessons would be modified to include best practices including argumentation. Dr. Rumsey also shared videotaped examples of her teaching lessons that provided evidence of the impact of a modified lesson on the quality of mathematics argumentation and discussion with students, providing a model of a mastery experience.

The team expectations were shared including focus of the lesson study on the learning and the team planned lesson, not the teacher that taught the lesson; respect for others; openness to new ideas; inclusion of egalitarian discussion where each person at the table was viewed as an equal with equally important ideas/suggestions shared, and a sense of community through collaboration and a shared responsibility for planning and teaching a quality lesson.

Finally, this session concluded with a time for teacher participants to share their questions or concerns. Questions mostly included calendar conflicts with state assessments, clarification on the lesson study process including MTEEBI pre and post, journaling prompts and videotaping. The teachers shared they were most excited about the opportunity to work together with colleagues and a content expert to plan a quality lesson through the process of lesson study, emerge as a team of leaders through the process, and implement language frames. The verbal/social persuasion that was evident in this initial professional development session set the stage for observed growing confidence within the teachers and positive physiological responses in moving forward with the lesson study process.

Planning Session

Step one was a 90 minute planning session devoted to goal setting and planning the quality lesson. Though each team was notified if they needed additional plan time with Dr. Rumsey and the researcher that could be arranged, only the 2nd grade team requested a second planning session to finalize the lesson planning. A portion of the planning meeting was spent discussing parent/student consents and organization of students in groups according to the consents received, in an effort to group students together at the back of the classroom, that were not permitted to be videotaped. Review of the lesson study dates and teachers teaching the lessons, along with the lesson study process, was discussed. During the planning session for each grade level team, teachers initially selected the CCSS of focus for the lesson based upon the Domain Numbers and Operations, integrating the mathematical practice standard of mathematical argumentation.

The planning session was casual, with snacks provided including fruit, cookies, crackers, candy, and chocolate. Teacher participants were encouraged to take care of any personal needs throughout the planning session including water or restroom breaks and gathering materials as needed.

Twelve of the thirteen teachers responded to a question of whether or not they have taught the lesson previously. Five of the 12 teachers reported they had never taught this lesson prior to lesson study, 6 of the 12 teachers reported they had taught the lesson previously but it was being taught with modifications brought about through the lesson study process as a result of the team planning. Finally, only 1 of the 12 teachers (Teacher #12) reported she had taught the lesson previously and said, “No, I really don’t see a lot of differences,” when discussing any modifications to the lesson. The teams defined the goal/objective of the lesson study after they selected the standard and lesson topic, which was open to their own choosing. To further promote development of the lesson plan, Dr. Rumsey provided additional resources on the math concept for the teachers to consider during the planning session. These resources included the progression document for each grade level and examples from Illustrative Mathematics and additional resources specific to each grade level. The teachers, Dr. Rumsey, and the researcher all collaborated during this planning meeting to create a math lesson utilizing the inquiry oriented 5-E lesson planning model: Engage, Explore, Explain, Elaborate, Evaluate (see Appendix F), to include a constructivist learning experience that allowed the students to begin creating their own understandings from the lesson activities and new ideas presented. The 5-E lesson plan served as a flexible guide and was used in all lessons studies, however, the use of the 5-E was to help structure a quality lesson and not drive a model that had to be strictly followed if it didn’t promote the natural flow of the lesson. In some lesson study teams different parts of the 5-E were combined. For example, the 2nd grade team made an important discovery through the process that it would be more helpful to do “free flow thinking” first and create their lesson and then go back and put the parts of the lesson into the 5E format and fill in as needed. This was an important discovery during this process because the teachers discussed how they will use this information to coach their teacher interns to consider the 5-E format as a flexible guiding tool as well so they are not stuck in the lesson planning process.

During the planning session, attention was given to creating a lesson goal/objective and considering the instruction from the students’ perspective. Possible student questions and anticipated misconceptions or errors was explored through discussion. In addition, directly tied to the student questions was a brainstorming of ideas for teacher responses, teacher questioning, and discussion points. This process dissected both student and teacher actions in the planning of the lesson for each grade level team to create the best mastery learning experience possible. Specific time was devoted in the planning session to discuss grouping of students and ways to challenge individual learners through differentiated instruction. Also, time was devoted to discussing the prior knowledge students needed to successfully understand the content and engage in lesson activities.

Each lesson created in the grade level teams included a hands-on exploration or investigation in which students were encouraged to share their ideas and explain their responses by justifying or defending their solution, making generalizations, and explaining connections to other ideas or strategies to solve the problem. The lesson planning also included finding ways in which to challenge the students to utilize their newly learned skills in an application to a different situation involving problem solving. Each team discussed ways in which to evaluate student learning in the lesson to determine student success through their demonstrated understanding at the end of the lesson. The strategic planning that went into the lesson study lesson planning provided evidence of the rigor and deep thinking that was created for both the teacher and student. Mathematical argumentation was built into the lesson study lessons by asking the students to justify their responses, solve a problem with varying methods, determine if answers were reasonable, or explain the rationale for problem solving. Throughout this planning, the teacher participants pulled from prior teaching mastery experiences in their discussions to build a lesson that would produce an additional mastery experience.

Finally, at the close of the planning sessions, the observation protocol (see Appendix G) was reviewed for note taking during the lesson study observations. Expectations were reviewed from the initial professional development session, with a reminder that the focus of the lesson study would be the lesson itself and the student learning, not the teacher teaching the lesson. The debriefing meeting procedure was reviewed with the cue that the teacher that taught the lesson would take the lead in the debriefing discussion. Additional details were also provided during this wrap-up including the process for videotaping lessons, copying videotapes to Dr. Rumsey's computer, additional materials that were needed and how such resources would be shared between the teachers, and finally the preparation of the students for visitors and video cameras in the classroom during the lesson.

Throughout the planning sessions, the researcher observed a comfortable collaborative environment that was evidenced through balanced input from the participants in offering ideas and suggestions, as well as asking questions. The teacher participants appeared to enjoy the team planning as was evidenced through their genuine laughter, light hearted joking, continuous brainstorming, and pondering additional ways to teach the topics. Teacher participants were open to the ideas and suggestions of others and even asked for help, input and the thoughts of others. For example, during the fourth grade planning session one teacher was thinking aloud and shared her thoughts on the engage portion of their lesson when she offered, “I’m kinda stuck, what do you think?” The teacher participants were comfortable enough to give their honest opinions of how they wanted parts of the lesson to go. For example, when discussing the student group size for an investigation in the third grade team a teacher shared, “I don’t think it should be as a group, I mean, I think pairs would be as big as I want to go with it.” The teacher participants asked for clarification and appeared at ease in asking the questions to better understand content or parts of the lessons. Teacher participants readily took on shared responsibility for preparation of materials that were needed. Notes were taken by all team members and Dr. Rumsey also typed her notes on the lesson plan template, which was shared with all team members who then added additional thoughts to the notes. The verbal/social persuasion observed in the planning session appeared to promote a positive physiological response as participants were at ease in the planning phase and were excited about the high quality lesson they planned.

The discussion was guided with the assistance of the teachers, Dr. Rumsey, and the researcher asking questions that stemmed from the natural flowing discussions that took place. The questions were centered around continued focus on the creation of a high quality lesson. Some of the questions asked included:

> “Does this lesson have a good way to engage?”
> “Is there an investigation or hands-on exploration we can do?”
> “What questions can be asked of students?”
> “Is there a pattern we want them to notice or anything we can get them talking about at this point?”
> “Could we….?”
> “Is there a place to introduce new vocabulary?”
> “What do you think?”
> “What discoveries do we want students to make?”
> “Should we…..?”
> “How would you like to evaluate their understanding?”
> “Are there other things you want to include?”
> “Is it ok if……?”
> “Is that what you were thinking?”
> “Can you anticipate any struggles the students will have?”
> “What if we……?”
> “I am being the devil’s advocate here….”
> “Do you think we should change……?”
> “Do you think we’ll have any early finishers and if so, what should we do?”

"Do you have a preference?"
"Is there another way to do this?"
"How are you feeling about the lesson so far?"

Excitement was observed by the researcher as the teams were creating their lessons, especially as the teacher participants were brainstorming and designing lesson activities. During this time the volume of the team typically increased with laughter, praise, and affirmations such as, "Yes!" "Cool!" "Look at you!" The body language of the teams was evident with smiles, strong eye contact, and continual engagement with verbal feedback as teachers generated ideas. Such body language was indicative of the positive collaborative experience observed by the researcher. These examples are evidence of positive self-efficacy, verbal/social persuasion and physiological response present during this experience.

Deep content discussions also were evident as each team worked through identifying the specific focus and direction of the lesson. Fine detailed decisions were made such as agreeing on the hands-on explorations, specific mathematic vocabulary presented, selection of materials provided for students to create the best learning experience, degree of content scaffolding to use and challenge to ensure differentiated instruction was effective for supporting learning and providing adequate rigor for all students. Within each grade level team, as questions were created for prompting mathematical discourse and argumentation, careful thought was given to how to engage students in discussion. Teacher #41 reflected on this with, "The real mathematical thinking is, 'Can you explain it?' It's not just enough to choose an answer, 'How did you do it?'" The deep content discussion promoted modeling for collegial peers through reflection on mastery experiences.

In each team planning session, the researcher observed the teachers fully engaged and on task a majority of the time, with only minimal off task discussions observed. This discussion was often representative of the strong team bonding with discussion of shared experiences or personal comments. This off task discussion was very short in duration and did not distract from the overall planning. For instance, during the planning of the fourth grade lesson, one teacher randomly brought up the idea of the other teacher moving by saying, "I heard Leavenworth is shutting down!" indicating her desire for her teaching partner not to move. After some initial laughter the team was back to planning. In addition, another team of teachers revealed work related dreams, more like nightmares, they were having about state assessment scores and lock-down drills. It was during this off task discussion that prompted some teachers to share being nervous about the outside observers in their classroom for the lesson study. One teacher voiced this with, "I'm kinda nervous, I'm not gonna lie." Another commented, "No judging!" Positive verbal/social persuasion was evident as support was given to participants that shared any fears or concerns. Reminders were given to reassure teachers that the focus was on the lesson and the learning and not the teacher and it was a team endeavor and all members were in it together. Strategies were discussed to support teachers, such as ways to post the questions they asked during the lesson. Such discussions revealed the team bonds and openness that existed in the various grade level teams, which included sharing vulnerabilities - all indicative of the positive physiological responses.

Praise was evident in all planning sessions and the researcher observed positive verbal/social persuasion with comments such as:

> "I like your idea!"
> "That seems like a good way to engage students."
> "I feel like we have a really good start."
> "I think this is AWESOME!"
> "I think that would be a good idea!"
> "There you go!"
> "Yes, Yes, YES!"
> "Yah! That's really good!"
> "You guys are awesome! Look at all this brain power here!"
> "You did a great job with….."

Comments such as the examples mentioned above all appeared to contribute to the positive physiological response demonstrated through smiles and laughter. These interactions encouraged the teachers to contribute and participate fully in the discussions, planning, brainstorming, and idea sharing. This was evident as an easy flow in conversation was continued throughout all of the planning sessions. Some responses were directed back toward teachers' responses to continue the depth of the discussion. For instance, after the teachers in the first grade team discussed their engage, Dr. Rumsey followed with, "It sounds like one of the questions we'll be asking in the engage is how many tens and ones are in a number?" and "Can you tell me a story problem that uses those?" This approach affirmed the input given from the teachers and was a way to initiate the next phase of the discussion in a positive way. The teachers were actively engaged in the discussions of the planning sessions and they readily asked clarification questions, provided input, gave constructive feedback and provided praise, contributing additional positive verbal/social persuasion further enhancing the physiological responses of the participants.

During the wrap-up discussion of the planning sessions, the researcher observed the teacher participants feeling proud of their accomplishments and excited about their lessons. These examples and discussions served as evidence of verbal/social persuasion to bolster the teachers' physiological response and ultimately self-efficacy.

An important transition was made during the lesson planning sessions. Three teachers revealed they had prior experience with lesson study prior to this research. Two of these teachers reported their previous experiences were not positive. However, in the process of planning, two of these teachers shared their changing perception of this new experience. One teacher commented towards the end of the planning session, "This actually seems kind of fun!" Another teacher revealed that she had participated in lesson study before in another city in the same state. She shared that during this past experience people, "yelled," "cried," and "got up and walked out." She reported that, "This is already going better." This knowledge was important for the researcher to consider in observing how these teachers viewed this lesson study in light of their prior experience and was evidence of the enhanced lesson study mastery experience that was underway, which impacted the teachers' physiological response with a more positive and relaxed outcome already evident just in the planning session phase of the study.

After the initial planning meeting, there was a gap in time of several weeks until the lesson was taught. This allowed teachers ample time to gather and/or create any additional materials needed and to finalize the lesson plan. It should be noted that during this time, other lesson studies were ongoing and being taught by other teachers and the building wide lesson study cycle was continuously fluid throughout this time.

First Teaching

There were a total of six teams that participated in the lesson study professional development, see Table 4.1 below for team details. Each team had two or more classroom teachers participating. The teams included the following grade levels: Kindergarten, First Grade, Second Grade, Third Grade, Fourth Grade, and a Fifth/Sixth Grade combined team. Fifth and sixth grade was a combined team because there was only one sixth grade teacher employed at the time of the research. In addition to the classroom teachers, Dr. Chepina Rumsey (a mathematics education professor from Kansas State University), and the researcher (who was the principal of the school at the time of the research) also participated in all aspects of the lesson study.

Table 4.1: Teacher Participant Teams

Grade Level Teams						
	Kindergarten "Team K"	**First Grade "Team 1"**	**Second Grade "Team 2"**	**Third Grade "Team 3"**	**Fourth Grade "Team 4"**	**Fifth/Sixth Grade "Team 5/6"**
Number of Teachers	2	2	2	2	2	3
Numerical Codes for Teachers	Teacher 1 Teacher 2	Teacher 11 Teacher 12	Teacher 21 Teacher 22	Teacher 31 Teacher 32* Teacher 33	Teacher 41 Teacher 42	Teacher 51 Teacher 52 Teacher 61

*Though Teacher 32 initially started the research, job duties and meetings at the university prevented full participation in the lesson study. For this reason Teacher 32 was removed from the study.

Each lesson in the lesson study lesson was initially taught by one of the grade level teachers for approximately 45 minutes. This lesson was observed by the grade level teaching partners, Dr. Rumsey, the researcher, and any other available participants and was video recorded. During this observation, each of the team members completed the observation protocol as seen in Appendix G. During the observation, the focus of the lesson study observation was on the students and their response to the lesson, not the teacher. Therefore observers were mindful of recording evidence that supported evidence the lesson goal/objective was met, students understood the mathematical concepts, discourse and mathematical argumentation occurred, students were engaged, and if any student misconceptions were present or addressed. All of this data served as a springboard for the debriefing sessions to discuss the success of the lesson and any modifications needed to be most effective in reaching all student learners.

Table 4.2 provides the specific CCSS addressed, the goal of the lesson and a rich, thick description of the lesson taught by each grade level team.

Table 4.2: Lesson Study Topics

Grade Level/Team	Common Core State Standard and Lesson Summary
Kindergarten **"Team K"**	**K.NBT.1 - Work with Numbers 11-19 to gain foundations for place value.** 1. Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (such as 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones. The goal of this lesson was for students to compose and decompose numbers to 20, or beyond. To do this, the students used ten frames and teddy bear counters, identifying tens and ones, and fast counting using 5s and 10s. Differentiated instruction was utilized by dividing the kindergarten students into three distinct groups with different tasks to provide challenge to meet the needs of each individual student. The on grade level group rolled two dice to compose and decompose numbers using ten frames, organized in tens and ones, and wrote the numbers they created combining the tens and ones. The above grade level group composed and decomposed numbers beyond 20 by rolling three dice, then they wrote the equation that corresponded with the numbers they rolled. The below grade level group composed and decomposed numbers rolling two dice using single ten frames (not organized by tens and ones) and then wrote the number they created and identified the tens and ones in the number. The students took turns rolling the dice to create addends for multiple addition problems.
First Grade **"Team 1"**	**1.NBT.4 – Use place value understanding and properties of operations to add and subtract.** 4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. The focus of this lesson was for students to add two digit plus one digit numbers and add two digit plus two digit numbers with and without regrouping up to 100. To do this, students used place value mats, tens sticks and ones cubes to demonstrate an understanding of place value by composing the numbers and then concretely adding the numbers by combining the manipulatives. Students created word problems to embed the numbers into a real world context. Students used cooperative learning and took turns being the team leader to explain their way of solving the problem and checking answers with their peers to discuss any differences. Differentiated instruction was built in by giving more complex problems with larger numbers to various students ready for a challenge.

Second Grade **"Team 2"**	**2.MD.8 – Work with time and money.** 8. Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using \$ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have? **2.NBT.7 – Use place value understanding and properties of operations to add and subtract.** Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. In this lesson, the students focused on solving real world problems with adding and subtracting money utilizing multiple problem solving strategies including: drawing a picture, fact families, counting on with using a number line, and bar modeling. Students were presented with a given amount of play money and counted and compared that amount with a peer to decide which amount was greater than/less than the other amount. The students created a real world problem with the money and then showed two different ways to solve the problem. Differentiated instruction was embedded by providing differing levels of problems for students to solve, giving varying amounts of money for students to work with, and student creation of one or two step story problems.
Third Grade **"Team 3"**	**3.OA.5 – Understand properties of multiplication and the relationship between multiplication and division.** 5. Apply properties of operations as strategies to multiply and divide.[2] Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) The goal of this lesson was for students to use the distributive property to solve multiplication problems by decomposing one of the factors, multiplying the parts, and then adding those partial products back together. Students viewed an array model of 9x7 and were challenged to find multiple ways to decompose the factors of that array and students wrote these on sticky notes attached to the original array [i.e., 9x7 = (5x7) + (4x7)]. Students were encouraged to strategically decompose an array into pieces that yielded multiplication of facts the students knew with automaticity (2s, 5s, &10s, etc.). Differentiated instruction was integrated by providing various materials for students to use (i.e., two- color chips, arrays) and problems with varying difficulty (i.e., single digit vs. double digits/triple digits).

Fourth Grade **“Team 4”**	**4.NF.5, 4.NF.6, 4. NF.7 – Understand decimal notation for fractions, and compare decimal fractions.** **4.NF.5** Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. *For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.* **4.NF.6** Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.* **4. NF.7** Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model. The focus of this lesson was for students to solve real world problems with addition and subtraction of decimals with money and measurement. The students did this through a simulation of creating a meal for their family by shopping through store ads from a newspaper. They had only $20 to spend per group and they had to purchase 5 items: 1 meat, 1 veggie, 1 fruit, and 1 dessert and another item of their choosing. The students were encouraged to solve the problem any way they wanted. Students shared multiple ways for problem solving (i.e., some rounded the cost of each item and then subtracted from $20 [subtracted either one item at a time or all 5 items rounded, then added then subtracted], some subtracted each item in exact amount one item at a time from $20, some added up all items [exact amounts or rounded] and then subtracted from $20.) Students then moved on to solve additional problems adding and subtracting decimals with money and measurement (liters and meters). Students created a bar model of their problems to help justify their reasoning. Discussion of all problems focused on the reasonableness of the answer, if the answer made sense, and various methods for problem solving with each problem.
Fifth/Sixth Grade **“Team 5/6”**	**5.MD.3 – Geometric Measurement: Understand concepts of volume and relate volume to multiplication and to addition.** 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. A. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume. B. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units. **6.G.2 – Solve real-world and mathematical problems involving area, surface area, and volume.** 2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that

	the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. In this lesson, the students focused on solving real-world problems to find the volume of rectangular prisms by using multiplication. Students were challenged to estimate the number of Starbursts in a rectangular prism container. After discussion of volume and further exploration, students came back to the Starburst problem to modify their estimate after having more understanding of finding volume and asked for specific information to get a more accurate estimate. Students also discovered they needed to provide their answers in cubic units when finding volume because of the three dimensions used: length, width, and height. Students then built a model of a cubic meter to get a visual for their next challenge. Students then calculated how many cubic meters of air it would take to fill the classroom. Differentiated instruction was embedded as students had different levels of challenge in their problems they did independently after they completed finding the number of cubic meters in the classroom.

Hands-on discoveries were evident in all of the lesson study lessons. In the $5^{th}/6^{th}$ grade lesson the students were challenged to find the volume of the classroom. Students built a cubic meter to demonstrate the actual size and then used measurements of the room to determine volume and number of cubic meters in the room. In the kindergarten lesson, the students composed and decomposed numbers to 20 or beyond using dice, ten frames and teddy bear counters.

Teachers often shared how beneficial it was to have more adults in the room to discuss mathematical understandings with different student teams and to gain a deeper appreciation of the understanding of each student group. It should be noted that typically in a lesson study the observers do not interact with students. However, in this professional development the observers actively engaged in discussions with students to better understand their thinking and asked questions for clarification or to further probe understanding.

Throughout the lesson study lessons, the students' responses to the lessons were captured. Hands-on exploration provided excitement for the students. In the first grade lesson, the students were excited to work on a problem that included adding a double digit number and another double digit number to find a sum over one hundred while building with place value mats, tens sticks, and ones cubes. When the first graders made this discovery, they inhaled and exhaled loudly, smiled, and cheered with their hands in the air. During this second teaching of this lesson, the kids were so excited they even asked for more problems to solve. In the initial third grade lesson, the researcher observed students give audible cheers when they learned they would be using arrays. In the reteach of the third grade lesson, students were continually commenting on how "easy and fun" the distributive property was as they physically cut apart arrays to create a model of the decomposition of factors. When the whole lesson was finished one student stood up and exclaimed, "That was like the BEST math lesson ever!" In the fourth grade lesson study, the news that the students would be creating a meal by shopping out of real grocery store ads was met with student cheers and air fist pumping. The enthusiasm from the students served as a boost in self-efficacy for teachers through verbal/social persuasion and physiological response. Outcome expectancy and self-efficacy were enhanced for teachers that were going to teach the next lesson through mastery experience and modeling from the lesson they observed.

The researcher observed high engagement throughout the lessons. The reteach of the second grade lesson had students fully engaged for over an hour and half in deep mathematical problem solving with real world money word problems which required adding and subtracting with decimals with bar modeling representation. In the fourth grade lessons, both classes of students literally had their 'heads together' as they poured over the grocery store ads and worked in their teams to create their family meal. During this work time the volume went up, there was laughter, smiles, and mathematical discussion of how they were going about solving the problem was observed. The researcher even observed verbal praise from student-to-student as well through the lesson studies and one fourth grade student told another, "You got it buddy!" when he was selected for his team to share out their problem solving strategy. Bandura's (1977) four sources of self-efficacy were observed throughout the lesson studies. The sources of self-efficacy were observed in teacher interactions, as well as student interactions.

A vast majority of the students throughout the lesson studies were engaged in mathematical discourse with coaching and praising their peers and justifying their methodology for problem solving and their final solutions. Teacher #22 reflected on the benefit of the peer coaching, "I think with coaching they are teaching each other and there is nothing more powerful than that." Though no further mention was made by teachers related to student learning through modeling, the researcher considered the benefits of peer learning in relationship to the entire lesson study cycle, including teacher participants learning from one another. The modeling enhanced the learning of both students and adults and provided a source of efficacy for teachers as described by Bandura.

Debriefing Session

Immediately following this initial lesson, the team met for a debriefing session in the school's main conference room, which was the same location as the planning sessions. The debriefing sessions lasted approximately 45 minutes to one hour. The discussion held for each grade level team was guided by the follow-up discussion protocol found in Appendix H. The teacher who taught the lesson always began the debriefing discussion to share how effective he/she thought the lesson was, noting any interesting discoveries, sharing any changes he/she made while teaching the lesson, and sharing any recommendations for changes in the future.

All teams discussed if the goal/objective of the lesson was met. The majority of the teams felt their lesson objective/goal was met and in some instances the goal was tweaked to build in additional challenge as needed. This was evidenced in the first grade team as they determined the second group of students would be ready to look at adding not only double digit numbers but also to include sums over one hundred.

Some teachers felt like the time went so quickly they were not always able to get in all parts of the lesson planned and had to trim parts to allow enough time for other investigations planned. For this reason, some teachers made shifts in the lesson while teaching the lesson. Teacher #41 felt as though she did not meet her learning objective when she taught the lesson because she did not have time to teach all parts of the lesson. However, the team reviewed the lesson objective to determine the students really had been successful solving real world problems with adding and subtracting of decimals.

Discussion about student understanding was a focus of the debrief sessions and students discoveries were shared. Specific examples were shared of student comments that demonstrated their understanding, advanced understandings, misconceptions, or confusion. Information that was missing in prerequisite knowledge was discussed and ideas for how to address that for the next lesson were generated. Specific misconceptions were explored and strategies were discussed to improve student understanding. For example, in the third grade lesson study the initial lesson revealed students were just breaking apart arrays without strategy or rationale for why they were breaking the arrays in the manner they chose other than, "it worked." One student broke apart 84 into 42 and 42 and another broke 101 into 71 and 30, however, these methods did not prove to be successful in helping the students simplify the multiplication. The teachers determined a better approach for the reteach lesson would be to teach students to look at arrays to find strategic ways to break them apart to make the multiplication easier with facts they already knew, i.e., 84 broken into 80 and 4 and 101 broken into 100 and 1. This simplified the multiplication with (80x100) + (80x1) and (4x100) + (4x1), which made the multiplication problems easy to solve.

Some teachers shared personal frustrations from their own teaching. For example, a teacher from the first grade team shared that she unintentionally gave one of the higher level questions to the students initially instead of towards the end of the lesson and reported, "That made myself mad [sic]." Another teacher in the $5^{th}/6^{th}$ grade team commented that she was disappointed that she "failed" to let her students know ahead of time to round their measurements. Though these teachers felt like these were important issues to point out, the other team members did not view these incidences as issues that caused concern in the learning. These discussions created an opportunity for further mathematical discourse among the teachers. Verbal/social persuasion was evident as the teachers reassured one another.

Peers also gave praise to their teaching partners during debriefing sessions. One teacher shared, "[Teacher 12] did such a good job!" When referring to the integration and use of technology one teacher commented that she sometimes struggles with technology but was pleased it worked in this lesson. Her teaching partner responded to her with, "You did it! You did it well!" Teacher #41 responded to her teaching partner that was unsure of her teaching at first, "I thought you were up there very confident, very relaxed and you could see you were having fun with some of their responses." She went on to include how the observation of her teaching partner gave her ideas for her own lesson, "I actually wrote down some things that I'm going to ask, like some of the terminology and some of things like the strategies." This provided evidence of the power of peer modeling to share ideas and the impact of positive verbal/social persuasion.

All teams also discussed the changes they wanted to make for the next teaching iteration during debriefing. Some teams adjusted the objectives to build in additional challenge as discussed with the first grade team. In the third grade team initial debrief it was determined that there was a lot of rich discussion in the small groups, but not as much in the whole group. This team decided to create prompts that would allow the students to do more of the problem solving and thinking during the group discussion instead of the teacher doing most of the talking in the reteach lesson. As previously mentioned, this team also did not feel the students understood the rationale for breaking apart an array into parts that would focus on facts that students already knew. The teachers then decided to focus on discussion of the strategic breaking apart of the array to ensure the result was two arrays with multiplication facts the students could solve with automaticity. The 5th/6th grade debriefing provided an opportunity for the teachers to discuss the way in which students were measuring in meters and the need to ensure accuracy of measurement. The team also decided to have students come to agreement upon the common identification of length, width, and height of objects being measured. This was done in the third iteration of the lesson taught through discussion of comparing 2D and 3D shapes. In addition, the 5th/6th grade team pointed out a need to build in additional ways for students to interact. This was done by changing the independent building tasks into a team building activity. These debriefing examples are evidence of how the collaboration of teachers provided an opportunity for them to reflect on their content knowledge and previous mastery experiences to share ideas with the group. The positive verbal/social persuasion that occurred while debriefing appeared to generate a positive physiological response, both supporting the teachers' self-efficacy.

During the debrief session some teachers shared a concern or question for their upcoming reteach lesson. For instance, a 4th grade teacher indicated she was "scared" that she did not teach her students well enough to make connections of decimals to everyday life like money, as the students were able to do in the lesson she observed her partner teacher teach. Her partner teacher, that taught the initial lesson, quickly gave the suggestion of pointing to the calendar as a reminder to her students they are doing this every day with money during calendar math lessons. This suggestion appeared to put the teacher at ease and to reduce her negative physiological response of stress. She commented that this was a great idea and she should have thought of that. This collegial support provided additional evidence of the ongoing verbal/social persuasion and positive physiological responses that were present throughout the debriefing process. The input from colleagues helped to provide reassurance for team members, building self-efficacy and outcome expectancy.

The final outcome of debriefing was to revise or modify the lesson to be taught again. After the teacher that taught the initial lesson shared out, other team members then shared their observations of student responses and understandings, offering suggestions for modifications to the lesson to improve student learning. Each team generated modifications based on their unique experiences and included modifications such as changing the materials that were used, adapting the questions that were asked, or adjusting examples given. Since the lesson study lessons were planned by the grade level teams, it was considered everyone's lesson and each person was open to the idea of modifying the lesson as suggestions were recommended by the team members. The teachers then modified the lesson plan as suggested and gathered any additional materials needed to prepare for the next teaching cycle of the lesson. Both the initial teaching of the lesson and the first debriefing session were combined into one session, back-to-back, the same day for a total of 90-120 minutes. The lesson modifications discussed during the debriefing session for each grade level team to be implemented in the reteach lesson are included in detail in Table 4.3. Some of the modifications included bar modeling, differentiated instruction, base ten modeling, introduction of new mathematical vocabulary, and expanding virtual manipulatives to allow for solving more challenging problems.

Table 4.3: Lesson Study Modifications

Lesson Modifications Changes Made from Initial Teach to Reteach Lessons	
Grade	**Modifications Created by Grade Level Teams for the Reteach Lesson**
K	The revised lesson included: Doubling the amount of virtual manipulative ten frames to allow for students to look at composing and decomposing bigger numbers; changing the introduction of the lesson by adding a specific visual and discussion about ten frames organized by tens and ones and the need to fill the ones first before the tens; using dice with dots and not just numbers to increase challenge; asking some students to fill their ten frames with a group of ten before they began rolling the dice to make it more challenging with larger numbers; adding a final discussion question, "Will the sum be larger or smaller?" to allow students to focus on the change in numbers as they rolled the dice and included more addends.
1	The revised lesson included: Vocabulary instruction on Digit & Sum (compared homophone some) in the introduction; comparing/contrasting numbers to determine which was greater than, less than, or equal to in the opening discussion; adding in double digit + double digit addition to equal sum over 100; the introduction of commutative property of addition where a + b = b + a; providing written models to look at addition problems presented both vertically and horizontally, and with the sum presented after the addends (□ + □ = □) and the sum presented before the addends (□ = □ + □).
2	The revised lesson included: The introduction of an error with an amount of money written that included dollars and cents with a missing decimal; added peer check of money values and coach or praise before comparing amounts to check for accuracy; the removal of direct instruction of problem solving strategies (draw pictures, use number line to count on, fact families, bar modeling) before students solved money word problems and reviewed them as students shared the strategies they used afterward that were most effective for large numbers; the presentation of a bar model misconception with the whole written as a part for students to identify the error; requiring students to show at least two different strategies to solve a word problem; the introduction of making a claim and guiding students through making a claim on a problem they solved as a team (i.e., So her friend has $120.13 more.)
3	The revised lesson included: Building in more student explanation prompts to replace teacher explanation of problem solving strategies with student input and discussion; introduction of mathematics vocabulary 'distributive property' and modeling it through problem solving with students; students used scissors to cut apart 9x7 arrays to create a physical model of the distributive property to help students better understand the concept within a concrete example instead of just using post-its to show the decomposition of the array; highlighting multiple methods for problem solving by including students sharing of the various methods for problems solving they implemented; including teacher color coding on the white board in red pen so the number that was distributed was in red and color coding using black pen for the decomposed numbers in each example (i.e., 121 x 7 = (100 x 7) + (20 x 7) + (1 x 7).
4	The revised lesson included: A discussion of equivalent fractions with 5.9 and 5 9/10 = 5 90/100 at the opening of the lesson; a student created a plan of action for student teams to share responsibilities of shopping to design a family meal, instead of requiring students to solve the shopping problem with a bar model initially; encouraging students to use numbers,

	pictures and words to see if that problem solving method naturally occurred in student strategies.
5/6	This lesson was taught three times (instead of two times) with two fifth grade classes and a sixth grade class. Changes made after the initial teach were: Discussing volume and rectangular prism right at the beginning of the lesson and gave a definition; building in more ways for students to interact with each other by doing partners when building a model of the room instead of completing it individually; problem solving with volume was broken down in finding layers with considering the floor first and then the added layers; discussing possible reasons for differences in calculations; adding the questions into discussion: "How can you use what you've learned to be more accurate in making predictions in guessing jars?" and "If you have the volume provided can you come up with some ideas for the measurements of the length, width, and height?"; correcting directions on the individual problems to make them easier to understand by taking out extraneous information. Changes made after the 2nd teach were: Building in more discussion of 2D and 3D characteristics including relating to a 3D movie; guiding discussion so students came to agreement on length, width, and height of objects for finding volume; creating a sheet for students to organize and record their measurements of length, width and height specifically identified but not in the same order to illicit discussion about commutative property and the order of measurements recorded not changing the product (volume); adding in discussion of the reasonableness of answers; teacher measuring and calculating the volume of the classroom to help determine if students were off target or close in their calculations.

Reteach Lesson

During the second teaching cycle, the lesson was retaught by the grade level partner that observed the original lesson. The reteach lesson was in the same week of the original lesson, so typically there were 2-3 days between the original lesson and the reteach. The same observation protocol was used for the reteach lesson as the initial teaching episode (see Appendix G). The lesson was taught by the new teacher to his/her students for approximately 45 minutes, incorporating the changes and modifications suggested from the debriefing session as outlined in Table 4.3. The lesson was once again observed by all participants, including the researcher, and was video recorded. All observers took anecdotal notes and recorded evidence of student learning, including mathematical discourse and argumentation that was discussed in the final reflection.

Researcher observations and teacher final reflection discussions of the reteach lessons indicated all the lessons were even stronger than the original lessons taught. The carefully planned modifications created and embedded in the reteach lessons allowed for more indepth student mathematical argumentation through revamped questions that guided student problem solving. The learning supports that were enhanced through added or modified manipulatives allowed for students to solve more complex problems. Excitement was observed from the students, very similar as evidenced in the original lessons, including cheers, smiles, "ah ha" moments of breakthroughs in understanding, and comments of enjoying the lesson and learning activities. After the reteach lesson, one 3rd grade student replied, "This was the best math lesson I have ever done!" Once again, the reteach process provided an additional mastery experience as well as verbal/social persuasion and enhanced the physiological responses of the teachers providing three of Bandura's (1977) sources of self-efficacy.

The enhanced student learning and understanding was discussed among the teams as it was evident from the first group of students to the second group of students in the reteach lesson. For example, the reteach of the kindergarten lesson demonstrated how students showed a stronger understanding identifying place value with tens and ones. Teacher #1 made note of this when she said, "You did a really good job of explaining that," contributing this progress to Teacher #2's instruction through the use of modeling and explanation. This evidence of verbal/social persuasion was met with gratitude (physiological response) from Teacher #2.

Student mathematical discourse and argumentation that was evident in the lesson also was discussed. In the reteach of the third grade lesson, one student took his learning to another level and reported that if the distributive property really was a good strategy it should work with any numbers. He had the confidence to then try the distributive property with a challenging problem he created on his own (4, 674 x 5), applying the distributive property to numbers with four digits. The student went to the board and demonstrated how he challenged this strategy himself and applied the distributive property to the thousands with the problem he created 4,674 x 5. After he explained his whole process of 4,000 x 5, 600 x 5, 70 x 5, 4 x 5 and then finding the sum of all the products, the other students were in awe of his discovery and exclaimed how hard that problem was to solve. The students celebrated his work as they erupted into clapping and cheering for him on their own. After hearing their praise, he said, "A good strategy should always work." At the end of the lesson he asked the teacher if he could have his paper back because he couldn't wait to go home and share it with his father, who is a mathematics professor. That was a powerful moment for the entire class, especially the teachers, as they realized the concept finally clicked after years of struggling to create a lesson to teach distributive property for conceptual understanding. This scenario exemplifies the power of modeling and mastery experiences, not only for adult efficacy but students as well. The verbal/social persuasion provided by his peers made the student smile with great pride. Student praise also elicited a positive physiological response from the teachers, providing an additional source of self-efficacy and outcome expectancy for the teachers.

Final Reflection

Immediately following the reteach lesson, the teams met once again for a final reflection to discuss the lesson and how effective the modifications were. The same methodology for this final reflection discussion (see Appendix H) was used with the teacher that taught the lesson beginning the discussion. The final reflection meeting lasted approximately 45 minutes to one hour. Both the reteach of the lesson and final reflection session were combined, back-to-back, into one day for a total of 90-120 minutes.

During the final reflection meetings, most teacher participants discussed being pleased with the overall result of the final lesson. Also, most teachers felt their students responded positively to the modifications that were built into the new lesson. Few student misconceptions were discussed in the final reflection meeting compared with the first debriefing session.

Final reflection discussions included the autonomous learning of the students that was evident in the lessons. In the second grade lesson study this was recognized by Dr. Rumsey when she said, "In both classes they have a lot of power over their own learning and I think that's one of the things that the schema chart does is, here's what I'm responsible for and here is the new learning that I myself have made the connections for and I think that's really important."

The second grade team reflected on the benefit of the lesson study process in the final reflection when Teacher #22 stated, "I just thought the preparation, the planning, it was time consuming, BUT I think it was worth it! And you know and then doing it and me watching [Teacher #21] do it, I think was very beneficial for me teaching it next and I thought I really like that. I wish, you know, every lesson that would be fun like to be able to do it twice, 'well this didn't really go ok and we probably should have said this', but obviously we don't have time." Teacher #21 also responded, "It was just fun to see how you can expand on what I did too." This is evidence of the powerful impact of modeling and mastery experiences while teaching a lesson, perfecting it, and then teaching it again. It was evident the verbal/social persuasion, along with the modeling and mastery experience built a positive physiological response, enhancing self-efficacy through the process. In addition, it is important to note that Teacher #22 was one of the participants that had a prior negative experience with lesson study and for her to express that doing a lesson study for each lesson would be beneficial and fun is revealing of the positive physiological response she experienced.

During the final reflection meeting with third grade, Teacher #33 felt a sense of relief and joy when she expressed being able to get the "ah ha" moment with her students with the distributive property for the first time ever. This is exciting breakthrough was palpable not only in the classroom during the lesson with student comments, it was also substantiated in the final reflection when the teacher reported, "Just something we have struggled on [distributive property] year after year, to hear them [students] say that was really easy and fun! I was like YES!" She went on to say, "Every year it will just be easier to implement, you know you get worked up like this is our one big lesson [most challenging], then ok, that was easy enough!" The lesson study professional development allowed the third grade team to create a lesson that provided a mastery experience that can be carried on with future classes. This mastery experience was a boost to self-efficacy and will be a source of increased self-efficacy when the teachers continue to teach distributive property again in the future. The positive physiological response was clearly evident in Teacher #33's reflection on the lesson's success.

Consideration of future instruction was a natural part of the final reflection meetings. The final reflection allowed teachers the opportunity to discuss and determine the student learning demonstrated in the reteach lesson and its impact on guiding future instruction. Teachers discussed how their student responses to the lesson, increased understandings, and fewer misconceptions would impact the direction of future instruction. For instance in the reteach final reflection, Teacher #41 expressed concern that her students went over the given amount of money to spend on the shopping problem. As a result, she concluded the need to continue to work on mental math with her students as she reflected, "….that's a life lesson, when you get up to the counter at Wal-Mart and you've over spent…"

In addition, Teacher #41 determined the need to go back and explore how students articulated subtraction to determine if a misconception was present or students just transposed the numbers when explaining their problem solving methodology. This same error was noted in both fourth grade classes. In the first lesson a student said they, "…subtracted $20.00 from $11.97" and in the reteach lesson a student said their group, "…subtracted $20.00 from 17.98." When this was explored in the first lesson with a teacher probe of, "Is this what you mean?" the student corrected the error. However, when another student was questioned in the reteach lesson, the student added in the dollar sign to make it $17.98, before recognizing the error. Teacher #41 reflected on this need for review because, "The way we actually word it has a lot of significance for how we carry out the algorithm." Through the discussion of this error pattern, it was decided that a review of this was needed because, "…some kids take it literally…" and may not understand this is incorrect. Teacher #42 also brought up the fact that this kind of misconception is presented both ways on assessments to determine if students truly command conceptual understanding of the algorithm. Another misconception brought up by the fourth grade team that needed to be addressed in future lessons was student confusion on how to write $2 and 3¢. Some students were writing it as $2.3 instead of $2.03. To address this misconception, the teachers determined the need to look at comparing .3 and .03 and the fraction equivalents of 3/10, 30/100 and 3/100 to allow students to discuss equivalence.

The teams also compared how students in the first lesson responded and how students in the second lesson responded to the same mathematical content and their varying approaches as learners. The fourth grade team recognized how the students in the first lesson tended to take exact amounts of each item and subtracted continually from the total amount of money they had to spend. However, the second class had more students that rounded the amounts and then subtracted. Consequently, the first class tended to stay within the $20 budget, whereas the second class tended to overspend their budget without doing some mental math to think ahead. Neither class had students that recognized 2.75 + 1.26 had decimal parts that equaled about 1 when combined to simplify the computation. This was discussed as a need for future instruction and the prompting that would be needed to allow students to see this was explored.

Overall, the teachers seemed very pleased with their lessons and the transformation of the lessons as they proceeded through the lessons study process. Teacher #51 reported after she taught her lesson, “ If we could only have more lessons like this it would be stellar!” This sentiment was shared by several teachers.

The thick, rich description of the observations provided confirmation that Bandura’s four sources of efficacy were evident throughout the lesson study process. These mastery experiences, modeling, verbal/social persuasion and physiological response all contributed to an overall growth in self-efficacy of the participants. This data is supported by the MTEEBI analysis that follows.

MTEEBI Analysis

The MTEEBI survey was used as a pre/post measure to determine self-reported teacher participant growth given the two constructs of Self-Efficacy (SE) and Outcomes Expectancy (OE). The MTEEBI originally had a total of 59 items, 33 SE items and 26 OE items when the survey was administered to the teacher participants in this research study. However, through an extensive refinement and enhancement process, a total of 33 items remained with 21 SE items and 12 OE items. The final items that were retained are shown in Figure 4.2.

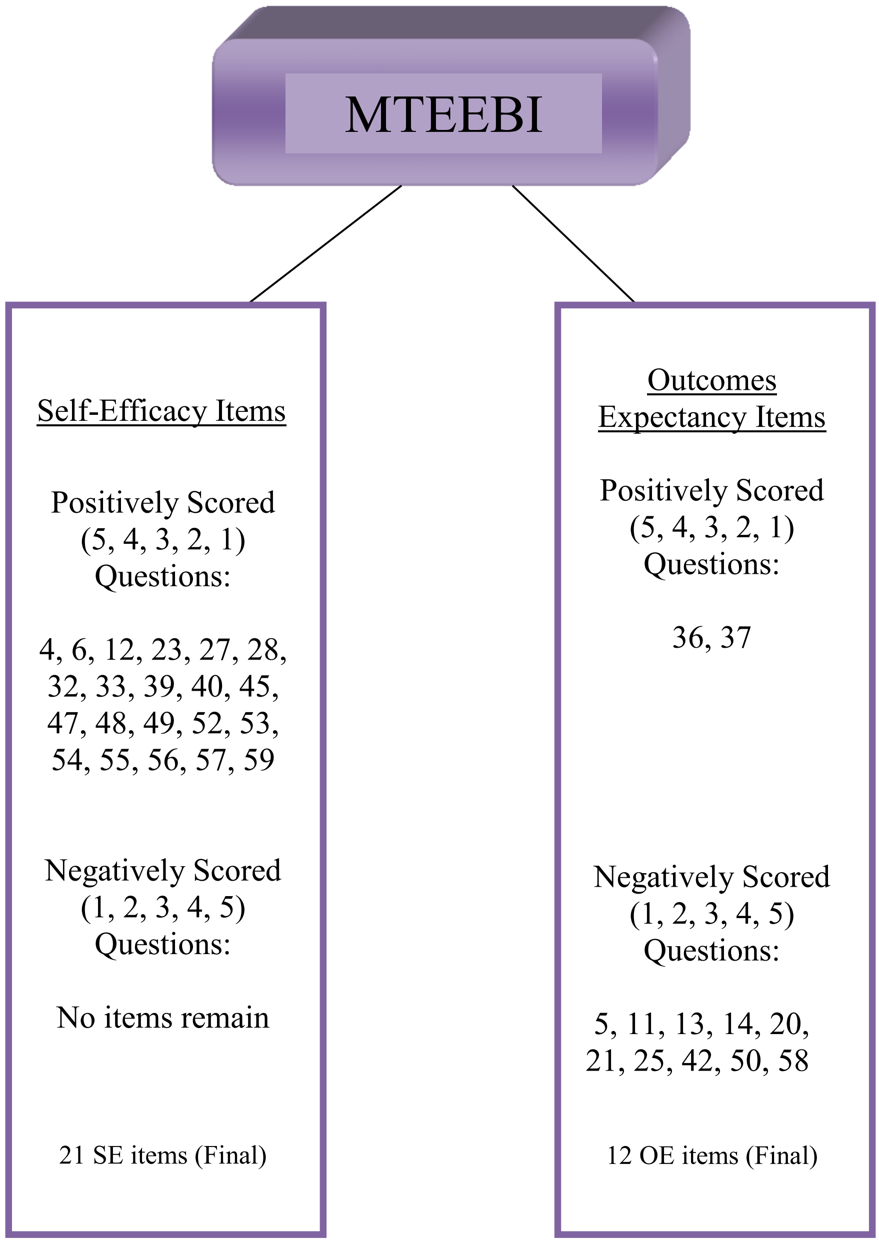

Figure 4.2: Structure of MTEEBI Self-Efficacy and Outcome Expectancy Items with Positive/Negative Scoring and Final Items Retained

The self-efficacy items and outcomes expectancy items were either positively or negatively worded and therefore some items were negatively or reverse scored. When the items were positively scored, strongly agree = 5, agree = 4, uncertain = 3, disagree = 2, and strongly disagree = 1. When the items were negatively scored, reverse scoring was used, resulting in strongly agree = 1, agree = 2, uncertain = 3, disagree = 4, and strongly disagree = 5. Figure 4.2 also shows the scoring coding for each of the self-efficacy and outcomes expectancy items. The researcher had statistics run on the full 59-item MTEEBI, prior to knowing the results of the refinement of the confirmatory factor analysis process. However, when these results became available to the researcher, the results were run again using only the final 33 items that remained after the confirmatory factor analysis. The researcher used this final statistics analysis to report on the data in this study because of the enhancement of the instrument.

Historically, the Paired-Samples t-test is the standard test used in analysis of the original self-efficacy scales, the STEBI and MTEBI. Use of the t-test analysis also was the recommendation given from the MTEEBI test developers and is the test being used in the field by the developers (I. Riggs, personal communication, July 3, 2014). Consequently, the Paired-Samples t-test was the primary analysis used in this study. However, the t-test is a parametric test and the likert response scale of the MTEEBI plus the limited sample size of this study do not meet the strict criteria for parametric statistics. Consequently, to confirm the results of the parametric t-test results, a non-parametric test, the Wilcoxon Signed Rank Test, was also used. In addition, the Cohen's d was calculated. The researcher will begin the data analysis of the MTEEBI with the overall results of the Paired-Samples t-test, followed by the overall results of the Wilcoxon Signed Rank Test. Since both tests indicated similar levels of significance, the overall results from both tests will be followed by a more indepth analysis of individual items, individual teachers, and results compared to teacher characteristics based on the Paired-Samples t-test.

Paired-Samples t-tests

The MTEEBI pre and post surveys were given and a Paired-Samples t-tests statistical analyses were run to answer the research questions and test the Null Hypotheses to determine the effect of the independent variable, the lesson study professional development had on the dependent variables, teachers' self-efficacy for teaching mathematics and teachers' outcome expectancy of students' mathematics ability. This research tested the following hypotheses: Null Hypothesis 1: "There will not be a difference in the MTEEBI pre and post self-efficacy mean scores before and after the lesson study professional development" and Null Hypothesis 2: "There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores before and after the lesson study professional development."The results of the Paired-Samples t-tests compared the pre and post means of each construct and are presented in Tables 4.4 and 4.5 below.

Self-Efficacy

Table 4.4: Paired-Samples t-tests for Self-Efficacy

Paired-Samples t-test: Self-Efficacy Average									
		Paired Differences					T	df	Sig. (2-tailed)
		Mean Diff	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PostSelfEffAverage PreSelfEffAverage	.28205	.34747	.09637	.07208	.49202	2.927	12	.013

Table 4.4 indicates the Paired-Samples t-test for self-efficacy revealed that a significant difference existed between teacher self-efficacy reported before the lesson study professional development (M = 3.8278, SD = .46272) and teacher self-efficacy reported after the lesson study professional development (M = 4.1099, SD = .34524), $t\,(12) = 2.927$, $p < .05$. This difference between the pre and post self-efficacy means was statistically significant at a probability level less than .05. Therefore, the Null Hypothesis 1: There will not be a difference in the MTEEBI pre and post self-efficacy mean scores before and after the lesson study professional development was rejected. It is assumed that the difference in the pre and post self-efficacy

scores is more likely related to the lesson study professional development than random chance. In addition, Cohen's *d* effect size value of (d = .81) is indicative of a high practical significance.

Outcome Expectancy

Table 4.5: Paired-Samples t-tests for Outcome Expectancy

Paired-Samples t-test: Outcome Expectancy Average								
	Paired Differences					T	df	Sig. (2-tailed)
	Mean Diff	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 PostOEAverage PreOEAverage	.18590	.24093	.06682	.04030	.33149	2.782	12	.017

Table 4.5 shows the Paired-Samples t-test for outcome expectancy revealed that a significant difference existed between teacher outcome expectancy reported before the lesson study professional development (M = 3.9423, SD = .25995) and teacher outcome expectancy reported after the lesson study professional development (M = 4.1282, SD = .40485), t (12) = 2.782, $p < .05$. This difference between the pre and post outcome means was statistically significant at a probability level less than .05. Therefore, the Null Hypothesis 2: "There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores after the lesson study professional development," was rejected. It is assumed that the difference in the pre and post outcome expectancy scores is more likely related to the lesson study professional development than random chance. In addition, Cohen's *d* effect size value of (d = .77) is indicative of a moderate practical significance.

Wilcoxon Signed Rank Test

Given the small sample size in this research, N=13, along with the likert scale response scores in the MTEEBI survey not representing true interval data, the researcher chose to analyze the data further using the Wilcoxon Signed Rank Test to include a non-parametric analysis in addition to the t-test analysis as a point of reference. This analysis compared two sets of scores, the pre and post MTEEBI scores that came from the same group of teacher participants. This non-parametric test also demonstrated a level of significance. The pre and post self-efficacy comparison was determined to be significant at the $p = .013$ level. The pre and post outcome expectancy comparison was determined to be significant at the $p = .022$. The level of significance was set at .05. Both values indicate that a statistically significant difference existed in self-efficacy and outcome expectancy pre/post score comparison using a non-parametric test. This non-parametric analysis supports the rejection of Null Hypothesis 1: "There will not be a difference in the MTEEBI pre and post self-efficacy mean scores after the lesson study professional development" and Null Hypothesis 2: "There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores after the lesson study professional development." Since both tests resulted in similar levels of significance and since the t-test is the test used by the MTEEBI developers (I. Riggs, personal communication, July 3, 2014), only the t-test data will be reported and discussed from this point forward.

Self-Efficacy

In table 4.6 and 4.7, the paired t-test samples data has been disaggregated according to pre/post self-efficacy and outcome expectancy items, demonstrating mean scores before the lesson study professional development training and after the training. The pre/post comparisons show the change in self-efficacy and outcome expectancy. Though the OE scores started higher and ended higher than SE scores, SE had a larger change in pre/post scores when compared to the change in pre/post OE change.

Table 4.6: Means and Standard Deviations for Self-Efficacy Change

Self-Efficacy	Mean	Std. Deviation
Pre Self-Efficacy Average	3.8278	.46272
Post Self-Efficacy Average	4.1099	.34524
Change in Self-Efficacy	.28205	.34747

According to Table 4.6, given the 5-point likert scale of the MTEEBI, where 3 indicated a neutrality response of “uncertain,” the teacher participants had a self-efficacy mean of 3.8278 prior to the lesson study professional development. This mean score increased to a mean of 4.1099 after the professional development, for an increase of .28205. This increase was indicative of their increased agreement with the MTEEBI items following the lesson study experience. A discussion of the significance of this difference, through analysis of a Paired-Samples t-test, was explored by the researcher earlier in this chapter.

Outcome Expectancy

Table 4.7: Means and Standard Deviations for Outcome Expectancy Change

Outcome Expectancy	Mean	Std. Deviation
Pre OE Average	3.9423	.25995
Post OE Average	4.1282	.40485
Change in Outcome Expectancy	.18590	.24093

According to Table 4.7, the teacher participants had an outcome expectancy mean of 3.9423 prior to the lesson study professional development on the MTEEBI. This score increased to a mean of 4.1282. The overall increase of .18590 was indicative of the increased agreement of with the MTEEBI items following the lesson study professional development. The significance of this pre/post difference was explored by the researcher earlier in this chapter.

An inspection of the self-efficacy and outcome expectancy differences indicated that both pre and post mean comparisons yielded a positive increase in beliefs following the lesson study professional development from moderate practical significance for outcome expectancy to high practical significance for self-efficacy. The teacher participants had a slightly higher pre outcome expectancy score when compared to the self-efficacy pre mean score. Also, the post outcome expectancy mean was only slightly higher than pre self-efficacy mean. When comparing the gains from self-efficacy and outcome expectancy pre and post scores, the increase in self-efficacy of .28205 was greater than the increase in outcome expectancy of .18590. Both self-efficacy and outcome expectancy pre/post comparisons showed a positive increase, with the increase in self-efficacy being only slightly higher.

Individual Teacher Changes in SE/OE

After analyzing the data for the overall changes in the self-efficacy and outcome expectancy beliefs as measured by the MTEEBI for the group of participants, the researcher then analyzed the data in terms of individual differences. The researcher determined that 6 of the 13 teacher participants showed an increase in both self-efficacy and outcome expectancy (see Figure 4.3).

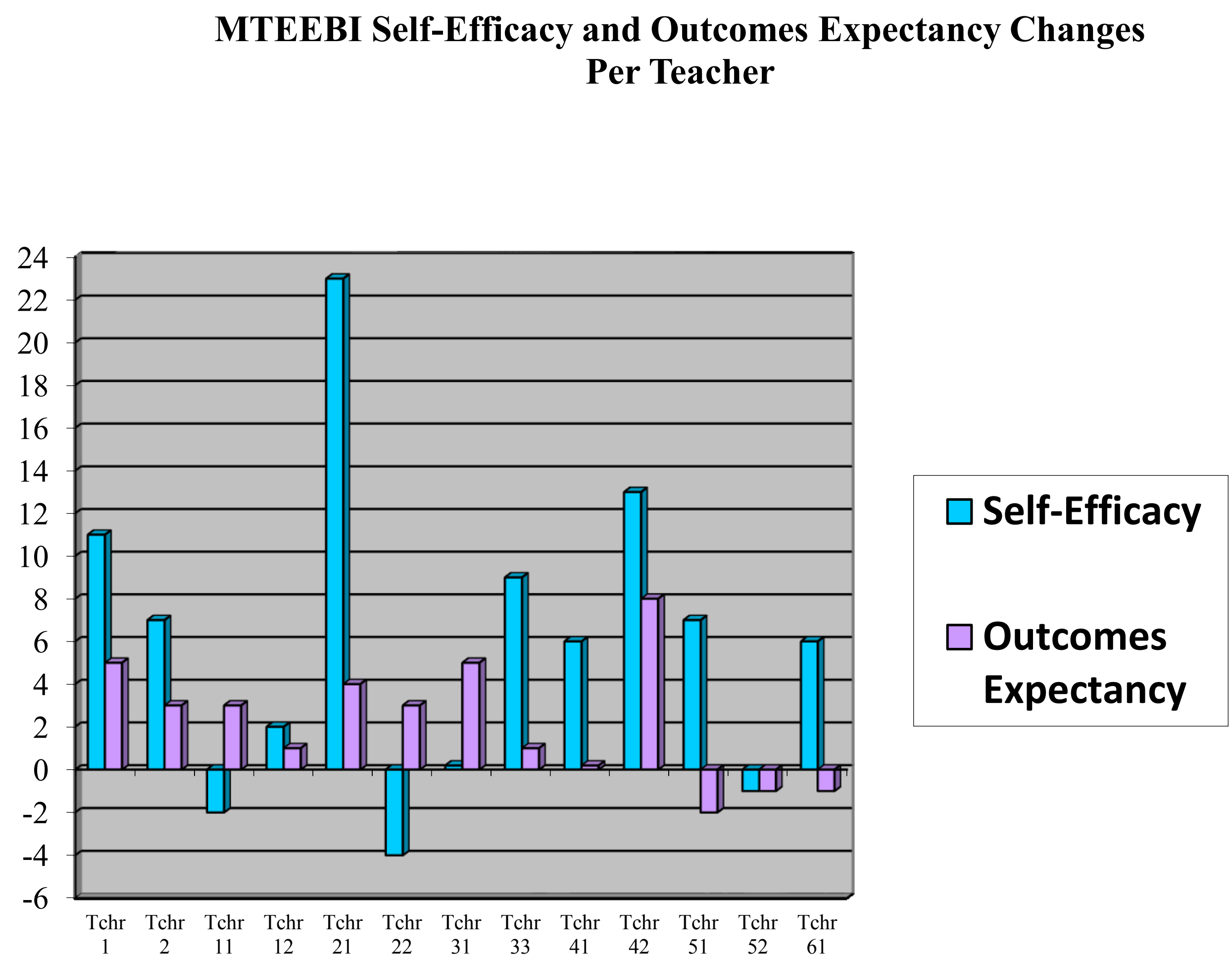

Figure 4.3: Individual Teacher Change on MTEEBI Self-Efficacy and Outcomes Expectancy (Derived from Self-Efficacy Pre/Post Change and Outcomes Expectancy Pre/Post Change, respectively)

Figure 4.3 demonstrates of the 13 participants, 9 teachers showed an increase in their pre/post self-efficacy comparison and 3 teachers showed a decrease in their pre/post self-efficacy comparison and 1 teacher showed no change in self-efficacy. The increases in self-efficacy ranged from 2 points to an extraordinary 23 point gain. A closer look at the increases revealed that 8 of the 13 teachers gained 6 points or more in self-efficacy. The 3 teachers that showed a decrease in the self-efficacy pre/post comparison declined by 1 point, 2 points, and 4 points respectively.

The overall changes in the outcome expectancy pre/post comparison were also impressive, if not even more so given the challenge of impacting outcome expectancy beliefs.

Data analysis showed 9 of the 13 teachers increased in their pre/post outcomes expectancy comparison, 3 teachers showed a decrease, and 1 teacher showed no change in outcome expectancy. The increases in outcome expectancy ranged from a 1 point gain to an 8 point gain. Upon further inspection, it was noted that 7 of the 13 teachers increased by 3 or more points in outcomes expectancy. Two of the teachers that showed a decrease in outcomes expectancy declined by just 1 point each and the third teacher declined by just 2 points. In figure 4.3, it can be noted that one of the teachers that decreased in outcomes expectancy was also one of the 3 teachers that showed a decrease in self-efficacy.

There was only 1 teacher that showed a decline in both self-efficacy and outcomes expectancy. This teacher was a late-career cluster teacher which will be explored further. This same teacher is an outlier in the fact that the pre self-efficacy sum scores and the outcomes expectancy sum scores both started low initially, in comparison to the other 12 teachers, and the post self-efficacy and outcomes expectancy scores showed a decrease in both constructs for this teacher. Consequently, this teacher ended with the lowest post self-efficacy sum score and outcome expectancy sum score of all the teachers. Because the one teacher that decreased in both self-efficacy and outcome expectancy was a late career teacher, the researcher decided to examine all scores in relation to length of time teaching, or phases of their career, to determine if a pattern emerged related to this single phenomenon for lower gains with the late-career cluster teachers as a group.

When considering the teachers in clusters by categories of career phases, the researcher organized the participants by early-career, mid-career, and late-career stages of teaching. The clusters were defined by the researcher as early-career teachers having 1-5 years of experience, mid-career teachers having 6-19 years of experience, and late-career teachers with 20+ years of experience. This resulted in 4 teachers in the early-career cluster, 5 teachers in the mid-career cluster, and 4 teachers in the late-career cluster. When considering the gains in self-efficacy and outcomes expectancy in conjunction with years of experience in the career clusters, each cluster had teachers in the group that made considerable gains in self-efficacy and outcomes expectancy and each career cluster made gains in both self-efficacy and outcomes expectancy as a group. Figure 4.4 provides a visual representation of the changes in self-efficacy and outcome expectancy by years of teaching experience in the specified career clusters.

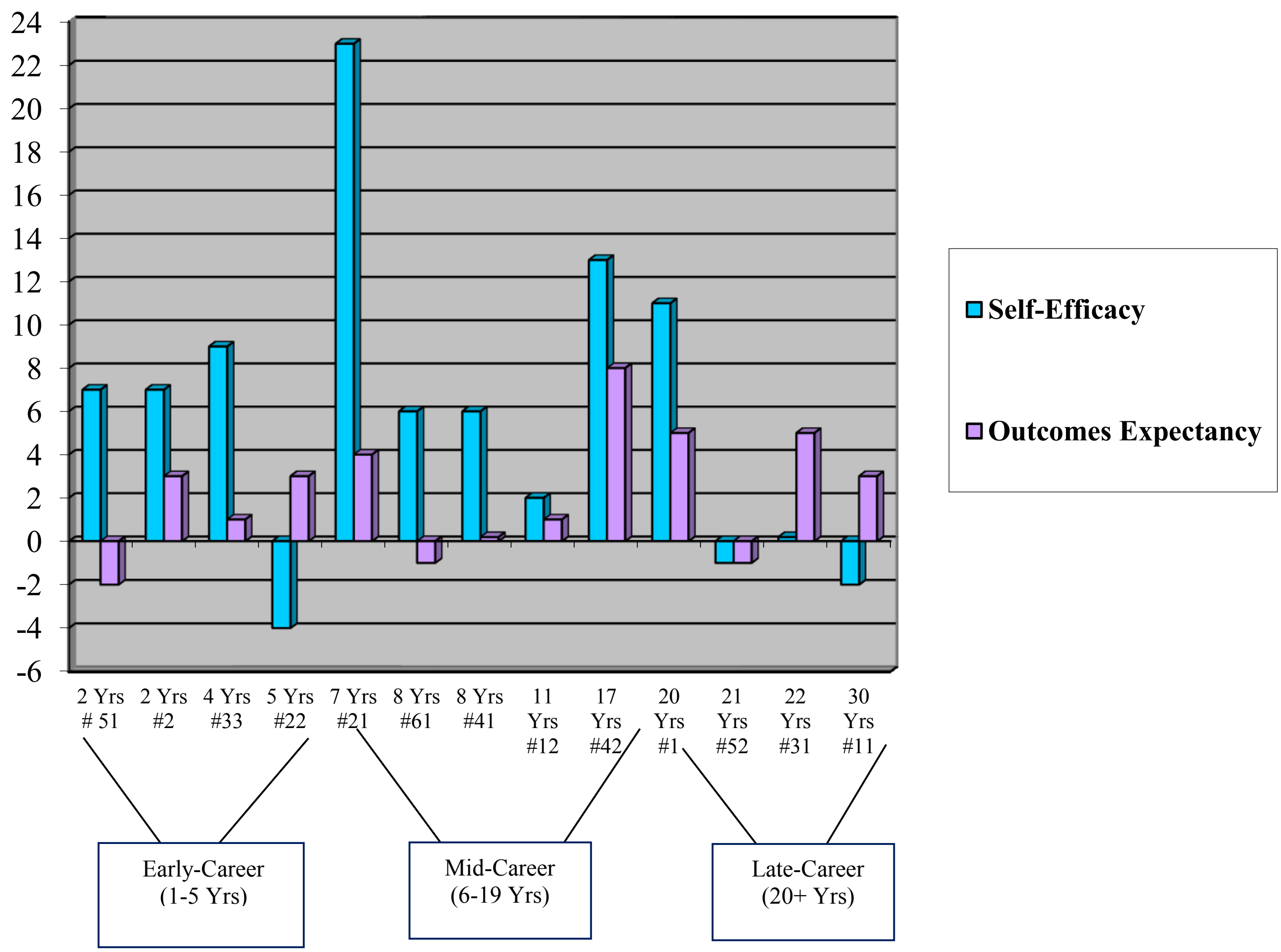

Figure 4.4: MTEEBI Self-Efficacy and Outcome Expectancy Changes by Career Clusters

Based on the results displayed in figure 4.4, the researcher determined there to be self-efficacy gains for all of the career clusters. In the early-career cluster, 3 of the 4 teachers increased in the self-efficacy pre/post comparison showing a gain in their self-efficacy after the lesson study professional development. These gains were 7, 7, and 9 point increases respectively. There was 1 teacher in the early-career cluster that experienced a 4 point decrease in the self-efficacy pre/post comparison. This teacher had the most teaching experience when compared to the other teachers in the early-career cluster, with 5 years of experience. The total average gains for the early-career cluster in the self-efficacy construct was 4.75 points.

The mid-career teaching cluster had all 5 of the 5 teachers show an increase in their self-efficacy pre/post comparison. These increases ranged from 2 - 23 points. The teacher with the greatest overall increase in self-efficacy, considering all teachers, had a 23 point gain and is in the mid-career cluster and had the least amount of teaching experience of this group with 7 years of teaching experience. Interestingly, the teacher with the next highest overall increase in self-efficacy, considering all teachers, was also in the mid-career teacher cluster and was the teacher that had the most teaching experience of this group with 17 years of experience and gained 13 points in self-efficacy. Total gains for the self-efficacy construct with the mid-career cluster was an average teacher gain of 10 points. This average gain in self-efficacy was the highest gain of the career clusters.

The late career-cluster had 4 teachers that have taught 20 or more years. Of these 4 late-career teachers, only 1 teacher had an increase in self-efficacy of 11 points. There was a decrease in self-efficacy for 2 of the late-career teachers with a 1 point decrease and a 2 point decrease. There was 1 teacher in this group that had no change in the self-efficacy pre/post comparison. As will be discussed further, this same teacher in the late-career cluster that decreased in self-efficacy by 1 point also decreased in outcomes expectancy by 1 point. The late-career cluster had an average teacher gain of 2 points in self-efficacy.

Teacher growth in outcomes expectancy showed gains in all three of the career clusters. In the early-career cluster, 3 of the 4 teachers increased in the outcome expectancy pre/post comparison showing a positive gain in their outcome expectancy beliefs after the lesson study professional development. These gains ranged from 1-3 points. Of the 4 teachers in the early career cluster, 1 teacher showed a decrease in outcome expectancy of 2 points. The average teacher gain for the early-career cluster in the outcomes expectancy construct was 1.25 points, which was the lowest gain in outcome expectancy of the 3 career clusters.

The mid-career teaching cluster had 3 of the 5 teachers showed an increase in their outcome expectancy pre/post comparison. These increases ranged from 1-8 points. Of the 5 teachers, 1 teacher had a decrease in outcome expectancy of 1 point. One teacher in this cluster had no change in outcome expectancy. The teacher with the greatest overall increase in outcome expectancy, when considering all of the teachers, was in t he mid-career cluster and had an increase of 8 points in outcome expectancy. This mid-career cluster teacher had the most teaching experience of this group with 17 years of experience. The mid-career cluster had an average teacher increase of 2.4 points.

Of the 4 late-career teachers, 3 had an increase in outcome expectancy ranging from 3-5 points. There was a decrease in outcome expectancy for 1 of the late-career teachers by 1 point. This same teacher also decreased in self-expectancy by 1 point as discussed previously. The total average teacher gain for the late-career cluster in outcomes expectancy was 3 points, representing the highest average cluster gain just ahead of the mid-career cluster average gain of 2.4 points.

The 5 teachers in the mid-career cluster increased the most in self-efficacy and the 4 teachers in the late-career cluster increased the most in outcome expectancy, when comparing average teacher gains. It should be noted that there were only 4 teachers in both the early-career and late-career clusters, while there were 5 teachers in the mid-career cluster and each cluster did not have equal number of teachers. In addition, the mid-career cluster included the top two teachers that made the highest overall increases when considering gains in self-efficacy and gains in outcome expectancy combined. The teacher with most teaching experience in the mid-career cluster, 17 years, had the highest combined increase (self-efficacy + outcome expectancy) of all and had an impact that raised the total mid-career cluster self-efficacy score by 23 points and raised the outcomes expectancy cluster score by 4 points. The teacher with the next highest overall combined increase (self-efficacy + outcome expectancy) also was found within the mid-career cluster and had the least amount of teaching experience in this group with 7 years of experience. This teacher raised the mid-career self-efficacy cluster score by 13 points and increased the outcomes expectancy cluster score by 8 points. Had the years of teaching per each cluster been redefined, the result would likely have shifted one or both of the teachers that made the most combined gains into another career cluster.

When considering the gains in self-efficacy and outcome expectancy, the greatest average teacher gain in self-efficacy was the mid-career teacher average gain of 10 points, followed by the early-career average gain of 4.75 and finally the late-career cluster with an average teacher gain in self-efficacy of 2 points. The greatest average teacher gain in outcome expectancy was the late-career teacher average gain of 3, followed by the mid-career cluster with an average teacher gain of 2.4 points and finally the early-career cluster with an average teacher gain of 1.25 points. These comparisons are further outlined in a visual format in Table 4.8.

Table 4.8: Self-Efficacy and Outcomes Expectancy Changes by Individual Teacher Years of Teaching Experience and Career Clusters

	Years of Experience Per Teacher Participant	Teacher Self-Efficacy Change	Self-Efficacy Change by Career Cluster	Teacher Outcomes Expectancy Change	Outcomes Expectancy Change by Career Cluster
Early-Career Teachers	**2**	7	Avg Tchr Gain 4.75 pts **	-2	Avg Tchr Gain 1.25 pts ***
	2	7		3	
	4	9		1	
	5	-4		3	
Mid-Career Teachers	**7**	23	Avg Tchr Gain 10 pts *	4	Avg Tchr Gain 2.4 pts **
	8	6		-1	
	8	6		0	
	11	2		1	
	17	13		8	
Late-Career Teachers	**20**	11	Avg Tchr Gain 2 pts ***	5	Avg Tchr Gain 3 pts *
	21	-1		-1	
	22	0		5	
	30	-2		3	

* Represents the highest cluster gain, ** second highest cluster gain, *** third highest cluster gain

In conclusion, though there are differences that have been discussed by the researcher in the career cluster gains, Table 4.8 demonstrates all teaching career clusters showed gains in both self-efficacy and outcomes expectancy, regardless of the number of years of teaching within each career cluster. Though the late-career cluster teachers made the least average gains in self-efficacy, they made the highest gains in outcome expectancy. Therefore, no clear pattern emerged regarding a relationship between self-efficacy and years of teaching experience, as was further investigated in this research.

In an effort to better understand the individual items, the researcher decided to inspect the three highest and the three lowest means of both the pre and post MTEEBI. This decision was made to determine if any patterns could be identified and if any repetition of items were visible in the pre and post item comparison.

Item Analysis of Individual MTEEBI Items

Pre MTEEBI Items

In Table 4.9, the pre MTEEBI items have been arranged in descending mean order. An inspection of the individual pre MTEEBI item mean scores revealed that three highest means were on question #36 (M = 4.62, SD = .506), question #20 (M = 4.38, SD = .506), and question #12 (M = 4.31, SD = .630). Question #36 was a positively scored outcome expectancy item and stated, “A teacher can be expected to help a student learn math despite his or her impoverished home environment.” This item has since been changed to read “background” instead of environment. Question #20 was a reverse scored outcome expectancy item and stated, “Even a very skilled teacher cannot expect English Language Learners to attempt to understand complex mathematics problems.” Question #12 was a positively scored self-efficacy item that read, “I understand math concepts well enough to be effective in teaching elementary school math.” This item has also since been changed with the words “elementary school” removed. Because Question #20 was a reverse scored item, the higher values on the question are obtained through disagreement with the question, therefore, though item #20 had a high mean of 4.38, that translates to teachers’ disagreement with the negatively worded item, which is a more desired response than agreeing with the statement.

Table 4.9: Pre MTEEBI Items - Arranged by Descending Mean Order (highlighted yellow = self-efficacy items)

	Minimum	Maximum	Mean	Std. Deviation
Pre_Q_36	4	5	4.62	.506
Pre_Q_20	4	5	4.38	.506
Pre_Q_12	3	5	4.31	.630
Pre_Q_5	4	5	4.23	.439
Pre_Q_14	4	5	4.23	.439
Pre_Q_55	4	5	4.23	.439
Pre_Q_59	4	5	4.23	.439
Pre_Q_13	2	5	4.15	.801
Pre_Q_37	1	5	4.08	1.038
Pre_Q_54	3	5	4.08	.494
Pre_Q_23	2	5	4.00	.707
Pre_Q_40	3	5	4.00	.707
Pre_Q_57	2	5	4.00	.707
Pre_Q_11	2	5	3.92	.760
Pre_Q_27	2	5	3.92	.954
Pre_Q_28	2	5	3.92	.760
Pre_Q_45	2	5	3.92	.641
Pre_Q_50	2	4	3.85	.555
Pre_Q_53	2	5	3.85	.987
Pre_Q_25	2	5	3.77	.832
Pre_Q_39	2	5	3.77	.832
Pre_Q_42	2	4	3.77	.599
Pre_Q_33	2	5	3.69	.855
Pre_Q_47	2	5	3.69	.947
Pre_Q_52	2	4	3.69	.630
Pre_Q_48	2	5	3.62	.768
Pre_Q_56	2	4	3.62	.650
Pre_Q_6	2	4	3.54	.776
Pre_Q_21	2	5	3.54	.877
Pre_Q_32	2	4	3.54	.660
Pre_Q_4	2	4	3.46	.660
Pre_Q_49	2	4	3.31	.751
Pre_Q_58	1	4	2.77	1.092

A theme emerges from data displayed in Table 4.9 among these high ranking questions as Question #36 indicated agreement a with teachers' ability to impact student learning despite personal obstacles of the student, Question #20 indicated disagreement with belief that skilled teachers do not expect ELL students to understand complex math and Question #12 indicated agreement with belief in his/her ability to teach math effectively based upon content knowledge. Teachers are demonstrating their belief in their ability to teach math effectively to all students, despite personal circumstances or language barriers.

Table 4.9 also demonstrates the three lowest mean scores on the pre MTEEBI items were on questions #58 (M = 2.77, SD = 1.092, question #49 (M = 3.31, SD = .751) and question # 4 (M = 3.46, SD = .660). The lowest mean pre item was question #58 and was a reverse scored outcome expectancy item that stated, "Even with appropriate instruction, most students rarely consider whether their math work makes sense." Question #49 was a positively scored self-efficacy item that read, "I feel comfortable teaching students to understand relationships between concepts of algebra and concepts of arithmetic." Question #4 was also a positively scored self-efficacy item that read, "I know how to prepare students to consider the meanings of units used in different contexts." Item #58 had the lowest mean of the pre questions and the reverse score reflects teachers' agreement that students rarely consider if their math work makes sense. The scores on question #49 and #4 indicate the teachers are uncertain about their comfort level with teaching students to understand relationships between algebra and arithmetic and are uncertain about their knowledge of how to prepare students to consider the meanings of units used in different contexts. Both self-efficacy items indicate uncertainty in the teacher's ability to impact student achievement outcomes specifically with meanings of units used in different contexts and understanding relationships between algebra and arithmetic, while the outcome expectancy item indicates teachers' agreement with students not considering the reasonableness of their work.

Post MTEEBI Items

In Table 4.10 the researcher arranged the post MTEEBI items in descending mean order. Further inspection of the individual post MTEEBI item mean scores revealed that three highest means were on question #20 (M = 4.69, SD = .480), question #40 (M = 4.54, SD = .519), and question #37 (M = 4.46, SD = .519). Question #20 was a reverse scored outcome expectancy item and stated, “Even a very skilled teacher cannot expect English Language Learners to attempt to understand complex mathematics problems.” Since this item was reverse scored, the mean response indicated teachers’ disagreed with the question. It should be noted that question #20 was also one of the three highest mean pre questions and now emerges as the top mean score item in the post responses. The pre $M = 4.38$ increased by .31, moving more toward the “strongly disagree” response with a post $M = 4.69$. Therefore, respondents indicated a stronger disagreement with belief that skilled teachers do not expect ELL students to understand complex math. Question #40 was a positively scored self-efficacy item and stated, “I can incorporate multiple representations into my lessons to improve student learning.” Question #37 was a positively scored outcome expectancy item that read, “Students who have low motivation for learning math can be turned on to learning by their math teachers.” A theme emerges from these questions as Q#20 and Q#37 indicate that after the lesson study process the belief in a teacher’s ability to impact student achievement by influencing motivation of students and learning by ELL students.

Table 4.10: Post MTEEBI Items – Arranged by Descending Mean Order (highlighted yellow = self-efficacy items)

	Minimum	Maximum	Mean	Std. Deviation
Post_Q_20	4	5	4.69	.480
Post_Q_40	4	5	4.54	.519
Post_Q_37	4	5	4.46	.519
Post_Q_12	4	5	4.38	.506
Post_Q_13	4	5	4.38	.506
Post_Q_55	4	5	4.38	.506
Post_Q_5	2	5	4.31	.855
Post_Q_36	1	5	4.31	1.109
Post_Q_57	4	5	4.31	.480
Post_Q_11	4	5	4.23	.439
Post_Q_27	2	5	4.23	1.092
Post_Q_28	1	5	4.23	1.092
Post_Q_39	2	5	4.23	.832
Post_Q_59	3	5	4.23	.599
Post_Q_23	4	5	4.15	.376
Post_Q_33	2	5	4.15	.801
Post_Q_42	3	5	4.15	.689
Post_Q_45	4	5	4.15	.376
Post_Q_48	2	5	4.15	.801
Post_Q_50	4	5	4.15	.376
Post_Q_54	4	5	4.15	.376
Post_Q_6	2	5	4.08	.760
Post_Q_14	3	5	4.08	.494
Post_Q_53	2	5	4.08	.862
Post_Q_56	3	5	4.08	.494
Post_Q_47	2	5	3.85	.689
Post_Q_52	3	5	3.85	.555
Post_Q_21	3	5	3.77	.725
Post_Q_32	2	5	3.77	.927
Post_Q_49	2	5	3.69	.855
Post_Q_58	2	5	3.69	1.109
Post_Q_4	3	4	3.62	.506
Post_Q_25	2	5	3.31	1.109

Table 4.10 indicates the three lowest mean scores on the post MTEEBI items were on questions #25 (M = 3.31, SD = 1.109, question #4 (M = 3.62, SD = .506) and question # 58 (M = 3.69, SD = 1.109) and question #49 (M = 3.69, SD = .855). The lowest mean post item was question #25 and was a reverse scored outcome expectancy item and stated, “Even a teacher with good math teaching abilities may not help some students learn math.” Question #4 was a positively scored self-efficacy item that read, “I know how to prepare students to consider the meanings of units used in different contexts.” Question #58 was a reverse scored outcome expectancy item that read, “Even with appropriate instruction, most students rarely consider whether their math work makes sense.” Question #49 (note Q#49 and Q#58 had the same mean scores) is a positively scored self-efficacy item that stated, “I feel comfortable teaching students to understand relationships between concepts of algebra and concepts of arithmetic.” The mean scores on these 4 items ranges from 3.31 - 3.69, indicating the participants’ uncertainty with these questions.

An examination of Question #25 & #58 from Table 4.10 indicated that even after the lesson study process, teachers were uncertain that even with quality instruction some kids can’t learn math or determine if their math work makes sense. The scores on question #49 and #4 indicate the teachers are uncertain about their comfort level with teaching students to understand relationships between algebra and arithmetic and are uncertain about their knowledge of how to prepare students to consider the meanings of units used in different contexts. Both self-efficacy items indicate uncertainty in the teacher’s ability to impact student achievement outcomes specifically with meanings of units used in different contexts and understanding relationships between algebra and arithmetic, while the outcome expectancy item indicates teachers’ agreement with students not considering the reasonableness of their work.

With further analysis of the highest and lowest means of the MTEEBI pre and post surveys, the researcher discovered overlap in items that appeared on the pre and post. For example, question #20 was the 2nd highest mean on the pre MTEEBI and was the highest mean on the post MTEEBI. The pre mean of 4.38 increased on the post mean to 4.69, for an increase of .31. This reverse scored outcome expectancy item means that teachers increased in their disagreement with not expecting ELL learners attempt to understand complex math problems, edging closer to a strongly disagree response, indicating their belief ELL students’ ability to do complex math.

In addition, items #4, #58, and #49 all appear in the lowest mean pre group and the lowest mean post group, shifting ordinal positions. Question #4 pre mean of 3.46 increased to a post mean of 3.62, though both means still indicate uncertainty of how to prepare students to consider the meanings of units used in different contexts it also represents a slight increase of .16 towards agreement. Question #58 had nearly one full point increase from the pre to the post survey, moving from a pre mean of 2.77 to 3.69. This gain of .92 indicates teacher participants moved from agreeing that even with appropriate instruction, most students rarely consider whether their math work makes sense to being more uncertain and are moving toward disagreement with this question. Finally, Question #49 increased .38 from a pre mean of 3.31 to a post mean of 3.69. Though the means of 3 indicate uncertainty with teachers feeling comfortable teaching students to understand relationships between concepts of algebra and concepts of arithmetic, this increase still shows movement toward agreement with the statement.

Pre/Post MTEEBI Item Comparison

To better understand the growth from pre to post items, the researcher arranged the pre/post mean differences in descending order in Table 4.11. The researcher set out to examine the three highest pre/post differences and the three lowest pre/post differences. However, upon analysis the researcher determined that in the highest difference category three items had the same value for the 2^{nd} highest pre/post gain and three items that shared the same value for the 3^{rd} highest pre/post gain. Consequently, the researcher decided to investigate all 7 items to determine if any similarities, themes, or patterns emerged.

Table 4.11: Pre/Post MTEEBI Difference Comparison

Arranged by Descending Mean Order (highlighted yellow = self-efficacy items)

	Minimum	Maximum	Mean Diff	Std. Deviation
PrePost58	-2.00	3.00	.9231	1.32045
PrePost6	.00	2.00	.5385	.66023
PrePost40	-1.00	2.00	.5385	.77625
PrePost48	-1.00	2.00	.5385	.77625
PrePost33	-1.00	2.00	.4615	.77625
PrePost39	-1.00	2.00	.4615	.96742
PrePost56	.00	1.00	.4615	.51887
PrePost37	-1.00	4.00	.3846	1.32530
PrePost42	-1.00	2.00	.3846	.76795
PrePost49	-1.00	2.00	.3846	1.04391
PrePost11	.00	2.00	.3077	.75107
PrePost20	-1.00	1.00	.3077	.63043
PrePost27	.00	1.00	.3077	.48038
PrePost28	-3.00	2.00	.3077	1.18213
PrePost50	.00	2.00	.3077	.63043
PrePost57	-1.00	2.00	.3077	.75107
PrePost13	.00	2.00	.2308	.59914
PrePost21	-1.00	2.00	.2308	.72501
PrePost32	-2.00	2.00	.2308	.92681
PrePost45	-1.00	2.00	.2308	.72501
PrePost53	.00	2.00	.2308	.59914
PrePost4	-1.00	1.00	.1538	.80064
PrePost23	.00	2.00	.1538	.55470
PrePost47	-1.00	2.00	.1538	.80064
PrePost52	-1.00	2.00	.1538	.80064
PrePost55	-1.00	1.00	.1538	.55470
PrePost5	-3.00	1.00	.0769	1.03775
PrePost12	-1.00	1.00	.0769	.64051
PrePost54	-1.00	1.00	.0769	.49355
PrePost59	-1.00	1.00	.0000	.70711
PrePost14	-1.00	.00	-.1538	.37553
PrePost36	-4.00	1.00	-.3077	1.25064
PrePost25	-2.00	1.00	-.4615	.77625

In analyzing the items ranking with the three highest mean pre/post difference, on Table 4.11, resulted in 7 items within the top three gains due to the shared values, as discussed previously. All 7 items had a pre/post increase of .4615 or greater. Further, 6 of the 7 pre/post gains resulted in teachers moving belief positions. On 5 of the positively scored items, teacher participants moved from the position of uncertain to the belief position of agree. On 1 of the negatively scored items, the teacher participants moved from agree to uncertain. One item remained with the belief position of agree on both the pre and post, but showed gain in the degree of teacher participant agreement. This data can be reviewed in more detail in Table 4.12.

Table 4.12: Pre/Post MTEEBI Item Gains/Losses

Note: * and ☆ denote shared values

Pre/Post Highest MTEEBI Gains					
Item	SE/OE Scoring	MTEEBI Statements	Pre Mean Position	Post Mean Position	Mean Diff
58	O-	Even with appropriate instruction, most students rarely consider whether their math work makes sense.	2.77 Agree	3.69 Uncertain	.9231
6	S+	When a student commits an error in math, I am able to diagnose his/her conceptual errors.	3.54 Uncertain	4.08 Agree	.5385*
40	S+	I can incorporate multiple representations into my lessons to improve student learning.	4.00 Agree	4.54 Agree	.5385*
48	S+	I can teach my students to decompose and re-combine numbers and expressions in different ways depending on the context.	3.62 Uncertain	4.15 Agree	.5385*
33	S+	I can develop students' ability to produce mathematics (e.g. a number sentence, expression or equation) to model their own interpretation of a situation.	3.69 Uncertain	4.15 Agree	.4615 ☆
39	S+	I am able to make sure my students can use materials to represent problems in multiple ways.	3.77 Uncertain	4.23 Agree	.4615 ☆
56	S+	I am comfortable analyzing and synthesizing different student approaches to a mathematics problem to bring closure to a mathematical discussion.	3.62 Uncertain	4.08 Agree	.4615 ☆
Pre/Post Lowest MTEEBI Losses					
25	O-	Even a teacher with good math teaching abilities may not help some students learn math.	3.77 Undecided	3.31 Undecided	-.4615
36	O+	A teacher can be expected to help a student learn math despite his or her impoverished home environment.	4.62 Agree	4.31 Agree	-.3077
14	O-	When students are given the opportunity to make their own generalizations, they end up more confused than if the teacher teaches the mathematics directly.	4.23 Disagree	4.08 Disagree	-.1538

The highest pre/post increase was on Question #58, with nearly 1 full point gain which changed from a pre mean of 2.77 to a post mean of 3.69 for a total gain of .9231. This reverse scored item indicated that teacher participants moved from agreement with the statement, "Even with appropriate instruction, most students rarely consider whether their math work makes sense," to being uncertain about this statement, moving toward disagreement. Question #58 emerged as being among the lowest group mean in both the pre and post item analysis. Throughout the entire lesson study professional development process for each grade level lesson study, there was an overriding focus on mathematical argumentation through implementing Standards for Mathematical Practice #3 (SMP3): Construct viable arguments and critique the reasoning of others. During the lesson studies, teachers encouraged students to justify their answers, which required them to consider the reasonableness of their work, which has a direct relationship to this item.

Teacher #41 reflected on her belief in her ability to help her students think critically and recognized students attending to their reflection on their work when she said, "…. because we presented them with a problem, and gave them time to work it out using any method they see. We allowed them time to struggle and hit some barriers along the way, but students used many strategies to check their work and reasonableness of answers," she went on to say, "…students are constantly showing their work and using different methods to check their work and track their thinking," and "Many students have different backgrounds and ways of interpreting math. The argumentation [mathematical] allowed students to not only check an answer, but prove their answer with reasoning and evidence." In addition, Teacher #42 offered, "Yes, I feel that my students showed argumentation effectively. I feel that most if not all students were able to justify their answers." The journal responses by both teachers were indicative of the effort that was given to encourage students to consider if their work makes sense throughout the lesson study, contributing to the overall increase of this belief. In addition, the researcher observed the fourth grade team asking their students, "How do you know your answer is reasonable?" and in one class the students shared out multiple ways in which they checked their work for reasonableness.

The three items that all had equal pre/post gains for the 2nd highest gain are Questions #6, #40, and #48 with a gain of .5385. These gains resulted from the following change in scores: Question #6 Pre 3.54/Post 4.08; #40 Pre 4.0/Post 4.54; #48 Pre 3.62/Post 4.15.

Question #6 refers to a teacher's belief in his/her ability to diagnose student conceptual errors; and teacher participants increased from their uncertainty to agreement with the statement. During the lesson study planning, the teacher participants explicitly addressed any possible student misconceptions and errors that would be likely in the lesson to address at the time of instruction (see Appendix F). Teacher #22 specifically reflected on her growth in getting her students to think critically and responding to their questions through the lesson study professional development in her journal response when she said, "The more I understand thinking critically, types of questions to ask and how to respond to their responses, I can help my students."

Question #40 pertains to a teacher's belief in his/her ability to incorporate multiple representations into lessons to improve student learning, which the teacher participants initially agreed with and their agreement increased moving more toward strongly agree. Teacher #51 addressed the shift in her instruction for including multiple representations through the lesson study professional development experience, "The role of the team approach in changing my beliefs about my ability to teach is that there are so many paths we can take to teach a math lesson. We can implement the varieties into CCSS and meet the needs of our learners to make them career ready!"

Question #48 relates to a teacher belief in his/her ability to teach students to decompose and re-combine numbers and expressions, depending on context. Teacher participants increased from uncertainty with this statement to agreeing with it. A kindergarten teacher shared how her students excelled with number decomposition in the lesson study, "The students were able to successfully decompose a larger number into smaller groups that represented the larger quantity." Number composition and decomposition was the focus of the lesson studies in the kindergarten, first grade and third grade lessons.

A common theme clearly emerged with these items as all three of these items pertained to teacher self-efficacy with teacher participants' belief in their ability to influence their students' math achievement increasing after the professional development lesson study. All three of these MTEEBI items were directly addressed during the lesson study process as the planning and debriefing process focused on understanding and addressing student misconceptions, creating multiple representations presented by teachers and students, and understanding number sense with decomposition of numbers. This pre/post analysis provides strong evidence that the teacher participants increased in their self-efficacy, or their belief in their ability to impact student learning, after the lesson study professional development which focused on these elements.

The three items that all had equal pre/post gains for the 3rd highest overall gain are Questions #33, #39, and #56 with a gain of .4615. These gains resulted from the following change in scores: Question #33 Pre 3.69/Post 4.15; #39 Pre 3.77/Post 4.23; #56 Pre 3.62/Post 4.08. All three of these items were positively scored self-efficacy items and each pre/post gain represented an increase in teacher agreement moving from uncertain to agreement with each statement. On Question #33, the teachers grew from uncertain to agreement with their skill to develop students' ability to produce mathematics (e.g., a number sentence, expression or equation) to model their own interpretation of a situation. This was a focus of the lesson study and was further supported in the journal entry as Teacher #41 discussed how the lesson study lesson was different than lessons she had taught previously, "The main difference is the students use bar models as to how they interpret the problem versus me providing them with the example. This will hopefully allow some discussion on how methods may vary." Teacher 41 discussed how her students used varying mathematics methods to model problems, "Some students rounded their items and adjusted their estimate others [sic] took the amount of items they were to purchase and divided the total amount given to estimate, others used bar models. It lead to great [sic] discussion." This teacher went on to say later in her journal, "I felt like students were encouraged to take risks, and learn from mistakes. Also, they were encouraged to use models throughout the lesson." This evidence confirmed the teaching shift that was supported as teachers were encouraged to have their students model mathematics and justify their rationale for their methodology and final answer during the lesson study professional development.

The participants agreed, after the lesson study professional development, they were able to include multiple representations in lessons in response to Question #39. Exploring the use of materials to represent mathematics in varying ways was a focus of the lesson study process as evidenced in a 3rd grade lesson study through the journal reflection of Teacher #33, "We have worked and worked to get them to understand the distributive property and how to use it to help them solve more difficult multiplication problems and they just haven't gotten it! We have tried a couple different ways and have come to the conclusion that they needed a more hands on approach to solving the problems. So we came together to figure out multiple hands on approaches that we could use in one lesson." In addition, Teacher #11 shared, "I think that in the past, when I have taught a similar lesson, I did not spend enough time letting students practice this skill with manipulatives."

Teachers showed their growth in confidence in moving from uncertain to agreement with their response to item #56 in their comfort with analyzing and synthesizing different student approaches to math problems and using that during closing classroom discussions. This teaching approach was addressed in Teacher #41's journaling as she stated, "We wanted a true discussion on how methods for subtracting many items from a total can vary. Also, we hope to see argumentation on if one method works better than the other," and she went on to say, "I feel like we gave them time to struggle and attend to precision and persevere through a problem. We also focused on the ability to use multiple strategies for students to critically solve problems." Through observations, the researcher witnessed the teacher participants including various student approaches to solving a problem in wrap-up discussions in the lesson study lessons.

Once again, a distinct theme emerges from these three items as they all relate to teacher self-efficacy belief's in ability to influence student learning outcomes through helping students model mathematics, including multiple representations in lessons, and analyzing and synthesizing student approaches in mathematics discussions. All three of these teacher interventions represented in items #33, 39, and 56 were tightly connected with the focus and goals of the lesson study professional development.

The lowest pre/post differences were on items #25 ($M = -.4615$, $SD = .77625$), #36 ($M = -.3077$, $SD = 1.25064$) and #14 ($M = -.1538$, $SD = .37553$). All three of these items were outcome expectancy items. Two of the items (#14 & #25) were reverse scored efficacy items and one item was a positively scored efficacy item. None of these pre/post score differences demonstrated participants shifting in belief positions. This data can be reviewed in more detail in Table 4.12.

Question #25 was a reverse scored outcome expectancy item that stated, "Even a teacher with good math teaching abilities may not help some students learn math." This item had a pre mean of 3.77 and a post mean of 3.31, for a decrease of .46. As previously discussed, item #25 was the lowest mean post item. The mean pre and post scores in the range of 3 indicated the participants' uncertainty with the item. However, because the item is reverse scoring, the decrease indicated that teachers are moving more toward agreement with the statement rather than disagreement. Throughout the journaling process, teachers reported their concerns with meeting the needs of all students in their classroom. A pattern emerged that indicated the teachers clarified their response of concern of students learning by expressing the need for more time to help struggling students. For instance, Teacher #12 stated, “Some of the lower students had some trouble with it but with more practice I do believe they will understand it better.” Also, Teacher #41 when referring to belief in students’ ability to understand and master CCSS math knowledge and skills, “At this point, I feel not because there is such a shift from the existing standards to the CCSS. I feel like it will take a couple of years for students to master the knowledge and skills because they layer upon themselves throughout grade levels.” Teacher #31 concurred with “I know that I can get just about every kid to understand math concepts if I just have enough time and start at the very basic hands-on level that helps them feel confident and then continue to build skills in a quick review type format until I can find the actual place where their learning ceased on the topic or where their thinking about the concept got confused.” All three of teachers mentioned the need for more time. The researcher believes the responses to Question #25 are most likely because the teachers were considering the special needs of the students and the time needed to teach individual students, and given more time students could learn, however, it could be out of the scope of the year the teacher had the student. For instance, Teacher # 42 revealed, “I feel that if I work hard enough and long enough, that I can get any child to understand math concepts. Where I struggle is when students come into your classroom mid year with math understand [sic] that is far below the level that you are teaching. Sometimes I feel like there isn’t enough time in the day to get them caught up.” Teacher #52 shared her thoughts, “In a perfect world, yes, I believe all students will be able to understand and master the CCSS. However, there are so many things out of the educational system’s control. Students will continue to come to us with holes in their learning they [sic] we try to plug and fill, which in turns [sic], put them behind. All students can learn, I believe that, and there will be those who succeed at the CCSS and those who will grow but many never meet the criteria for CCSS.”

Question #36 was a positively scored outcome expectancy item and stated, “A teacher can be expected to help a student learn math despite his or her impoverished home environment.” As discussed previously, Question #36 was the highest mean pre item with a mean of 4.62 and post mean of 4.31. This decrease of .31 still indicated agreement with the statement, however, the change is moving toward a response of agree rather than strongly agree. Question #14 is a reverse scored outcome expectancy item which stated, “When students are given the opportunity to make their own generalizations, they end up more confused than if the teacher teaches the mathematics directly." The mean pre score was 4.23 and the post mean was 4.08 for a mean decrease of -.15. Though the score of 4 indicated disagreement with this reverse scored item, there is a slight decrease in the level of disagreement. However, Teacher #2 shared in her journal writing her growth with her ability to encourage students to engage in making independent generalizations, "I can do my part by allowing my students the opportunity for mathematical argumentation now, and provide the situations and contexts as how to use that language and defend your answer." Teacher #1 also reflected on mathematical discourse that was encouraged and observed in her students, "Moving around the room at the different leveled centers, I was able to ask questions to encourage high-level critical thinking explanations as to how students were coming up with solutions." She went on to say, "I heard conversations take place at the leveled grouping validating understanding of CCSS. There were different explanations of problem solving skills."

Question #25 and #36 seem to be somewhat contradictory with Question #25 teacher participants indicated uncertainty with a good teacher not being able to help some students learn math, however, Question #36 respondents responded that they agreed that they can be expected to help a student learn math despite his or her impoverished home environment. The teacher participants might have taken other factors into consideration when answer item #25, which is discussed further in Chapter 5.

There was one item on the pre/post comparison analysis that the researcher found to have no change from the pre to the post survey. Question # 59 had a pre and post mean of 4.23, indicating no difference in the teacher participants' belief in their agreement with their ability to be able to help students from impoverished backgrounds excel in math. This item was not a focused target of the professional development experience. However, the school where this research took place is the home school for students who are homeless, living in various shelters provided by the community. Teaching students of impoverished backgrounds is a natural daily occurrence for these teachers.

A visual inspection of the pre/post MTEEBI item comparison data in Table 4.12, reveals that the majority of the highest pre/post gains, 6 of the 7 items, were self-efficacy items and are highlighted in yellow. However, when considering the lowest pre/post gain items it is apparent that all three of the lowest gains were with outcome expectancy items. In addition, when considering the overall SE and OE gains through the Paired-Samples t-test, there was a greater pre/post SE mean difference of .28205 when compared to the OE pre/post mean difference of .18590. This data supports most research on teacher self-efficacy indicating the difficulty in changing outcome expectancy beliefs compared to self-efficacy beliefs (Shroyer, Riggs & Enochs, 2014).

Removed MTEEBI Items

The researcher inspected the items removed from the MTEEBI through the confirmatory factor analysis process to determine if items relevant to the lessons study professional development research conducted were removed. Three items were identified as being relevant to the professional development. These items and the mean pre, post, and difference scores are presented in Table 4.13 below.

Table 4.13: MTEEBI Removed Items Relevant to Lesson Study Professional Development

Removed MTEEBI Items					
Item	SE/OE Scoring	MTEEBI Statements	Pre Mean Position	Post Mean Position	Mean Diff
34	S-	I have a difficult time getting my students to use clear explanations when discussing their math thinking.	3.00 Uncertain	3.46 Uncertain	.46
44	O+	When students do not make progress in their ability to communicate mathematical ideas, the teacher’s instruction was inadequate.	3.00 Uncertain	3.38 Uncertain	.38
46	O+	Students can be taught to find the logical flaws in a mathematical argument by themselves.	4.15 Agree	4.23 Agree	.08

All three items indicated positive growth. Two of the items were outcome expectancy items and one item was a self-efficacy item. Teachers moved more in the direction of disagreement with experiencing difficulty in getting students to use clear explanation in mathematical discourse. Teachers moved more toward agreement with taking responsibility for students who are not making progress with communicating mathematical ideas. Finally, teachers made a slight increase with agreement with students' ability to find flaws in mathematical argumentation on their own.

The increases in these items could possibly have been due to the fact that they were poorly performing items or because the professional development activities were focused around these items. It is worth noting that these teachers showed an increase in these items and the increase could be influenced by the lesson study professional development.

Journal Analysis

The qualitative data collected through the journaling process allowed for authentic diverse perspectives to be shared from the participants by promoting individual self-expression resulting from the lesson study professional development experience. The journaling results provided the researcher with a deeper understanding of the introspective reflection of teachers as they documented their experiences throughout the lesson study professional development process to triangulate the results of the MTEEBI quantitative survey and classroom observations.

The teacher participants completed reflective journal entries at three distinct phases throughout the lesson study professional development (see Appendix I to view the journal prompt items in their entirety). The Planning Phase Questions (PPQ) were completed before the lesson study was conducted and during the planning phase of the experience, after an initial professional development on lesson study and mathematical argumentation. The Lesson Study Phase Questions (LSQ) were answered after the teacher had completed teaching the lesson study lesson and finally, the Reflection Phase Questions (RPQ) were the culminating journal questions that were responded to after the entire lesson study process was completed. Technology was used as the journaling prompts were emailed to participants by the researcher. These prompts were written by the researcher to specifically target the separate, but related constructs of self-efficacy and outcomes expectancy to gain an understanding of how the lesson study professional development impacted self-efficacy through Bandura's four sources: mastery experiences, modeling, verbal/social persuasion, and physiological response. A written response format was selected by the researcher to allow participants to take their time in their reflective responses, in a non-threatening, private manner to better capture a rich perspective of the teachers' experiences, allowing them the opportunity to more fully share their genuine thoughts and feelings about their experiences more openly.

Though every effort was made to collect reflective journal entry data from all participants, this qualitative data was not provided to the researcher from all participants. As noted previously, of the initial 14 teacher participants, Teacher #32 was removed because she was not able to participate fully in the lesson study professional development because of the part-time nature of her teaching position and the responsibilities from the other part-time position the teacher held. In addition, teacher #61 did not return any portions of the journals, leaving the total number of journals collected to 12. However, not all phases of each journal reflection were completed in all of the 12 journals that were submitted. Teachers #33 and #31 did not submit responses to the final reflection phase questions of the journaling process. Therefore, though 12 journals were submitted, only 10 of the 12 journals submitted were completed entirely. In addition, not all responses submitted could be utilized because the teacher participants did not always answer each question in each phase of the journaling and not all teachers answered the question as it was asked. Therefore, when the researcher reported the results on journal questions, the number of responses varied per question.

Impact of Lesson Study Shared from Journal Entries

Impact of Previous Mathematical Experiences

Part of the Planning Phase Questioning in the journaling was intended to gather an understanding of the previous educational math experiences of the teachers themselves, when they were students to ascertain any impact on their self-efficacy and outcome expectancy beliefs. These early experiences provide a deeper understanding of teacher beliefs before the professional development sessions began. Having an understanding of teacher beliefs before the professional development was important to determine the shifts and changes in beliefs after the professional development experience. When reflecting on their own personal learning experiences and thoughts about math as a learner, a variety of perspectives were expressed. Teacher responses revealed the powerful influence of prior learning experiences on their own self-efficacy. Using

Bandura's theory of Social Learning, these positive experiences can be coded as mastery experiences.

Upon reflection on their elementary math learning experiences, teachers often reported successful experiences or reported they had little to no recollection of learning math in elementary school. More teachers said they struggled with math in middle school and high school to a greater extent than in elementary school. Two of the teachers specifically recalled struggling with word problems. Three teachers recounted they had a tutor and sought out extra help in math. Overall, five teachers reported having positive learning experiences, while two teachers had more negative experiences and five teachers reported a combination of positive and negative learning experiences.

Some of the positive experiences were described as follows:

> "Math has always been an easy subject for me."
>
> "I enjoyed math yet found it challenging."
>
> "I have always enjoyed math and felt like it came fairly easy to me in elementary and middle school."
>
> "…I loved that it made sense and that I could control my grade more than with any other subject."
>
> "I loved math as a student. I took as much as I could."

These positive comments indicate that enjoyment of math was often because it was a subject that the teachers understood as a learner. This feeling of enjoyment brought about a willingness to engage in math classes. These mastery learning experiences then promoted a positive physiological response that has remained through the years.

Negative math experiences were described as follows:

> "drill-based instruction…boring and tedious"
>
> "I hated timed tests because I knew I wouldn't do as well as most of the students in the class."
>
> "I had a lot of tears and confusion. It was a lot of worksheets and rote memorization. I felt stupid and inadequate when I was asked to give answers in front of the class."
>
> "Since I struggled through math so much I chose not to take the advance math class [sic]. In college, I steered clear of math as much as possible."

> "I had a horrible teacher, who one day, gave me the gold star on the board for being the dumbest in the class."

These negative recollections demonstrated feelings of inadequacy as a math learner and in some cases resulted in teachers avoiding math as a student and in one instance, this avoidance of math persisted when the teacher was an adult learner in college. These negative experiences and verbal/social persuasion resulted in poor physiological response outcomes.

Nine of the twelve teachers responded about their teaching now and how their own experiences as a learner have helped shape their teaching practices and described their practices in more depth. Only 1 of the 12 teachers said personal experiences with math as a student did not influence her teaching practices in any way and 2 of the 12 teachers did not answer this part of the question.

The teachers described how these personal life experiences influenced their own teaching and beliefs, with most responses describing the teachers' desire and goals to provide quality learning experiences in their classroom. To further highlight this point, the following comments shed light on this perspective:

> "I like to make sure I reach all learning styles and work on confidence building activities. I like to help children believe they can problem solve with their own ideas. And, it is ok to make mistakes because that is part of learning." [Tchr #1]

> "…I remember thinking of math as more paper pencil based. Through my college experiences, it took me some time to transition to thinking more of math as concrete experiences." [Tchr #2]

> "Because math comes fairly easy to me, I have to be mindful of the fact that not all kids or adults are comfortable with the subject. There are many times throughout the week that I use math in daily living so any time I can incorporate math into the other areas of the curriculum, I try to do so." [Tchr #11]

Teacher #42 made a detailed and specific correlation with her own math experiences and her teaching beliefs and practices today. She mentioned how her struggles in math made her reluctant to take higher level math classes in high school and college, as quoted previously, and shared this impact on her teaching, "I feel that my experience has challenged me to be the best math teacher that I can be. I understand now, how important being able to manipulate numbers and feel confident with mathematics is for students and the choices that open up to them in the future." Another teacher [#21] highlighted her desire to have been, "challenged to problem solve and persevere with difficult concepts," while she was a student in school. This experience provided her reflection as teacher and her goal to, "….teach strategies, so they have the tools they need to persevere and think critically when they are presented with a challenging problem or a new skill." One teacher mentioned how she shared her love for math with her students, "I think I show my excitement for math through my goals and lessons as a teacher."

Teacher #33 shared her experiences as a math student strugging with fluency in elementary school and having difficulty with algebra in middle school, and finally an "ah ha" moment in high school when math clicked allowing her to take advanced courses. This teacher shared her commitment to her students' learning through her own learning experiences when she stated, "I think that having been through all of the levels of understanding math it helps me teach all of my students. I can relate to students on each level and challenge them or remediate for them as needed. I also think it has helped me see that learning takes place in many different ways and that it is good to present information from different perspectives."

Teacher #51 described physiological responses about her own teaching and the desired goal of impact on her students, "…I am very positive and excited when I teach math. I try to get my feelings/emotions to rub off on the students."

In summary, the teachers' responses about their own learning experiences as a student that were affirmative responses stemmed primarily from mastery experiences where the teachers felt successful as learners in their attempts with learning math, often resulting in positive physiological responses of "enjoying" math and feeling good about themselves as learners with heightened self-efficacy. However, the negative responses stemmed from mastery experiences where teachers as learners had unsuccessful outcomes where they struggled with learning math, which encouraged negative physiological responses of feelings of inadequacy as a math student with lowered self-efficacy. As a result of these experiences, most of the teacher participants went on and described learning environments they strive to create in their own classroom as ones that provide mastery experiences that lead to success for their students that allow their students to, "make mistakes," "build confidence," "make their own discoveries and conclusions," "allows investigation and discovery opportunities," and help students "feel confident." The teacher participants are working to create successful learning experiences for their students that will result in positive learner outcomes through mastery experiences that promote positive physiological response, often in light of their own experiences. From these journal reflections described, it is clear that past learning experiences as a student can, in part, shape the attitudes, beliefs and actions of a classroom teacher. These beliefs obviously existed before the professional development experience began and in part, contributed to the foundation for the pre professional development MTEEBI scores.

Organization of Journal Entries by Bandura's Sources of Self-Efficacy

The impact of lesson study on self-efficacy and outcome expectancy can be more fully understood through the rich descriptions shared by the teacher participants themselves about their experiences and the impact on their belief in their ability to teach math and the CCSS and their belief in their students' ability to learn math. The journal entries provided strong evidence of the positive impact the lesson study professional development had on teacher participants' self-efficacy (SE) and outcome expectancy (OE). After an open coding process and sorting self-efficacy and outcome expectancy responses, the journal entries were then organized around Bandura's Social Cognitive Theory (1986) that identified four contributing sources that influence one's self-efficacy beliefs. These sources are 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions. New codes were merged into the priori codes of Bandura's four sources (i.e., collaboration was merged under modeling). In other cases, open codes were not aligned with the scope of the research questions and were not included (i.e., teaching practices). Data will be presented according to these four sources of efficacy (Bandura, 1977). For each of the four sources, the impact of this source will first be described in relation to its impact on self-efficacy, then in relation to its impact on outcome expectancy. It should be noted that not all of the participant comments and discussions fit neatly into one of Bandura's sources that influence self-efficacy. These examples were then included as a separate discussion of other contributing factors following the Bandura framework.

Analysis of the journals revealed the teachers openly and clearly discussed all four sources of self-efficacy when reflecting on their self-efficacy changes. However, when reflecting on changes in outcome expectancy, the teachers discussed only three contributing sources: mastery experiences, modeling, and physiological response, leaving one source of efficacy missing in the data provided through the journal responses. Verbal/social persuasion was not evidenced in the journal responses when the participants discussed OE. Rationale for this finding will be discussed further in Chapter 5.

Impact of Lesson Study on Self-Efficacy

As seen in Table 4.14, the journal entries supported the MTEEBI results indicating growth in self-efficacy and outcome expectancy. The results provide further evidence the lesson study process did positively impact the vast majority of teachers' self-efficacy and outcome expectancy beliefs. Of the total 125 responses given for the 8 SE items and 3 OE items, 100 responses, or 80% of the responses, were positive showing agreement with supportive, positive responses to the question stem. Of the responses, 23 or 18%, were mixed where respondents gave a positive comment and shared a concern as well or vice versa. Only 2 responses, or about 2%, were negative responses in disagreement with the question stem. These self-efficacy and outcome expectancy items represent just a portion of the journal prompts. There were a sum total of 19 prompts and 11 of these prompts, or 58% of the total journal questions noted in Table 4.14, are of the items that specifically elicited a yes/no or positive/negative response. The additional 8 questions that do not appear in Table 4.14 included questions pertaining to personal experience with math as a student as discussed previously and other questions to be discussed that pertained to SE and OE that did not elicit a yes/no response and were more open-ended or addressed the effectiveness of the lesson study professional development overall.

Table 4.14: Journal Questions Yielding Yes/No, Positive/Negative or Mixed Responses

Questions	Self-Efficacy Responses			Outcome Expectancy Responses		
Planning Phase Questions (PPQ)	+	-	+/-	+	-	+/-
PPQ#2 – How comfortable do you feel with teaching math?	10/12 83%		2/12 17%			
PPQ#3 – How confident do you feel in your ability to affect student learning outcomes in math?	9/12 75%		3/12 25%			
PPQ#5 – Do you believe you will be able to implement the math CCSS in your math instruction?	11/11 100%					
PPQ#7 – How prepared do you feel to teach the lesson study lesson?	7/12 58%		5/12 42%			
PPQ#8 – How are you feeling about the lesson study?	8/12 67%		4/12 33%			
PPQ#6 – Do you believe students will be able to understand and master the mathematical knowledge and skills represented in the math CCSS?				8/10 80%		2/10 20%
Lesson Study Phase Questions (LSPQ)	+	-	+/-	+	-	+/-
LSPQ#2 – Do you believe you can help your students think critically?	12/12 100%					
LSPQ#4 – How has feedback from others impacted your belief in your ability to teach math?	8/12 67%	1/12 8%	3/12 25%			
LSPQ#3 – Did your students learn what your team intended them to learn?				11/12 92%		1/12 8%
Reflection Phase Questions (RPQ)	+	-	+/-	+	-	+/-
RPQ#3 – Do you believe the lesson study impacted your belief in your ability to teach math?	7/10 70%	1/10 10%	2/10 20%			
RPQ#4 – Do you believe your instruction led your students to perform the skills of mathematical argumentation effectively?				9/10 90%		1/10 10%
*The total number of responses varies according to the number of teachers who responded to each question. + = yes/positive response, - = no/negative response, +/- = mixed response/positive & negative						

A detailed analysis of the lesson study professional development's impact on self-efficacy and outcome expectancy, including the remaining open-ended journal responses, will be explored further based upon the responses as they demonstrated influence by Bandura's four sources that impact self-efficacy.

Table 4.14 displays the extracted yes/no or positive/negative response items from the journal prompts. A review of these self-efficacy items highlighted in the table show an impact of the lesson study on self-efficacy with the majority of the teacher participants indicating a positive response, confirming the results from the MTEEBI. Of the total 93 responses on the SE items, 72 were positive responses or about 77% of the responses were indicative of a positive agreement with the questions. Only 2 of the responses, or about 2%, were negative or disagreement responses, while 19 of the responses, or about 20%, were mixed responses. Of the mixed responses, often the teacher shared a positive comment and then paired it with a concern or vice versa. For example, Teacher #1 shared how prepared she felt for the lesson study she commented, "I feel ready but a little nervous!" This response was coded into mixed category because though she feels "ready" and that is a positive feeling, she also feels "nervous" which is more of a negative feeling, resulting in a mixed response.

This positive impact teachers reported has been delineated by the researcher into the four contributing sources of self-efficacy identified through Bandura's Social Cognitive Theory (1986). These sources are 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions. Because many of these areas overlap in their connectivity, it was often difficult to pull apart the influences described by the teacher participants to categorize in just one area.

A majority of the group, 9/12, responded to the journal question, PPQ#3, inquiring about their confidence level with affecting student learning outcomes with an affirmation ranging from, "confident" to "very confident." Of the 12 teachers, 3 teachers gave a more neutral response.

One teacher [#1] indicated, “With more teaching practice my confidence grows,” and it is interesting to note the teacher who made this comment is a late career teacher with 20 years of experience. This response reveals how self-efficacy continues to grow throughout the duration of one’s career, particularly when confronted with new experiences such as teaching to the CCSSM. Two teachers outlined some specific challenges in their teaching when responding to this question. Teacher #52 relayed, “I am doing better working with students who have at least some mathematical reasoning. I have a few students I struggle with because they have virtual no [sic] number sense. Working with those students in particular is time consuming, and affects the quality of instruction for the other students. I don’t want to leave them behind, but sometimes they need specialized assistance.” The other teacher reported, “I am still having difficulty differentiating instruction and meeting the needs of all of my students.” These two teachers were not alone in their concern for meeting the needs of all the learners in their classroom. In total, 9/12 teachers commented about the need to meet individual student needs. Though the teachers reported feeling overall positive in their ability to affect student learning outcomes in mathematics (SE), it is evident that meeting individual student needs is a goal most of the teachers are concerned about and continually working toward.

Though many journal prompts provided responses that were easily coded into one of Bandura’s sources of influence on self-efficacy, at times several sources appeared in response to a single prompt. This is true for the prompts shared here where all 4 sources were evident in a single response. In reflecting overall on the impact of lesson study on belief in the teachers’ ability to teach math (SE) as seen in RPQ#3 in Table 4.14, of the 12 participants, 10 responded to the question and 7 of the 10 respondents confirmed that indeed, the lesson study positively impacted their belief in their ability to teach math. Two of the 10 reported positive examples of the lesson study, though their responses were not absolute confirmation of the impact of lesson study on SE and were therefore coded as mixed responses. Finally, 1 of the 10 teachers reported not feeling any differently about ability to teach math after the experience. The majority of the teachers reported feeling more confidence in their ability to teach math because of the contributing factors that impacted all areas of Bandura’s framework: Mastery Experiences was exemplified as having a well-planned lesson and a better understanding of CCSS; Modeling was demonstrated through an explanation of the impact of shared ideas and support from colleagues, which is evidenced in one teacher’s account, “…this is a great way to get many heads together to see what ways are best to teach math."; Verbal/Social Persuasion was represented in terms of positive reinforcement from others, such as the experience shared by Teacher #42, "Everyone was so positive after the lesson, I believe it helps you to believe in yourself."; and Physiological Response was evident in one participant's words, "It was exciting to plan but equally exciting to see how much further we went with our lesson than we had originally planned." One teacher summed up the experience by saying, "I think it just showed how easy and effective this really can be [lesson study]. I didn't feel we 'dressed up' our approach any, we just taught really good math!" All of these examples highlight the rich, authentic experiences of the participants and clearly provide evidence the lesson study did have a positive impact on improving participants' self-efficacy and outcome expectancy through the contributing sources presented by Bandura (1977).

Impact on Self- Efficacy through Mastery Experiences

The mastery experiences discussed by teacher participants in the journal responses positively impacting self-efficacy included having taught successful lessons that stemmed from well-planned lessons that resulted from the team planning experience. The participants often discussed the positive impact of having a team to jointly plan the successful lesson with. Throughout the journal responses, the four sources of efficacy tended to overlap a great deal especially around the experience of collaboration. This was especially true for the mastery experiences and modeling categories. Lesson study involves intense collaboration. This collaboration leads to modeling as well as mastery experiences. The teachers often described modeling as having a positive benefit on self-efficacy as they were referring to the modeling of sharing ideas or model teaching of a successful lesson, which both could be referred to as a mastery experiences. This point is illustrated through a response given by Teacher #33, "I think that we all brought different abilities, skills, and ideas to the table. Putting all those together made this lesson such a success. It also was nice to see how easy it can be to plan a really great lesson; it doesn't have to be extremely intricate in order for it to be effective."

In addition to the positive belief in their ability to impact student learning outcomes in mathematics, the teachers also demonstrated a strong belief in their ability to implement the CCSS math standards which was evident at the onset of the study in response to PPQ#5. In fact, 100%, all 11 teachers that answered the question, reported that they feel confident in their ability to implement CCSS in their mathematics instruction. Teacher #33 had a response that showed her appreciation and reflection on the team aspect of the school,

> I do believe we'll be able to implement the math CCSS in our math instruction because we are [school's name used] teachers, that's just what we do! ☺ Each time that something is thrown at us that is new and intimidating, we rise to meet the challenge. Our Math in Focus curriculum does a pretty good job of aligning with the CCSS so there will just be a few areas that we have to work to meet the standards outside of the curriculum. I'm not saying it will not be challenging, but I think we will do it!

Many teachers attributed this confidence to mastery experiences including teaching from curriculum aligned to CCSS, having support and training from knowledgeable and experienced professionals in the field, and continued practice for teachers and students to enhance knowledge and understanding. It should be noted that even though the Planning Phase Questions were done before the actual lesson study, the teacher participants had already participated in a professional development session with Dr. Rumsey before they answered this question. The support that is mentioned by some teachers, such as when teacher #21 responded she will be able to implement the math CCSS in her math instruction, "Yes, but only with support and training from people who are smarter and more experienced than I…," is confirmation that these responses were influenced by the professional development that had already taken place.

When the teacher participants were asked, in RPQ #5, to share what three things throughout the lesson study most likely impacted their belief in their ability to teach math and CCSS (self-efficacy), 10 teachers responded to the question. Of the total 30 responses possible, given three factors per each of the 10 teachers, nearly half of the responses and more specifically 14 references were made to mastery experiences. The experiences shared presented an overlap between mastery and modeling, they were combined into the mastery category here because most of the modeling was colleagues modeling of mastery experiences. Given the challenge of delineating the impact of modeling or mastery since both are clearly present, the researcher determined the modeling represented mastery experiences. However, the overlap will be noticed as some of the items are included in modeling as well as the mastery category.

When the researcher analyzed the frequency count categorically by naturally occurring topics, as shared by the teacher participants, the three mastery experiences that emerged were collaboration, team planning, and colleague observation. Of these three experiences, team planning was mentioned 6 times, the most of any of these three experiences. Both colleague observation and collaboration were represented equally, with each experience being referenced four times. The four teacher participants that mentioned collaboration did not provide additional detail to highlight what aspect of the collaboration was most helpful to them. When considering collaboration, it can be viewed as an overarching theme with team planning and collegial observation being specific examples of collaboration. These findings correspond with Bandura's statement that mastery experiences are most powerful of the four influences that impact building self-efficacy (Shroyer, Riggs & Enochs, 2014).

Following the teacher participants teaching of the lesson study lesson, 100% or 12 of the 12 respondents reported that they believed they can help their students think critically [LSPQ#2]. After analyzing the responses for why they felt this way, the researcher found similarities in their rationale in these responses. The teachers described mastery experiences they created and/or would need to continue to create would substantiate their reasoning for impacting student critical thinking. The teachers' belief in their ability to impact student learning with critical thinking included creating mastery experiences for them to think critically. Some of the examples cited include implementation of:

- differentiated instruction
- higher level questioning
- creating opportunities through real-world problem solving and applications
- modeling critical thinking for students

Teacher #21 referred to this mastery experience as a source of increased self-efficacy with, "Yes, because we observed the students thinking critically and making connections. After planning as a team, we were able to create opportunities within the lesson for students to think critically."

The teachers reported mastery experiences of their students also led to an increase in self-efficacy through perseverance when the teacher assisted students with learning a mathematics concept. When asked what helps with perseverance, 8/12 teachers reported that student understanding, a mastery experience, is their source of perseverance in teaching a student a concept. Teacher #41 summed it up by saying, "What helps me to persevere is when I see a student who has been struggling to not only grasp it, but coach other students and apply the strategies and methods in other context. The student and I feel a sense of accomplishment."

Impact on Self-Efficacy through Modeling

Teachers reported the positive impact on self-efficacy through increased confidence because of the modeling that was experienced throughout the lessons study process. This modeling experience was described by the teachers as: a collaboration, team planning, and collegial observations. As previously stated, the participants did not specify their definition or provide examples of “collaboration” when they mentioned it as part of the three contributing factors that most likely impacted their belief in their ability to teach math (i.e., self-efficacy). However, their responses are precise in attributing increased self-efficacy through collaboration. Teacher #51 shared this when she stated, “More time to collaborate with my team would improve my belief in the ability to teach math!”

The researcher viewed some of the other factors listed that most likely impacted self-efficacy: team planning and collegial observation as examples of the collaborative aspect of the lesson study which allowed teacher participants to work together cooperatively to plan and create exemplary lessons and then have the opportunity to observe colleagues teach these lessons. This collaboration effort provided an opportunity for collegial modeling. One teacher described the experience of “putting our heads together.” Teacher #11 shared the value of collaboration and the team approach when she said it, “….. allows colleagues to share ideas and learn from one another.” This collaboration provided an opportunity for teachers to see different approaches to teaching CCSS. In addition, this collaboration contributed to a positive physiological response for participants. For example, Teacher #52 shared the feeling of being “in this together” and receiving “help” and “support” from her team. Teacher #52 took the experience of working collaboratively as a team with her colleagues and reflected on how this comes full circle with what is often shared with students about collaboration, “We ‘practiced’ what we preach to our students. Working together can help us do better.” Teachers not only reflected on the benefits of collaboration activities, they also voiced a need for continued opportunities to work together as a team. Teacher #11 shared, “I would like to see more opportunities for collaboration… I believe strongly that we can all learn from each other.”

Team planning was noted as an experience that participants felt affected their self-efficacy. Teacher #33 shared, “I think we all brought different abilities, skills, and ideas to the table. Putting all those together made this lesson such a success." Teacher #1 reflected on the impact of team planning on her ability to teach math self-efficacy as, "Brainstorming ideas made me gain a deeper understanding of what we want our student to know and understand and how they validate their learning through mathematical talk." Teacher #2 mentioned how self-efficacy improved, "the whole team was so positive and encouraging, it really gave everyone confidence" and "…the team planning session was good to bounce ideas off of and [sic] get good quality experiences for students." Teacher #21 mentioned that as a result of the team approach, including planning, teaching, and providing feedback to each other she, "felt more competent and also appreciated feedback that was given." These examples highlight the interwoven nature of Bandura's four sources of efficacy. It is evident here that the collaboration and modeling have also provided positive verbal/social persuasion and physiological response for the participants.

Observation of colleagues, an example of modeling inherent in lesson study, was often listed as a highlight for teachers. Teacher #1 explained that through the observation of a colleague she was able to, "observe more updated technology," as a way to learn new techniques. Teacher #11 mentioned the benefit of observing a colleague teach resulting in her gaining new ideas to improve her lesson, and she specifically mentioned implementing an idea of managing materials she learned through observing her colleague. Teachers reported the opportunity to observe peers as a way to recognize similarities and differences in their teaching through modeling. The teacher participants also noted that it was affirming to realize their strengths in their own teaching by observing these strengths in other teachers. Teacher #42 mentioned that she noticed how she and her partner teacher, "both ask a lot of justification questions" of their students throughout the lesson. Teacher #21 specifically mentioned that, "It gave me confidence," observing her teaching partner and that through this process it, "made me want to have more collaboration time with my awesome teaching partner." Teacher #22 also mentioned the impact of observing a peer on her self-efficacy when she stated, "...it gave me more confidence because I had seen her teach it first and knew what was coming." Finally, Teacher #52 summed up her experience with, "The greatest lesson for me was confirmation that I know what I was talking about and I felt more comfortable about presenting the lesson when it was my turn." These statements provide evidence that collegial observation, or modeling of mastery experiences, in this lesson study professional development experience increased the self-efficacy of the observing teachers.

It also should be noted teachers, at times, reported that though they benefited from observing others and felt this experience increased their self-efficacy, being observed by others also was a source of stress for some teachers. One teacher articulated this feeling by saying, “It is always a little scary having other educators come into my classroom, even when I know that they are not there to evaluate my teaching.” [Teacher #11]. So being observed by peers potentially could be a negative source of self-efficacy by negatively impacting physiological responses. This will be discussed further under impact on self-efficacy through physiological responses.

Impact on Self-Efficacy through Verbal/Social Persuasion

When the teacher participants were asked to share what three things throughout the lesson study most likely impacted their belief in their ability to teach math and CCSS, self-efficacy, 10 teachers responded to the question. Of the total 30 responses possible, given 3 factors per each of the 10 teachers, nearly 30% or one-third of the responses and more specifically 9 references were made to verbal/social persuasion experiences. When the researcher analyzed the frequency count categorically by naturally occurring topics, as shared by the teacher participants, the two verbal/social persuasion experiences that emerged were collegial feedback and group reflection/debriefing. Of these two experiences, group reflection/debriefing was mentioned 6 times, while collegial feedback was mentioned 3 times.

The journal responses indicated the majority of the participants, 8 of the 12, gave positive responses regarding the impact of feedback from others on their belief in their ability to teach math [LSPQ#4]. Of those 12 responses, 3 responses were mixed, giving both positive and negative responses. Though the positive seemed to outweigh the negatives, the hesitation focused mostly on the feeling of being nervous with having outside observers in the classroom. One of the 12 respondents reported that she did not feel that the positive feedback from others impacted her belief in her ability to teach. She explained this, “Hmm, I don’t think it really changed it. I know I am a good math teacher, I just want to be great and yesterday didn’t have enough moments of greatness for me since my low kids were still struggling at the end.”

When delving deeper into the reflection of the impact of feedback from others on self-efficacy the researcher found, 4 of the 12 teacher participants specifically mentioned confidence building as a result of the verbal/social persuasion received from colleagues and the other lesson study participants. Some examples of these comments include:

- I have a bit more confidence, but see my need to continue to work as a team to continue to grow in teaching math.
- Hearing from my colleagues about my teaching has given my [sic] confidence in how I interact with my kids and teach them math.
- The feedback from others has impacted me in my confidence level of teaching math. It was rewarding to hear compliments and things that people thought were important that I said in my lesson.
- I think feedback is a tremendous asset to becoming a better teacher. Everyone was so positive in what they had to say, which helps your confidence. The viewpoint of others, with so much teaching background, is essential if you want to grow and become a better educator.

These comments highlight Bandura's underlying impact of verbal/social persuasion from others, especially those who are considered to be a knowledgeable resource.

Additional reflection on verbal/social persuasion was shared that highlighted the impact this input from others had on the participants improving in their ability to teach, which further promotes self-efficacy growth.

- I am more cognizant of the questions I ask and the approaches I use.
- I have always gotten better when colleagues give me feedback. I can't improve my abilities without help from others. As a person, I have to [be] open for ideas that will have a greater impact on my students learning [sic].

Positive verbal/social persuasion does not appear to compensate for a person's perception of an experience if the experience was not perceived as being positive by the individual him/herself. Once again demonstrating the power of mastery experiences. For example, Teacher #12 shared, " I did appreciate the positive feedback from my group. It is always great to hear that you did well. Although, I didn't feel like it went that well and I was very nervous. I was very 'tight' and not as flowing in my lesson as I usually am. I wish it would have felt better for me." The team felt the lesson was a success and this teacher's perspective was seen in other lesson studies, where the teacher was the harshest critic on self-evaluative perspectives. So initial stress or negative physiological responses, can be overcome through positive verbal/social persuasion when the lesson was successful (providing a mastery experience also). However, it appears the stress of being observed can impact the success of the lesson and self-efficacy when the teacher does not feel the lesson was successful, regardless of verbal/social persuasion of others. Though this teacher received verbal/social persuasion from peers, the stress that was brought on by observations was not eliminated by this interaction. Despite this experience, Teacher #12 did show an increase of two points in self-efficacy from the pre and post MTEEBI comparison.

Impact on Self-Efficacy through Physiological Responses

When participants responded to their feeling of how prepared they felt for the lesson study teaching [PPQ#7], 7 of the 11 respondents felt positive and prepared and 5 of the respondents had comments that were coded as “mixed,” both positive and negative, as the comments included positive feelings, but also feelings that revealed some of the participants were feeling anxious. Of the positive responses, teachers used phrases and words like: “very comfortable,” “extremely prepared,” “no stress,” “ready,” and “excited,” to describe their emotional reaction to their preparedness for the lesson study. Of the responses that showed the teachers were feeling anxious, the words used to describe their emotion included: “a little nervous,” “apprehensive,” and “a little nerve wracking,” when describing their feelings of preparedness for doing the lesson study, which were specifically in regard to having observers in their classroom.

Similar results were found when accounting for the feelings teachers had about the lesson study in general [PPQ#8]. Of the responses to this prompt, eight participants reported positive feelings and four responses showed mixed emotions including positive feelings, but also showed their concerns. These four responses were coded as +/- to indicate a “mixed” response. With the four mixed responses, three of the concerns were once again about having outside observers in their classroom. Two of these participants reported feeling nervous about the observers and mentioned being “taped” and “recorded” as part of the stress discussed. One response mentioned the amount of time the lesson study required. However, this teacher also reported, “But, it is a valuable experience with positive outcomes.”

Though there were concerns reported, the vast majority of the responses indicated an overall positive emotional response with convincing evidence to demonstrate an impact on self-efficacy and this impact as viewed as not only important for the teachers, but also the students as well. Teacher #41 sums this up with, “I am feeling excited because I want to learn new strategies. I am also anxious to see how the lesson chosen will grow after one teacher teaches the lesson. I am also feeling confident that we, as a staff, will learn something new and empowering.” In addition, Teacher #51 echoes the same sentiment by saying, “I am so grateful to have been a part of this lesson study. It has greatly impacted me on my teaching abilities and has blossomed relationships between my co-workers. I would love to be part of this again in the future!” Finally, Teacher #42, stated, “Sometimes, I feel that since teachers are such busy people, that we need to be put in situations that may make us uncomfortable, to push ourselves to set higher goals not only for ourselves but also for the students we teach. She further stated, “I wish we had the time to do this for every lesson that we teach.” Settlage, Southerland, Smith & Ceglie (2009) posited the notion that having some degree of uncertainty can be a powerful source of motivation.

The evidence of the positive impact on self-efficacy through all of Bandura’s (1977) four sources is clearly outlined from the teacher journal responses. The following quote sums up the experience and impact of modeling through a team and its impact on self-efficacy, “It also made me feel more confident, in supplying many ideas of different ways to teach/implement the instructional goals. It wasn’t just my brain doing the thinking/brainstorming.”

Impact of Lesson Study on Outcome Expectancy

Table 4.9 displays the extracted yes/no or positive/negative response items from the journal prompts. A review of these outcome expectancy items highlighted in the table show an impact of the lesson study on outcome expectancy with the majority of the teacher participants indicating a positive response, confirming the results from the MTEEBI. Of the total 32 responses on the outcome expectancy items, 28 were positive responses, or about 88% of the responses were indicative of a positive agreement with the questions. There were no negative or disagreeable responses. Only 4 of the responses, or about 12%, were “mixed” responses. Again, of the mixed responses, often the teacher shared a positive comment and then paired it with a concern or vice versa. For example, when Teacher #41 shared her thoughts on students being able to understand and master the knowledge and skills of CCSS she replied, “At this point, I feel not because there is such a shift from the existing standards to the CCSS. I feel like it will take a couple of years for students to master the knowledge and skills because they layer upon themselves throughout grade levels." This response was scored as a mixed response because though this teacher initially commented that she didn't feel the students were ready, which is a negative response, she qualified this statement by indicating her belief that students need time to be able to accomplish the task but they were capable of learning when given ample time, indicating a positive outcome expectancy belief.

The majority of teacher participants demonstrated strong initial outcome expectancy as indicated through their report they believed in their students' ability to understand and master the mathematical knowledge and skills represented in the math CCSS [PPQ#6]. Ten of the 12 participants responded to the question and of these respondents, 8 of the 10, or 80%, gave a definite yes and positive response regarding their belief in their students' ability to understand and master the CCSS. In addition, 2 teachers gave more of a qualified response explaining their hesitation to say yes, these responses were mixed giving both positive and negative responses. One teacher that gave a mixed response felt the shift from existing standards to CCSS would take a couple of years for students to fully "master the knowledge and skills." However, the other teacher that gave a mixed response qualified it as, "All students can learn, I believe that, and there will be those who succeed at the CCSS and those who will grow but may never meet the criteria for CCSS."

The teachers' belief in their students' abilities, outcome expectancy, highlighted their belief in the importance of providing quality instruction. For instance, two of the teachers indicated that students would be able to understand and master the mathematical knowledge and skills of CCSS given more time, while four teachers mentioned the need for students to have ample opportunities to practice and learn these skills. Two of the teachers correlated their outcome expectancy beliefs directly to their own job performance. Teacher #21 stated, "Absolutely, if I am doing my job. Students can meet and excel expectations [sic] set for them." Teacher #51 outlined her beliefs with, "Yes, they absolutely will be able to understand and master math CCSS because of my well-planned lessons and formative assessment. I am setting a goal to make their foundation of number [sense] stronger through the use of concrete objects. Also, using manipulatives to solve problems – hands-on!" In these examples, the outcome expectancy beliefs of the teachers were tied to the teacher providing quality instruction, including instruction that includes additional time for learning and opportunity for practicing the skills. This finding will be discussed in further detail in the conclusions in Chapter 5.

A total of three questions were written in the journal prompts encouraging teachers to specifically address outcome expectancy through open-ended responses that were then qualitatively analyzed. The questions are:

*Planning Phase Question #6: Do you believe students will be able to understand and master the mathematical knowledge and skills represented in the math CCSS?

*Lesson Study Phase #3: Did your students learn what your team intended them to learn?

*Reflection Phase Question #4: Do you believe your instruction led your students to perform the skills of mathematical argumentation effectively?

Open-ended responses revealed many examples of teachers' high expectations; however, they did not talk about these outcome expectancy beliefs in terms of all four sources of self-efficacy. Given these three specific questions, data could only be coded for impact on self-efficacy through mastery experiences, modeling, and physiological response. No data could be coded for impact on outcome expectancy through verbal/social persuasion. In analyzing the data, sources of outcome expectancy were found in responses to questions other than just those listed above that were directly tied to outcome expectancy. The outcome expectancy responses were combined from all questions where outcome expectancy was discussed and was not limited to the three questions designed to address this construct.

Impact on Outcome Expectancy through Mastery Experiences

The mastery experiences discussed by teacher participants in the journal responses as positively impacting outcome expectancy included the importance of perseverance until ultimately students understand a concept. The teachers reported mastery experiences of their students also led to an increase in self-efficacy through perseverance when the teacher assisted students with learning a mathematics concept. When asked what helps with perseverance, 8/12 teachers reported that student understanding, a mastery experience, is their source of perseverance in teaching a student a concept. Teacher #41 summed it up by saying, "What helps me to persevere is when I see a student who has been struggling to not only grasp it, but coach other students and apply the strategies and methods in other context. The student and I feel a sense of accomplishment."

Journaling responses to LSPQ #3, "Did your students learn what your team intended them to learn? Why/Why not?," revealed evidence of high outcomes expectancy as 11 of the 12 teachers said their students learned what they intended through the lesson study lesson. Some of these comments referred back to students' mastery experiences such as when Teacher #51 shared, "My students did learn to find volume, as intended. They learned this because of the complete structure of the lesson. It was clear, well planned, and engaging!" Other mastery experiences mentioned included:

- "….the lesson objective concepts were explored very deeply within one lesson."
- "Finally, I felt like they had a good grasp on what the distributive property is and how it can help them solve more difficult problems."

Four of the teachers discussed having a "…variety of levels of understanding among the students." This variance of understanding spanned from reports that students needed more time to fully grasp the concepts through additional practice to students who moved beyond the objective taught and applied the concepts to more advanced applications as a result of the lesson study lesson. Teachers believe students can learn (critical thinking) because they saw it happen in the lesson studies. Teacher #21 referred to this mastery experience as a source of increased self-efficacy with, "Yes, because we observed the students thinking critically and making connections."

There was only 1 of the 12 teachers that did not feel her students learned what was intended. Teacher #52 shared that she felt her students only learned some of the objectives presented, however, she reflected on additional learning that was gained, "Those who didn't get the volume concept did discover things about their measuring and their understanding of area."

Teachers also discussed the importance of building mastery experiences for their own students in the lessons they plan as a mechanism to bolster their outcome expectancy. Teacher #51 reported she had strong outcome expectancy and believed her students were capable, stating, "…they absolutely will be able to understand and master math CCSS because of my well-planned lessons and formative assessment." She also went on to report a factor influencing her increased belief, "I felt confident about my students' abilities after the lesson was over." Given the mastery experience of the lesson she taught and seeing the outcome of her students' strong performance, helped to boost her outcome expectancy even more given the experience.

Impact on Outcome Expectancy through Modeling

As previously mentioned, modeling and mastery experiences were extremely difficult to separate during the analysis process since teachers referred to both constructs simultaneously. This was particularly evidenced when analyzing journal responses for impact on outcome expectancy. When analyzing the journal responses for sources of modeling that impacts outcome expectancy, the researcher identified the modeling that occurred when teachers observed lessons being taught that resulted in student understanding (also mastery experience). Teacher #31 questioned herself because not all students understood the concept taught as she had hoped, demonstrates she believes they can. She explained, "I know I am a good math teacher, I just want to be great and yesterday didn't have enough moments of greatness for me since my low kids were still struggling at the end." Though this provides evidence that she does have outcome expectancy and believed in her students, she taught the lesson first. Teacher #31, along with her colleagues, modified the lesson to provide a stronger lesson. There was a noticeable difference between student understanding from the initial lesson to the reteach. Though this teacher did not complete the reflection phase journal questions, during the final debriefing session this teacher noted the learning of the students. This modeling by another teacher served as a catalyst for enhanced outcome expectancy when Teacher #31 went back to review distributive property with her students.

When asked if the teacher participants believed their instruction led to students' ability to perform mathematical argumentation effectively [RPQ#4], 9 of the 10 teachers that answered the question reported they did believe their instruction helped develop this skill. Throughout these responses, the teachers commented on the support of others to provide modeling of mathematical argumentation. Teachers of younger students indicated their belief in their students to perform this challenging task and noted the need for adults to model this skill for them. For instance, teacher #12 stated, "I think they did a great job, but at this age they need adults to lead them through the process." The journal articles also provided evidence that the students applied the skills of argumentation independently through verbal responses, written responses, and schema chart feedback. The observations of the lessons provided support that the students also served as models in the development of mathematical argumentation as they worked together through the lessons with peer modeling and adult modeling.

Collegial modeling was evident throughout the lesson study process. From planning, teaching, and debriefing and reflecting, the teachers were continuously modeling for one another. OE beliefs were even modeled from one teacher to another as discussions took place to ascertain how teachers believed their students would respond to the learning tasks. Modeling of strategies by one teacher was used by another teacher, when he/she noticed student learning was impacted. Since the teachers believed the strategy used had a positive influence on student learning, the modeling provided a source of increased OE for their own students and prompted the willingness to use strategies modeled that were effective.

Impact on Outcome Expectancy through Physiological Responses

Journal entries that indicated the impact of physiological responses on outcome expectancy were most frequently accounts of teachers' excitement and sense of reward and accomplishment when students were able to understand the mathematics concept. The teachers described feeling excited when describing their students' demonstrated understanding with a mathematics concept. Though PPQ#4: "What helps you to persevere in helping a child understand a math concept?" was not an outcomes expectancy question per se, the participant responses clearly indicated their outcome expectancy beliefs in their responses, particularly in relation to physiological response. Teacher #33 described their team's perseverance with teaching, "We have worked and worked to get them [students] to understand distributive property and how to use it to help them solve more difficult multiplication problems and they just haven't gotten it!" Then she later discussed how the students did learn what was intended, "Yes! Finally, I felt like they had a good grasp on what the distributive property is and how it can help them solve more difficult problems." She went on to say in PPQ#4, "I love the look on my students' faces when they go from being lost in a math concept totally understanding it!" This teacher shares her sense of excitement of her students' breakthrough in understanding. Teacher #1 shared a similar belief, "Nothing is more rewarding in teaching than seeing and knowing a child understands something new." Teacher #11 specifically references a student's understanding with the physiological response of excitement with her statement, “When a child finally understands a concept, it is exciting.” This physiological response to student achievement was further described as a feeling of success as Teacher #41 “…when I see a student who has been struggling to not only grasp it, but coach other students and apply the strategies and methods in other context. The student and I feel a sense of accomplishment.” Teacher #22 shared how physiological response through outcome expectancy prompts her teaching motivation, “Once you have seen the outcome of understanding a concept, it excites you to help other children towards the instructional goals.” These these examples, provide evidence that the teacher participants’ outcome expectancy beliefs were related to enthusiasm and excitement when their students learned concepts that met teacher expectations. Further, this physiological response is directly connected to future instruction.

Indirect Contributions

Although teaching practices was not an area specifically addressed in this research, there were many comments and references to teaching practices as a natural link in the lesson study professional development process. The researcher felt the impact was significant enough to include this additional contribution.

When the teacher participants were asked to share what three things throughout the lesson study most likely impacted their belief in their ability to teach math and CCSS (self-efficacy), 10 teachers responded to the question. Of the total 30 responses possible, given 3 factors per each of the 10 teachers, 20% of the responses and more specifically 6 references were made to teaching practices. When the researcher analyzed the frequency count categorically by naturally occurring topics, as shared by the teacher participants, it was discovered that technology was mentioned 2 times, videotaping oneself and reviewing the instruction was mentioned once, the use of mathematical argumentation was mentioned once, using multiple methods for problem solving and discussion with students was mentioned once, and use of differentiated instruction was also mentioned once. Though these teaching practices were mentioned only one to two times each, the fact that these, mostly new teaching strategies included in this research, were identified as a source positively impacting self-efficacy is an important factor to consider when providing lesson study professional development to teachers in an effort to increase self-efficacy in the future. In addition, teaching strategies were mentioned throughout the lesson study in the planning, debriefing, and reflection sessions, as well as in the journaling responses. Additional teaching strategies mentioned throughout the study included: new vocabulary, base-ten, arrays, bar modeling, Kagan structures, and mathematical argumentation frames. Utilizing these teaching strategies then become a mastery experience. Mastery experiences are closely related to self-efficacy and therefore these mastery experiences with teaching techniques contribute to self-efficacy. Learning new or improved teaching techniques is a way to enhance teaching, thus leading to additional mastery experiences that bolster self-efficacy and outcome expectancy in teachers. As teachers are learning new ways to teach, it promotes excitement within them with positive physiological responses, especially when learning these new strategies through collaboration with peers as in a lesson study environment. In addition, when these new strategies result in mastery experiences that results in improved student learning, as evident in this research, outcome expectancy is improved in addition to self-efficacy.

Summary

Both the qualitative and quantitative data gathered in this research indicated the lesson study professional development had a positive impact on both self-efficacy and outcome expectancy of the teacher participants. Though the teacher participants indicated they possessed a satisfactory level of self-efficacy and outcome expectancy at the onset of the study, a measurable gain was evident. The participant responses on the MTEEBI reflected a positive change in their perception of self-efficacy and outcome expectancy after the lesson study professional development. Comparison of the pre and post MTEEBI surveys, through statistical analysis using a Paired-Samples t-test, indicated a significant positive change in both self-efficacy and outcome expectancy. In addition, the researcher chose to run a non-parametric analysis with the Wilcoxon Signed Rank Test, given the nature of the small sample N=13 and the likert scale items of the MTEEBI. Both the pre/post self-efficacy and outcome expectancy differences resulted in a statistically significant difference with the increases in both constructs. As a result, both Null Hypotheses were rejected.

In addition, the qualitative data that was gathered through observations and reflective journal prompts, revealed overall positive and supportive comments about the experience, despite some initial reluctance about being observed by others. The observations and journal responses provided evidence of improved self-efficacy and outcome expectancy through the lesson study process. The thick, rich observational descriptions indicate that mastery experiences played a vital role in the teachers' increased self-efficacy and outcome expectancy, followed by modeling. Coding of the journal responses was guided by Bandura's four sources of efficacy. Consequently, the observations by the researcher and reflective journal responses from the participants indicated the lesson study professional development collegial interactions and collaboration were especially instrumental in providing modeling, peer mastery teaching experiences, and positive verbal/social persuasion which ultimately contributed to positive physiological responses. These four sources were evident in self-efficacy analysis in the journal responses. However, only three of the four sources were evident in the outcome expectancy analysis, with verbal/social persuasion not present in the journal responses.

Chapter 5 – Conclusions

Introduction

"The need for more challenging mathematics content for students means that their teachers will also have to learn more challenging mathematics content and how to teach it" (Loucks-Horsley, 1998, p. 3). This need for more rigorous mathematics content for students has been a continual reform effort during the last century, evident through initiatives such as the Chicago Movement, New Math, and Standards-Based Mathematics Reform (Bay, 1999). To bring about this shift in instruction, the Common Core State Standards (CCSS) for Mathematics were adopted by the Kansas State Board of Education on October 12, 2010 (CCSSI, 2010). The adoption of the CCSS also have resulted in new assessment measures that include a degree of higher complexity to meet the challenge of performance based and technology integrated assessment items across the nation.

In order to improve mathematics there must be, "a substantial investment in professional development" (Larson, 2011, p. 41). A key component to change, such as the CCSS initiative, is what teachers do in their classroom and what they believe (Fullan, 2010). To bring about this shift in instruction and fulfill the need for more rigorous mathematics content for students, teachers must believe they are capable of teaching the CCSS and they must also believe their students are capable of learning these standards. These beliefs, teacher self-efficacy and outcome expectancy, are the essential constructs of this research. These constructs were viewed in light of the implementation of the professional development practice of Japanese Lesson Study (Stepanek et al., 2007).

The central purpose of this study was to ascertain the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, this study focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy viewed through an indepth examination of the entire process, grounded in actual teaching practice through observations by the researcher to effectively capture and study teacher efficacy in a natural setting revealing teacher beliefs and practices in action, rather than relying solely upon teacher self-reporting.

This research was conducted in a public K-6 elementary school. This elementary school is an award winning Professional Development School (PDS) in partnership with Kansas State University and was one of the first schools in the district to be recognized as a PDS partner with the university in 1989. The school had a total enrollment of approximately 258 students during the research project in grades K-6. The participants initially included fourteen kindergarten through sixth grade teachers from this elementary school in northeastern Kansas, who were actively involved in the semester long lesson study professional development process. However, as the research progressed, one teacher was not able to fully participate in all parts of the lesson study process, therefore the final number of participants was reduced to thirteen teachers. Two teachers from each grade level K-5 and one 6th grade teacher participated in the study.

Summary of the Study Design

This intrinsic mixed methods case study research explored the impact of lesson study professional development on the constructs of self-efficacy and outcome expectancy through a mixed methods approach, utilizing both qualitative and quantitative data to more fully understand the impact of the lesson study. This professional development was provided through support of a University Small Research Grant (USRG) from Kansas State University, *Modeling and Characterizing Elementary School Students' Mathematical Arguments,* which was written by Dr. Chepina Rumsey.

The theoretical framework for the research was grounded in Albert Bandura's Social Cognitive Theory (1977). This theory explains how interactions of a person and varying social influences can shape human behaviors in the way of beliefs, motivation, goals, accomplishments, and personal well-being (Bandura, 1986). Bandura's Social Cognitive Theory defined the two constructs included in this research: self-efficacy and outcome expectancy. Further, Bandura identified four contributing sources that influence one's self-efficacy beliefs and these were used as priori codes in the qualitative data analysis. These sources are: 1. Mastery Experiences – a person's previous experiences of success or failure with a task; 2. Modeling – vicarious experience when a skill or task is successfully performed by a person believed to be competent and comparable to the individual observer; 3. Verbal/Social Persuasion – positive encouragement from others, especially a knowledgeable source; and 4. Physiological Responses – individual responses and emotional reactions to tasks, including: mood, emotional state, physical reaction, and stress level and how the individual perceives these reactions.

The impact of lesson study professional development on self-efficacy and outcome expectancy was examined through the following overarching research question:

1. In what ways does lesson study professional development impact teachers' self-efficacy and outcome expectancy?

This overarching question was explored through two more specific subquestions.

A. In what ways does the lesson study process impact teachers' personal mathematical self-efficacy?

B. In what ways does the lesson study process impact teachers' mathematical outcome expectancy?

This case study employed both qualitative and quantitative data collection methods to more fully examine the impact of the professional development on teacher self-efficacy and outcome expectancy. The quantitative data collection included the completion of the MTEEBI (Mathematics Teaching Efficacy and Expectancy Beliefs Instrument) before and after the professional development for pre and post comparative measures. The qualitative data collection included observations, participant reflective journal responses to gather the perspective of the participants and videotaped documentation of all parts of the lesson study professional development. Both the journals and the videotaping were completed before, during, and after the professional development. The qualitative data supports the quantitative through triangulation of multiple sources of data. The study began with a total of fourteen K-6 elementary teachers. Of these teachers, thirteen teachers completed the lesson study cycle and were included in this study.

The researcher examined all of the data holistically as well as individually (Yin, 2003). This examination included the videotaped documentation of the entire lesson study cycle with planning sessions, teaching episodes, debriefing/reflection meetings; pre and post MTEEBI survey results; and journal entries. According to Patton (2002), part of qualitative data analysis can be completed through the organization of the data. The researcher's field notes and observational notes were organized by the main events of the lesson study process including planning session, first teaching episode, debriefing session, reteach episode, and final reflection meeting. This data was then used to summarize the lesson study professional development experience with thick, rich description. Teacher participant quotes were extracted verbatim and provided additional credibility to the description. The researcher examined data for repetition and correspondence between the multiple data sources collected and identified patterns and categories that began to emerge. A coding system was used to track similar responses, which were then coded and later became themes. Data was coded by self-efficacy and outcome expectancy items and responses. Analysis of the qualitative data was further guided by Albert Bandura's Social Cognitive Theory (1986) and deductive coding was implemented as all codes were applied based upon this theoretical framework. The priori codes of Bandura's four sources of self-efficacy were implemented, including mastery experiences, modeling, verbal/social persuasion and physiological response.

Analysis of the MTEEBI quantitative results was established through a Paired-Samples t-test as this is the recommendation in the field by the test developer. However, since the sample size was small, N=13, and the likert scale scores did not represent true interval data, the researcher also analyzed the MTEEBI data using the Wilcoxon Signed Rank Test for confirmation analysis to ensure significance using a non-parametric test. Both the Paired-Samples t-test and the Wilcoxon Signed Rank showed a positive significant difference from the pre MTEEBI to the post MTEEBI for the constructs of self-efficacy and outcome expectancy. The qualitative and quantitative data analysis results were highlighted in chapter four with great detail.

This final chapter will present a summary of the findings of this study. The results and conclusions related to the two sub-questions, organized by the sources of data including the MTEEBI, observations, and reflective journal responses will be shared. Next, the overarching question will be presented and discussed in light of the triangulated data. The implications drawn from the findings of this study will be discussed. Finally, recommendations for future research relevant to practitioners and policy makers will be presented followed by the closing summary.

Summary of Findings

Overall, the qualitative and quantitative data utilized in this research revealed the lesson study professional development did have positive impact on both self-efficacy and outcome expectancy of the teacher participants. Through a Paired-Samples t-test that compared pre and post MTEEBI self-efficacy and outcome expectancy scores, the mean difference revealed for self-efficacy was M = .28205. The Paired-Samples t-test mean difference for outcome expectancy was M = .18590. The *t* statistic of t =.013 for self- efficacy and the *t* statistic of t = .017 for outcome expectancy both indicated there was a positive statistically significant difference in teachers' self-efficacy and outcome expectancy when comparing pre and post MTEEBI scores. Both self-efficacy and outcome expectancy pre and post MTEEBI differences were significant at the .05 level of probability. A Cohen's d effect size value of (d=.81) is indicative of high practical significance for self-efficacy and (d=.77) a moderate practical significance for outcome expectancy. A non-parametric analysis, the Wilcoxon Signed Rank Test, was also included given the small sample size in this research, N=13, and the non-interval data given the likert scale response items of the MTEEBI. The pre and post self-efficacy and outcome expectancy comparison revealed once again both scores were statistically significant at the .05 level.

Observations revealed the teacher participants' attitudes were positive throughout the lesson study professional development. The participants were at ease and comfortable throughout the lessons study process. The only indication of discomfort was evident when teachers discussed the uneasiness of being observed by colleagues and other observers. However, when discussing the benefits of lesson study, teachers reported observing peers' modeling mastery experiences as a powerful learning experience. Observation of participant planning, teaching episodes, debriefing and reflection discussions provided confirmation that Bandura's four sources of efficacy were evident throughout the lesson study process, which contributed to the growth in self-efficacy and outcome expectancy.

Data gathered from the participant reflective journals suggested the vast majority of the teachers' self-efficacy and outcome expectancy beliefs were positively impacted by the lesson study process. As seen in Table 4.14, the journal entries supported the MTEEBI results indicating growth in self-efficacy and outcome expectancy. Of the total 125 responses given for the 8 self-efficacy items and 3 outcome expectancy items, 100 responses, or 80% of the responses, were positive showing agreement with supportive, positive responses to the question stem. Of the responses, 23 or 18%, were mixed where respondents gave a positive comment and shared a concern as well or vice versa. Only 2 responses, or about 2%, were negative responses in disagreement with the question stem. Self-efficacy was positively impacted through all of the four sources of efficacy outlined by Bandura, as these sources were discussed in the journal responses from the participants. The journals responses also indicated that teachers' outcome expectancy was impacted by Bandura's sources of efficacy. However, only three sources were evident and coded. Teacher participants discussed impact on outcome expectancy through mastery experiences, modeling, and physiological responses. The participants did not talk about outcome expectancy in terms of verbal/social persuasion.

Discussion

Results related to research Question A: In what ways does the lesson lesson study process impact teachers' personal mathematical self-efficacy?

The focus of research Question A was to determine the impact of lesson study professional development on teacher personal mathematical self-efficacy. All the data sources, including qualitative and quantitative measures, in this study provide evidence to support the lesson study professional development did increase the vast majority of the participants' personal mathematical self-efficacy. The MTEEBI quantitative data will be reviewed first, following by the qualitative data with journal data discussed first then the observational data.

A Paired-Samples t-test of the MTEEBI data indicated a significant difference in the comparison of teachers' self-efficacy reported before the professional development and after the professional development. Given the self-efficacy pre mean of 3.8278 and the self-efficacy post mean of 4.1099, a mean difference of .28205 with a significance of .013, below $p = .05$, indicated the difference in the pre and post self-efficacy scores is more likely related to the lesson study professional development rather than random chance. Therefore, the Null Hypothesis 1: "There will not be a difference in the MTEEBI pre and post self-efficacy mean scores before and after the lesson study professional development" was rejected. In addition, 9 of the 13 participants increased in their self-efficacy pre/post MTEEBI by a range of 2-23 points. Of the 13 teachers, 1 did not show a change in pre/post self-efficacy MTEEBI measures. There were 3 participants that had a decrease in their self-efficacy pre/post MTEEBI comparison by a range of 1-4 points. In addition to the Paired-Samples t-test, a non-parametric statistic was also run, to determine confirmation of the findings of the t-test, given the small sample size, N=13, and the non-interval data of the likert scale MTEEBI items. The Wilcoxon Signed Rank Test results revealed pre and post MTEEBI self-efficacy comparison was significant at the p=.013 level, with the significance level set at .05. The Wilcoxon Signed Rank Test provided additional confirmation and support for rejecting the Null Hypothesis.

MTEEBI Item #6: “When a student commits an error in math, I am able to diagnose his/her conceptual errors,” is a particularly important item because it represents the greatest overall gain of the self-efficacy items and it is the second highest gain of the MTEEBI items as a whole. This data can be reviewed in Table 4.11. The pre mean score of 3.54 with a position of ‘uncertain’ shifted to a post mean of 4.08 for a mean difference of .5385 and a shift in position from ‘uncertain’ to ‘agree,’ demonstrating specific growth in participants’ mathematical self-efficacy.

Teacher participant journal responses provide evidence the teachers perceived their self-efficacy was enhanced through the lesson study professional development. Of the total 93 possible responses on the SE items, 72 were positive responses or about 77% of the responses were indicative of a positive agreement with the questions. Only 2 of the responses, or about 2%, were negative or disagreement responses, while 19 of the responses, or about 20%, were mixed responses. Of the mixed responses, often the teacher shared a positive comment and then paired it with a concern or vice versa. The data also indicated participant self-efficacy was positively impacted through Bandura’s four sources of self-efficacy: mastery experiences, modeling, verbal/social persuasion, and physiological response and examples of all were coded from the journaling responses. As noted throughout this study, Bandura’s four sources for strengthening self-efficacy were often seen in conjunction with each other, typically not in isolation. Demir and Ellett (2014) reflected upon this phenomenon, “The four sources of self-efficacy are not independent entities and they may be evident in different combinations depending on the task in hand” (p. 180). When answering Lesson Study Phase Question #2, “Do you believe you can help your student think critically?” 100% of the participants that answered this question responded they believe indeed they can. There are many questions in the journal prompts related to self-efficacy fully discussed in Chapter 4. However, for the sake of brevity here in Chapter 5, a tightly focused lens was put on the impact of lesson study professional development on self-efficacy. The question that most directly provides evidence is Reflection Phase Question #3: "Do you believe the lesson study impacted your belief in your ability to teach math?" Seven of the 10 teachers or 70% that answered the question, responded that the lesson study did positively impact their belief in their ability to teach mathematics. This perhaps is the most powerful, single indicator of the participants' increased mathematical self-efficacy yielded from the journal responses, given the direct line of questioning. Two of the 10 respondents gave a mixed response, indicating both a positive comment and a negative comment together. Only 1 of the 10 respondents felt the lesson study professional development did not impact his/her belief in ability to teach mathematics.

In addition, the observations of all parts of the lesson study professional development process also supported an increase in mathematical self-efficacy. The sessions were rich with conversations, which included deep discussions and questions of the mathematical content taught in the lessons. Participants demonstrated confidence as they freely shared ideas and provided input about the lesson content, including ways in which the lesson could be improved based upon student understanding. Excitement was observed throughout the process and verbal praise was evident as well. Participants expressed the benefits of collaboration resulting in a stronger overall lesson, increasing their belief in their ability to teach. Throughout the lesson study process, Bandura's four sources of self-efficacy were represented by most of the participants. Through mastery experiences, modeling, verbal/social persuasion and physiological responses, the self-efficacy of teacher participants was enhanced. During the course of the lesson study process, teacher participants had the opportunity to explore the CCSS, modify existing curriculum to enhance student learning, and dive more deeply into understanding mathematics content knowledge. Participants were given the opportunity for collegial observations to witness the instructional practices being taught. Along with the benefit of this mastery experience of modeling, it also created an element of stress anticipating colleagues would then be observing their classroom instruction. Participants reported that though some stress was present, it was well worth the effort and in fact, some teachers voiced a desire to be able to conduct lesson study for all lessons. However, the benefit of the collaboration to produce quality, constructivist lessons that provided adequate challenge within a positive supporting environment provided, including experiences with all four sources of self-efficacy, provided a support to overcome the viewed stress and resulted in an increase in self-efficacy. Overall, the data collected from the observations indicated a positive, supportive environment that included opportunities for team planning, collaboration, and collegial observations along with positive mastery experiences led to improved self-efficacy.

Results related to research Question B: In what ways does the lesson study process impact teachers' mathematical outcome expectancy?

The focus of research Question B was to gain an insight into the impact of lesson study professional development on teachers' mathematical outcome expectancy. This belief, according to Bandura (1997), is defined as, "…outcome expectation is a judgment of the likely consequences such performances will produce" (p. 21). When related to the field of education, this is translated into the belief that given a teacher teaches a concept effectively, the students will learn. The students' learning becomes the outcome expectancy of the effective teaching. The research has revealed the challenges present with impacting change in outcome expectancy beliefs. Shroyer, Riggs and Enochs (2014) discussed this point, "As a point of comparison, outcome expectancy beliefs (STOE) of pre-service teachers were more difficult to interpret and not as easily changed" (p. 108). The research of Cantrell, Young and Moore, 2003; Liang and Richardson, 2009; Schoon and Boone, 1998; and Tosun, 2000, also reported no changes in outcome beliefs (STOE) while finding considerable changes in self-efficacy beliefs (PSTE). Given this historical perspective in the research, the data sources employed in this study, including qualitative and quantitative measures, provide evidence to support the lesson study professional development did increase the vast majority of the participants' mathematical outcome expectancy. The difficulty in impacting outcome expectancy beliefs makes this finding even more exciting.

The Paired-Samples t-test of the MTEEBI pre and post data indicated a statistically significant difference between the comparison of teachers' outcome expectancy reported prior to the professional development and following the professional development. The outcome expectancy pre mean of 3.9423 and the outcome expectancy post mean of 4.1282, yielded a mean difference of .18590 with a significance of .017, below the probability level of .05. This result indicated the difference in the pre and post outcome expectancy scores is more likely related to the lesson study professional development rather than mere random chance. Therefore, the Null Hypothesis 2: "There will not be a difference in the MTEEBI pre and post outcome expectancy mean scores after the lesson study professional development" was rejected. The overall change in outcome expectancy, given the difficulty of impacting these beliefs, is impressive. Of the 13 participants, 9 of the 13 teachers increased in their pre/post MTEEBI outcome expectancy comparison by a range of 1-8 points. Of the remaining teachers, 1 teacher showed no change in outcome expectancy and 3 teachers showed a decrease in pre/post MTEEBI measures. Of the 3 participants that had a decrease in their pre/post MTEEBI comparison, two showed a decrease of just 1 point each and the third teacher declined by 2 points.

Outcome expectancy MTEEBI Item #58, "Even with appropriate instruction, most students rarely consider whether their math work makes sense," was the item that had the greatest pre/post gain of all the MTEEBI items. The pre mean score of 2.77 with a position of 'agree' shifted to a post mean of 3.69 for a mean difference of .9231 and a shift in position to 'uncertain,' moving more towards disagreement with the statement, demonstrating specific growth in participants' mathematical outcome expectancy. This evidence of outcome expectancy growth is particularly important because the lessons study lessons incorporated an overriding focus on mathematical argumentation through implementing Standards for Mathematical Practice #3 (SMP3): Construct viable arguments and critique the reasoning of others. Throughout the lessons, teachers encouraged their students to justify their answers, which required them to consider the reasonableness of their work, which has a direct relationship to this item. Therefore, the fact that this item yielded the highest outcome expectancy gain of all is especially significant in shedding light on the impact of the lesson study professional development on teacher participant outcome expectancy beliefs.

The observations of the lesson study professional development process also supported an increase in mathematical outcome expectancy. Teacher participants having the opportunity to observe their students engage in challenging problem solving and understanding it, served as a source that further enhanced their outcome expectancy beliefs. The open-ended prompts given to students allowed the teachers to observe their students come up with their own unique method of problem solving and then requiring the students to justify their response further bolstered outcome expectancy beliefs.

Teacher participant journal responses provided evidence the teachers perceived their outcome expectancy was enhanced through the lesson study professional development. The journal data analysis indicated participants' reported positive responses 28 times of the possible 32 responses, for a total of 88% percent positive responses to the 3 outcome expectancy items. There were no negative or disagreeable responses to the outcome expectancy items. However, 4 of the responses were "mixed" responses where teacher participants shared a positive comment paired with a concern or vice versa. For example, when answering Planning Phase Question #6, 80% of the teacher responses indicated their positive belief in their students' ability to understand and master the knowledge and skills represented in the math CCSS. When asked if students learned what the team intended during the lesson study lesson, Lesson Study Phase Question #3, 92% of the teachers reported they believed the students learned what was intended in their lesson. Finally, 90% of the teachers believed their instruction led to students performing the skills of mathematical argumentation effectively as shared in responses to Reflection Phase Question #4. As noted, the majority of the data gathered in the journal prompts pertaining to outcome expectancy beliefs provided positive feedback, although the data analysis revealed only three of Bandura's sources of efficacy were present in the outcome expectancy responses. Impact on outcome expectancy through mastery experiences, modeling, and physiological responses was evident and coded in the journal responses. However, data could not be coded related to the impact of verbal/social persuasion on outcome expectancy. One explanation for the journals not including any evidence regarding the impact of verbal/social persuasion on outcome expectancy may be the type of questioning, as created by the researcher, in the journal prompts did not elicit this line of thinking within the teachers when they formulated their responses. Another explanation could be that teachers do not tend to give verbal/social persuasion feedback in relationship to outcome expectancy as they did so freely with self-efficacy. The journal responses indicated overall the teachers did believe in their students' ability to understand and master the mathematical knowledge and skills represented in the math CCSS. This outcome expectancy belief response highlighted the teachers' belief in the importance of providing their students with quality instruction. The teachers shared that their students will understand and master math CCSS when they are provided with enough time, opportunity to practice the new skills, and well-planned lessons.

Results related to the overarching research Question: In what ways does the lesson study professional development impact teachers' self-efficacy and outcome expectancy?

The review of the data in light of the impact of lesson study professional development on teacher's self-efficacy and outcome expectancy, discussed above, indicates that lessons study professional development had an overall positive impact on both constructs. All sources of data were triangulated and both the quantitative and qualitative measures provide support that the lesson study professional development did positively impact self-efficacy and outcome expectancy beliefs of the teacher participants.

Conclusions

Conclusion 1: Quantitative and qualitative data sources indicated both self-efficacy and outcome expectancy were positively impacted by the lesson study professional development. The MTEEBI, observations and journal responses all show indication that the majority of the teachers' self-efficacy and outcome expectancy beliefs were positively influenced. Though the MTEEBI showed growth for both constructs, the pre and post comparison of the self-efficacy yielded a greater growth mean difference of .28205 than the outcome expectancy growth mean difference of .18590. This finding is supported in the research as other studies have indicated that outcome expectancy beliefs tend to be more difficult to change than self-efficacy beliefs (Cantrell, Young & Moore, 2003; Liang & Richardson, 2009; Schoon & Boone, 1998; and Tosun, 2000).

Conclusion 2: Qualitative data indicated mastery experiences are most critical to both self-efficacy and outcome expectancy. The analysis of data indicated that the teacher participants felt the mastery experiences, including mastery lessons planned and taught, were experiences that enhanced their self-efficacy and outcome expectancy. The observation of their colleagues successfully teaching the lesson they jointly planned was a source of encouragement for them as they had insight as to how they were going to teach the lesson themselves, putting them as ease. Also, observing their students learning during the lesson and being successful with their problem solving served as a source to enhance teacher outcome expectancy beliefs in their students. The teachers' continual mention of the mastery experiences as key in their self-efficacy and outcome expectancy is supported by Bandura (1994) as he postulated mastery experiences are the most influential because it is the most authentic experience which one can demonstrate success with a given task. In addition to the mastery experience, Bandura (1997) suggested the mastery experience is followed by some reflection of the experience which could include success or failure with the task, the perceived task difficulty and effort spent on the task. The mastery experiences in this research were paired with debriefing and reflection discussions which focused on strengths of the lesson including evidence of learning, any perceived areas that needed to be modified, etc. These discussion questions can be viewed in the Follow-Up Discussion Protocol in Appendix H.

Conclusion 3: Qualitative data indicated modeling experiences play a key role in self-efficacy and outcome expectancy beliefs and may provide additional opportunities for mastery experiences. Modeling was an important component of the lesson study professional development experience. When the teacher participants were asked to share what three things throughout the lesson study most likely impacted their belief in their ability to teach math and CCSS (self-efficacy) in response to Reflection Phase Question #5, 10 teachers responded to the question. Of the total 30 responses possible, given 3 factors per each of the 10 teachers, nearly half of the responses and more specifically 14 references were made to mastery and modeling experiences. When the researcher analyzed the frequency count categorically by naturally occurring topics, as shared by the teacher participants, the three mastery and modeling experiences that emerged were collaboration, team planning, and colleague observation. Of these three experiences, team planning was mentioned 6 times, the most of any of these three experiences. Both colleague observation and collaboration were represented equally, with each experience being referenced 4 times. As is noticed, there is difficulty in sorting out mastery experiences and modeling as they are so intertwined. Modeling of team planning, for instance, often resulted in the modeling of a mastery experience given the teachers' knowledge and expertise for designing a quality lesson. For this reason, modeling support mastery experiences by providing additional experiences.

Conclusion 4: Qualitative data indicated verbal/social persuasion plays a key role with self-efficacy beliefs, but little evidence supports it is key for outcome expectancy beliefs. Throughout the lesson study process verbal/social persuasion was clearly shared and evident when teachers discussed their self-efficacy beliefs. However, the teacher participants did not discuss verbal/social persuasion when discussing outcome expectancy beliefs. Perhaps the line of questioning designed by the researcher did not promote or elicit this line of discussion. Or perhaps teachers do not discuss outcome expectancy in relation to verbal/social persuasion. It is possible, given the high stakes accountability of education today, teachers are more reliant upon data or their own observations of their students' learning performance to foster belief in their students' abilities.

Conclusion 5: Teachers vary in their degree of self-efficacy and outcome expectancy. The researcher investigated career clusters as a possible understanding of any pattern that may emerge in looking at degree of self-efficacy and outcome expectancy in terms of the number of years the participants had been in the teaching profession. However, career clusters in this study provided no clear pattern to further explain this variance.

Emergent Themes

As the researcher analyzed the data, repeated themes emerged across the lessons studies. These themes were determined as they emerged through repetition and correspondence between the multiple data sources collected. These overlapping coded items were then combined into the common themes. The themes that emerged are:

1. **Qualitative data indicated there is a natural alignment between lesson study and Bandura's four sources of self-efficacy thus promoting self-efficacy and outcome expectancy.** This research revealed lesson study professional development is a natural catalyst for Bandura's four sources of self-efficacy. Throughout the lesson study process Bandura's four sources of self-efficacy: mastery experiences, modeling, verbal/social persuasion, and physiological response, were continually present and observable as evidenced through direct observation and as evidenced in the teachers' journal responses. These four sources of efficacy

were referenced by participants as sources that bolstered their self-efficacy. This finding is especially important for those in the field conducting professional development with the hope of increasing teacher self-efficacy.

The very essence of the design of the lesson study experience is one that allows each of the four sources of self-efficacy to authentically emerge when moving through the lesson study process. For example, the collaboration of teachers in planning a lesson collectively generated the opportunity for modeling, verbal/social persuasion and physiological response through the discussion of content and pedagogical ideas that are shared. The collegial observation component of the lesson study process provided for ample modeling of mastery experiences. The teaching (modeling/mastery experience) and observation (modeling/mastery experience) of the successful lesson created by the team resulted in a sense of pride and feelings of success (physiological response) within the participants, which in turn improved self-efficacy. In this study, the debriefing meetings were rich with positive verbal/social persuasion and physiological response as teachers reflected on the learning of the students. In addition, excitement (physiological response) was evident as the participants brainstormed ideas to modify the lessons to create for an even stronger lesson (mastery experience) during debriefing meetings. This specific conversation focused on the lesson allowed for the teachers to grow in their repertoire of content and pedagogical knowledge (mastery experience) which also served as a source to enhance self-efficacy.

Leaders responsible for in-service teacher learning should take note of the benefits of further promoting collegial interactions through professional development that provide experiences with Bandura's four sources of efficacy, such as lesson study, in an effort to continue to build teacher self-efficacy and outcome expectancy. Lumpe, Vaugh, Henrikson & Bishop (2014) discussed the importance of addressing these sources of efficacy, "Each of these sources may purposefully be targeted in order to develop positive and robust beliefs leading to more effective teacher functioning in the classroom" (p. 60). Utilizing lesson study professional development provides a catalyst to promote self-efficacy by engaging these sources of efficacy in an authentic collaborative professional development experience.

2. Quality lessons and instructional practices created mastery experiences that impacted self-efficacy and outcome expectancy. Higher level questioning was evident, requiring students to justify their answers throughout their learning in the lesson study lessons. Differentiated instruction was embedded to appropriately support/challenge students to meet individual needs of the learners. Cooperative learning opportunities were built in, using Kagan Cooperative Learning structures, allowing students to work together and discuss their problem solving strategies as a team. Technology integration, including virtual manipulatives, was evident as a tool to support student learning. These high quality lessons created with high quality teaching strategies provided a strong foundation for the modeling of (mastery) teaching experiences. It was these powerful mastery experiences and modeling that provided strong support for increases in teacher self-efficacy.

2a. High engagement was evident with all learners throughout the lesson study process thus promoting self-efficacy. The learning that was observed and discussed through the lesson study professional development provided active engagement opportunities for both teachers and their students. Engagement is the heart of effective instruction (Danielson, 2007). Desimone (2009) described active learning in professional development as including, "observing expert teachers or being observed, followed by interactive feedback and discussion; reviewing student work in the topic areas being covered; and leading discussions" (p. 184). Teachers were engaged in these active learning opportunities throughout the entire process. In addition, students were engaged with hands-on investigations that stemmed from real world examples that presented math problems embedded in situational context vs. isolated calculation without context. The active engagement of the teachers helped to promote self-efficacy through mastery experiences, modeling and verbal/social persuasion, building upon the physiological response of the teachers. In addition, the students' active engagement and enjoyment of the lessons was a source that further promoted teacher self-efficacy. Teacher observation of their students "getting it" served as a source to promote teacher outcome expectancy.

2b. Multiple pathways to solve problems were encouraged, supporting both self-efficacy and outcome expectancy. As the teachers were planning lessons, open-ended situations were presented that encouraged the participants to consider multiple solutions. For instance, the question of how to meet all student needs or how to teach a specific concept allowed teachers to brainstorm multiple options and agree upon the method they felt was most effective. This process allowed teachers to model their own problem solving with peers and praise each other's efforts, which promoted a positive experience to enhance self-efficacy. The lessons that were planned also presented students with open-ended math problems in which they were encouraged to find multiple ways of solving. This approach allowed teachers to see the complexity of their students' reasoning, further supporting teacher outcome expectancy.

2c. Enthusiasm was evident throughout the process with participants impacting self-efficacy. Excitement from teachers during the planning, teaching, debriefing/reflection phases was observed as the majority of the teachers were pleased with the outcome of their lessons and the learning and understanding their students demonstrated. Students were also enthusiastic as they were presented with lessons that were highly effective and engaging. Enthusiasm from both teachers and students was shown through laughs, active engagement, positive comments and participation, and non-verbal cues such as smiles, high-fives or fist bumping, which contributed to the overall positive environment and increase in self-efficacy of the participants.

3. Lesson study professional development provides an opportunity for continuous collaboration that promotes self-efficacy. The lesson studies as conducted in this research were highly effective, which was in part related to the intensive amount of time that was invested in the collaborative process. It was this collaboration of teacher participants that made this professional development experience effective in improving self-efficacy. The collaboration provided a natural opportunity to experience Bandura's four sources of self-efficacy.

4. Although stress was expressed by some teacher participants with regard to having their instruction observed by others, this stress did not negatively impact self-efficacy. Throughout the lesson study professional development, a concern with having others observe his/her teaching was voiced by some of the teacher participants. However, the opportunity of observing mastery teaching experiences as modeled by colleagues was often referred to as one of the most powerful experiences of the lesson study professional development. Though stress was induced through this process and the participants reported they felt some stress, they also reported it as a source that ultimately contributed to their self-efficacy and in the end they felt the benefits outweighed the stress they reported.

5. **Bandura's sources of self-efficacy: mastery experiences, modeling, verbal/social persuasion, and physiological responses were observed in teacher-to-teacher, student-to-student, and teacher-to-student interactions.** Throughout the lesson study cycle, the researcher observed Bandura's sources of self-efficacy were not isolated to the teacher-to-teacher interactions. These sources of self-efficacy were present in interactions between the teachers and students and interactions between students and their peers. For example, students modeled methods of problem solving for each other, through peer coaching strategies they used verbal/social persuasion to encourage their classmates to continue or praised a strategy used, these exchanges helped create a positive physiological response.

Implications

1. Given the demands of rigorous educational reform efforts, lesson study professional development is a promising approach to positively impact teacher self-efficacy and outcome expectancy, through engaging Bandura's (1997) four sources of efficacy to develop and strengthen these beliefs. Therefore lesson study ought to be considered for implementation more often in teacher professional development and teacher education preparation programs. In light of the reform efforts across our country in an effort to prepare students for the demands of college and career readiness with the implementation of the Common Core State Standards, this study suggests that lesson study professional development is a viable way to promote teacher self-efficacy and outcome expectancy through an approach to professional development that relies heavily upon teacher collaboration to provide multiple on-going opportunities for engaging Bandura's four sources of self-efficacy: mastery experiences, modeling, verbal/social persuasion, and physiological response. This implication is supported by Demir and Ellett (2014), "….the sources of self-efficacy beliefs are key components for designing and implementing effective professional development programs for teachers" (p. 180). Quality professional development opportunities must be available to teachers to foster growth in content knowledge and pedagogical methods, through an experience that recognizes the importance of also impacting teacher beliefs. Larson (2011) proposed, "a substantial investment in professional development" is the most productive way in which to improve mathematics instruction (p. 41). Further, Ballone-Hartzell and Czerniak (2001) and Bray-Clark & Bates (2003) have encouraged a focus of professional development research to include teacher self-efficacy beliefs. In addition, they went further to propose that self-efficacy should be a consideration when creating professional development opportunities for teachers. This study demonstrated that lesson study professional development promotes self-efficacy. Studies have shown that improved teacher self-efficacy in turn is indicative of improved student achievement (Ashton & Webb, 1986; Ross, 1998). Bandura (2005) discussed how self-efficacy beliefs influence one's actions and environment. Change is the result of a collective effort and Bandura (1982) proposed that self-efficacy plays a vital role in how willing individuals are to work toward improvement efforts collectively as a team. A stronger self-efficacy empowers individuals to problem solve with greater effort and perseverance (Bandura, 1982). Educational leaders responsible for designing and implementing quality professional development opportunities for teachers should be encouraged to consider lesson study professional development as an avenue to increase teacher self-efficacy and outcome expectancy.

This study presents implications not only for in-service teacher professional development, but also for pre-service teacher education and preparation. University teacher preparation that affords its students with early experiences with lesson study professional development, which builds upon collaborative experiences, could promote this community of practice mindset to provide a foundation for quality professional development as the new teachers move into the profession. This implementation would have the potential to impact pre-service teacher self-efficacy and outcome expectancy beliefs. This exposure prior to entering the field of education could elicit a ripple effect of implementation.

2. Lesson study professional development may not always be effective. Key attributes of lesson study effectiveness in this study include: investment of time that is directly related to job-embedded teaching; financial support through a grant; support from a content knowledge expert; and willing participants eager to collaborate with colleagues. The researcher learned through this study that three of teacher participants had previous experiences with lesson study they reported were not positive experiences, therefore lesson study professional development may not always have the desired outcome. Some key components to implementing lesson study professional development successfully were evident in this study, which must be a consideration for those implementing this high-quality professional development practice in an effort to bolster self-efficacy and outcome expectancy. Ongoing support in investing time in job-embedded teaching through financial means of support and a content expert are key components helpful for successful implementation of lesson study. Some of the teacher participants commented on the considerable time investment the lesson study professional development required. However, they also shared that this investment of time was well spent and was worth the effort they put forth during this experience, given what they gained in the process. Lesson study professional development is especially relevant because it is a job-embedded learning experience time investment. Lindeman (1926) outlined this premise with teacher learners, "Subject matter is brought into the situation, is put to work, when needed…The situation-approach to education means that the learning process is at the outset given a setting of reality" (p. 15). Lumpe, Vaughn, Henrikson and Bishop (2014) further supported this idea, "Adult learning is a cultural event grounded in experiences and belief systems" (p. 50). Lesson study is important because it allows teachers to focus on the teaching done within their own classroom, without adding additional teacher learning time unrelated to daily instruction. The lesson study professional development is an investment of significant amounts of time as one cycle can take 2-4 weeks to plan and complete. Desimone (2009) argued that professional development must include learning over a given period of time versus a single workshop configuration.

Given this strong connection to classrooms, lesson study requires teachers to step away from their classroom to do collegial observations. While the teacher is away from his/her students to participate in collaborative planning, observe colleagues, or attend debriefing/reflection meetings, the classroom must be covered in some fashion in the teacher's absence. In this study, substitutes were hired to cover classrooms and/or colleagues stepped up to help cover when substitutes were unavailable. For this reason, some financial support must be available to a degree to fully implement lesson study professional development. With continued budgetary deficits at the state and district levels throughout the country, many schools find themselves alone in solving the dilemma of how to fund much needed quality professional development. This same predicament was overcome as this study was funded through a University Small Research Grant (USRG) from Kansas State University for the project, *Modeling and Characterizing Elementary School Students' Mathematical Arguments*, written by

Dr. Chepina Rumsey. Lack of funding is a barrier that must be overcome in an effort to provide professional development experiences that are connected to the daily work of teachers in their classrooms. This study indicated that lesson study professional development promotes positive changes in both self-efficacy and outcome expectancy. Consequently, another implication of this study is that leaders should seek avenues to fund such impactful professional learning experiences through new and innovative funding sources, including grant funded opportunities.

Access to a content expert was a crucial factor for the successful implementation of the lesson study professional development in this study. Seeking support from a content expert from a local university or from a panel of teacher colleagues would be beneficial to participants as they move through the lesson study process of planning and modifying lessons to create high quality learning for their students. In this study, the content expert was Dr. Rumsey, a mathematics education professor, from the local university. She was able to pose questions to support the discussions encouraging teachers to think more deeply about the content, provide additional resources and materials to consider for designing the instruction to create high quality lessons, and presented additional pedagogical options for teaching a single concept for the teacher participants to consider. The support of a content expert should be considered as a way to enhance the lesson study professional development experience.

In addition, this lesson study professional development was successful, in part, because of the willing teacher participants that were excited and eager to collaborate with their colleagues. The teachers from this school consider themselves not only colleagues and friends, they view their peers as an additional family. The high investment of time in collaboration with the lesson study model was more fully supported with these teacher participants that were willing to participate and went out of their way to make this a positive experience for themselves and those they collaborated with.

3. Lesson Study can produce stress in participants due to modeling of teaching for peers and outside observers. However, lesson study also has built in stress insulators that promote self-efficacy, therefore, the amount of stress present propels productivity while leaving a positive feeling of accomplishment. Being observed by others during teaching can produce a sense of anxiety for some teachers, as was evidenced in this research. Lesson study relies upon modeling for colleagues and observers to better understand the implications of the planned lesson and the impact on student learning. Though some teachers mentioned feeling stress from the teaching that was observed by others, participants also reported the modeled mastery experiences as meaningful learning opportunities for them to observe their peers. Four participants specifically stated that observing colleagues gave them increased confidence in their ability to teach math. The stress, to a degree, seemed to boost the teachers' efforts in creating quality lessons. The amount of stress that was present in the lesson study experience was not overwhelming to the point that it hindered self-efficacy or outcome expectancy growth. In fact, even given the stress that was mentioned the participants overall expressed positive feelings about their lessons and experience as a whole. Bandura's four sources of self-efficacy: mastery experiences, modeling, verbal/social persuasion and physiological responses act as stress insulators that balance stress and promote self-efficacy, despite the presence of stress. Khan, Shah, Khan and Gal (2012) refer to stress insulators as "teacher resources" that are either job or personal related (p. 24). Job related resources include, "autonomy, support, feedback, opportunities for professional development and occupational success" and self-efficacy is included as a personal resource (Khan et al., p. 24). Lesson study has stress insulators which can help reduce stress and promote self-efficacy when taking on new challenges such as implementing CCSS, new curriculum and novel instructional strategies. Teacher participants in this study made positive comments about their opportunities to collaborate through team planning, collegial observations, collegial feedback, group reflection/debriefing discussions. These positive experiences can be grouped within Bandura's sources of efficacy. Therefore, components of lesson study provide stress insulators, which can been seen as sources to bolster self-efficacy. If stress is not balanced and used productively with a positive outcome, teachers may feel torn down and feel bad as a result. Attention to the level of stress with stress insulators in place, such as the Khan, et al. (2012) resources mentioned previously, are needed to help produce positive results with self-efficacy and outcome expectancy beliefs.

This implication is important for professional development providers to understand in order to ensure the amount of pressure or stress being presented is counterbalanced by the support of stress insulators. Some pressure or stress is helpful to push educators beyond their comfort zone to prevent status quo being the norm. However, too much stress can cause teachers to give up. Stress insulators as described here can provide the support necessary to propel teachers to withstand stress to be exceedingly productive and successful despite the pressure that was introduced initially.

4. Given the limited research available of self-efficacy combined with lesson study professional development and Bandura's four sources of efficacy, this study contributes to a foundational research base with implications for researchers. The researcher discovered minimal studies that considered the impact on self-efficacy through lesson study. This research can serve as an impetus to continue this line of study to better understand the benefits of self-efficacy and outcome expectancy through lesson study. In addition, viewing the impact of lessons study on self-efficacy through Bandura's four sources of efficacy would provide further support for the natural occurring relationship that appears to be present.

Limitations

This study was completed in an elementary school that is unique in that it was established as a Professional Development School (PDS) with the local university in 1989. This partnership provides avenues for additional quality professional development conducted in collaboration with the university faculty, such as the one conducted in this study. The study's findings are limited to the school and sample group as the school and teachers are not a reflection of all schools and teachers in this Kansas or the U.S. The results can only be applied to the 13 teacher participants in this unique setting. However, a rich, thick description was provided about the school setting and context of the study, as well as the participants in the study, and methodology within Chapter 3. This rich description allows readers to determine transferability of findings of this study to their own setting by determining any shared characteristics with their own scenario and setting (Guba & Lincoln, 1989).

The small number of classroom teachers in the building also was a limitation in this study. Teacher participation in the study was presented as optional based upon volunteerism. Of the classroom teachers, 93%, or 13/14 teachers participated fully in the lesson study professional development. In addition, this flexibility in participation by volunteerism presented a limitation in the data collection and analysis phase of the study. Complete data was not collected from all participants. As a result, the data that was collected was analyzed, though 3 participants did not return any of the reflective journal responses, 2 teachers turned in journals with omitted responses to some questions, and 1 teacher did not return any portion of the journal responses.

A final possible limitation was that the researcher also was the principal of the school where the study took place. Creswell (2007) notes caution in conducting research in your own "backyard" where one is employed because it could potentially "raise questions about whether good data can be collected when the act of data collection may introduce a power imbalance" (p. 122) and "may keep him or her from acknowledging all dimensions of the experience" (p. 139). The researcher was cognizant of the potential concern of conducting research within the school with teachers, given this dual role. The researcher took great caution in determining if the study should take place at all. After discovering the teachers' willingness to participate, the researcher proceeded with care and consideration for the teacher participants. The researcher provided ample opportunity for the teachers to "opt out" of the research if they preferred. In addition, participants had the right to withdraw from the research at any given time in the study. Integrity of the participants was honored and respected throughout the study, including confidentiality and anonymity of their responses in the written summaries of the research.

Recommendations for Future Research

This mixed methods intrinsic case study which investigated the impact of lesson study professional development on self-efficacy and outcome expectancy sought to fill a gap in research by providing an indepth examination of the entire process, grounded in actual teaching practice through observations by the researcher to effectively capture and study teacher efficacy in a natural setting revealing teacher beliefs and practices in action, rather than relying solely upon teacher self-reporting. In addition, the study addressed another significant gap within the field of research on self-efficacy within the educational setting, including specificity to include content specific measures to examine self-efficacy within a specific domain. This study contributed to the research in respect to the need for both data beyond teacher self-reporting and content specificity measures. However, there is a need for continued research to more fully understand the impact of lesson study professional development on self-efficacy and outcome expectancy.

Additional research in the way of investigating the impact from a longitudinal study may provide greater insight of the changes in teacher self-efficacy and outcome expectancy over time. This professional development was sustained over a period of time from January through May of

2013. The researcher is still the principal at the elementary school where this research was conducted and the lesson study professional development continues currently through support of Dr. Rumsey and Kansas State University. Ongoing research of the continued effectiveness of lesson study, as 12 of the 14 original teachers remain at the school, would be a valuable study to provide further insight into the impact of lesson study on self-efficacy and outcome expectancy over time. Are more significant changes in self-efficacy and outcome expectancy evident after several years of implementation of the lesson study professional development? In what ways is this growth sustained over time? Is there any impact on the growth in self-efficacy and outcome expectancy with lesson study professional develop when a team shifts and new teachers are brought on board and other team members are absent?

Expanding research to contain more schools including elementary, middle and high schools would provide a breadth of insight into the impact of lesson study professional development on self-efficacy and outcome expectancy across grade level teachers spanning K-12. Including schools in future research that are non-Professional Development Schools (PDS) in partnership with a university would be another important perspective to capture to determine the similarities and differences in providing lesson study professional development when outside support from content experts and support in the way of funding is not readily available, as it was in this research. Does a school without external support from a university yield similar growth in self-efficacy and outcome expectancy as a school with university support? Are there additional challenges that are presented that hinder the implementation of lesson study professional development process when external support is lacking? Expanding this research to include schools with varying demographics at various grade levels with larger sample sizes, would allow the findings greater transferability beyond the confines of this study.

A look at the impact of self-efficacy and outcome expectancy beliefs on teaching practices would be worthwhile research to potentially improve classroom instruction. As self-efficacy and outcome expectancy beliefs strengthen, do teaching practices also show improvement? Likewise, is the converse true? Do teachers who possess weak self-efficacy and outcome expectancy beliefs also have weak teaching practices?

In hindsight, the researcher should have given more consideration to the journal entry prompts that were designed to gather teacher participant insight on their self-efficacy and outcome expectancy beliefs and any perceived change in these beliefs. A balance of both constructs would allow for more data to possibly uncover new discoveries with outcome expectancy beliefs. The journal entries designed by the researcher included 8 self-efficacy items and 3 outcome expectancy items. An important consideration for future research is an understanding of the challenges in changing outcome expectancy beliefs versus self-efficacy beliefs. For this reason, it is even more important to include ample outcome expectancy prompts to gather a rich source of data on these beliefs. Also, at the inception of this research, the MTEEBI had nearly an even distribution of self-efficacy (SE) and out expectancy (OE) items, with 59 total items originally: 33 SE items (56%) and 26 OE items (44%). However, through the confirmatory factor analysis process in refining the instrument to retain strong items there was a shift in this balance of the constructs' representation. The MTEEBI went from originally having a total of 59 items to currently having 33 items. Of these retained items, 21 are SE (64%) and 12 are OE (36%). With these MTEEBI changes in mind and the difficulty in changing outcome expectancy beliefs, it would be important for future researchers to take this into account and find methods to gather ample data on both constructs. One way to balance this could be to ensure additional data collection sources include more outcome expectancy items to strive for more even data sources on both constructs. In this research, it appears teachers do not naturally talk about their outcome expectancy beliefs, therefore as researchers we must continue our efforts in developing journal prompts and additional questioning that would change our culture of schools to talk more about teacher beliefs regarding their students' ability to learn.

The qualitative journals provided additional insight, along with the quantitative data in this study. However, supplementary qualitative techniques such as conducting follow-up interviews with teachers after completing the MTEEBI pre and post measures to ascertain and understand the rationale behind the responses given would be beneficial. This insight through ongoing dialogue would provide further understanding of the foundational roots for the beliefs held by the participants. These additional reflective statements would be helpful in providing depth in the analysis of the data by answering the 'why' of the belief statement responses. In addition, follow-up interviews to discuss the responses to the journal questions would provide clarification that could potentially lead to more precise coding of responses into Bandura's sources of self-efficacy. Shroyer, Riggs and Enochs (2014) provide further support for inclusion of additional qualitative methods, "This understanding can be deepened by continuing to refine the construct of self-efficacy, tending to instrumentation challenges and by using a variety of additional qualitative research methodologies to interpret or clarify teacher responses on quantitative instruments" (p.114).

Lesson study can be mutually effective not only for self-efficacy and outcome expectancy, but also for content knowledge and teaching practices. Tschannen-Moran et al., (1998), shared this connection:

> …the proficiency of a performance creates a new...experience, which provides new information that will be processed to shape future efficacy beliefs. Greater efficacy leads to greater effort and persistence, which leads to better performance, which in turn leads to greater efficacy. The reverse is also true. Lower efficacy leads to less effort and giving up easily, which leads to poor teaching outcomes, which then produce decreased efficacy. (p. 233)

Future research including an understanding of the impact of lesson study professional development on teachers' content knowledge and teaching practices would be insightful as, "research provides that intensive professional development programs can help teachers to increase their knowledge and change their instructional practices" (Borko, 2004, p. 5). As teachers increase their content knowledge, what impact does this have on self-efficacy and outcome expectancy? In what ways is teaching practice changed through the lesson study professional development process? One way to examine shifts in teaching practices would be to do observations and videotape lessons taught for a pre/post comparison after the lesson study professional development to identify similarities and differences in teaching practices. Are differences evident in the questions that are asked of students? Are there any changes in the learning activities that are used to help students explore and learn new concepts? How are individual students' learning needs attended to in the different teaching episodes? What impact do these changes in teaching practices have on self-efficacy and outcome expectancy?

Though this study did not encompass investigation of the impact of lesson study professional development on student self-efficacy, this is an aspect that was observed through the lesson study process. Bandura's four sources of self-efficacy were observed in student-to-student interactions, in addition to the teacher-to-teacher interactions. Further investigation might consider the perspective of change in self-efficacy from the student perspective in addition to the teacher perspective.

In addition, teachers felt their outcome expectancy beliefs in their students were, in part, dependent upon them providing quality instruction to their students. The quality instruction included teachers providing more time and opportunity for learning skills. This instruction could be seen as providing modeling and mastery experiences for their students as teachers described:

"More mathematical learning time is devoted to making sense of problems and being able to communicate solutions."

"….allowing my students the opportunity to for mathematical argumentation now, and provide the situations anc [sic] contexts as how to use that language and defend your answer."

Tentative findings of this study suggest, this could possibly a cyclical recursive relationship. With continued quality instruction provided by the teacher and their students learning, the teacher's outcome efficacy beliefs in the students continue to flourish. Further exploration would be insightful to determine how the quality of instruction provided and students' learning responses impact teacher outcome expectancy beliefs .

Finally, understanding the impact of lesson study professional development on student achievement would provide further insight into the practice and its potential to reach beyond the positive impact on teacher self-efficacy that was evident in this study. Future studies including a view of impact on student achievement is supported by Fischman et al. (2014), "Few studies are able to demonstrate a link between professional development and measure of teacher learning, instructional performance, or student learning outcomes at scale" (p. 160). Research focus needs to embed a lens that takes into consideration a view of how professional development learning produces results in enactment in the classroom to identify shifts in teaching practices and the resulting impact on student learning. Though teachers' content knowledge, teaching practices, and student achievement was not a focus in this research study, certainly all three of these characteristics were clearly observable and present in this research and would be attainable to study indepth in the future if this study were to be replicated.

Summary

Current educational reform efforts face the challenge of adequately preparing our students for college and career readiness. All educators and stake holders must reflect on effective professional development practices that support our teachers' ability to grow in their content knowledge and pedagogy to effectively meet the demands of successfully implementing and teaching the CCSS, attending to the complexities of these standards. According to Tschannen-Moran, et al., (1998), as teachers collaborate in an effort to address student learning, their efficacy is likely to increase. According to Lumpe, et al., (2014), "teacher beliefs serve as one important factor in the goal of teaching effectiveness" (p. 54). Further, teachers with higher self-efficacy experience greater degrees of success with their students' learning and achievement (Tschannen-Moran, et al., 1998). It is, therefore, paramount for those leading professional development efforts in hopes of improving teacher self-efficacy and outcome expectancy to enhance student achievement to consider lesson study as a viable means of creating a positive learning environment for teachers and students. "What people think, believe, and feel affects how they behave. The natural and extrinsic effects of their actions, in turn, partly determine their thought patterns and affective reactions" (Bandura, 1986, p. 25). Teachers with higher self-efficacy persevere in their teaching efforts, seeking novel ways to teach a concept for understanding.

The central purpose of this mixed methods case study research was to ascertain the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy. More specifically, the study focused on how the lesson study professional development impacted personal self-efficacy and outcome expectancy viewed through an indepth examination of the entire process. The data was grounded in actual teaching practice through observations by the researcher to effectively capture and study teacher efficacy in a natural setting revealing teacher beliefs and outcome expectancy in action, rather than relying solely upon teacher self-reporting. The qualitative and quantitative data analysis from this study revealed both the teacher participants' self-efficacy and outcome expectancy were positively impacted through the lesson study professional development process.

This study is a benefit to the research in several ways. By ascertaining the impact of lesson study professional development on K-6 teachers' self-efficacy and outcome expectancy, the researcher discovered a positive impact on both self-efficacy and outcome expectancy through the lesson study professional development. Further, a deeper understanding of lesson study professional development directly related to implementation of the mathematics CCSS was established. Viewing self-efficacy through a lens which incorporated professional development with a focus on CCSSM is important to the literature because little research can be found connecting professional development with CCSSM and self-efficacy. This study found a positive impact on self-efficacy through the lesson study professional development providing support in the implementation of CCSSM. This research has shed light upon ways in which to provide support for teachers to make the goal of the CCSSM standards based instruction a reality and in turn provide avenues to deliver professional development that increases self-efficacy to retain teachers and also create high quality mathematics instruction to all students, to help ensure they are prepared for college and career readiness upon graduation from high school. Utilizing lesson study professional development was found to be a catalyst for Bandura's four sources of self-efficacy.

This study has contributed to the literature by setting out to address two of the most significant issues within the field of research on self-efficacy in the educational setting, which includes specificity and teacher self-reporting methods. Much discussion in the field included the need for content specific measures to look at self-efficacy within a specific domain. Therefore, this study focused on mathematics to provide a narrow content specific domain in which to view self-efficacy. The MTEEBI survey was employed as it is the most specific tool available at this time to address self-efficacy and outcome expectancy in relationship to CCSSM.

The second major issue within the field this study set out to address was the need for reliance on actual observations of teaching episodes versus utilizing solely teacher self-reports of classroom practice. Much of the research examining self-efficacy beliefs in education discusses the issue of teacher self-reporting methods and the potential discrepancy that could be present between what teachers say and what they do in the classroom. To address this concern, the design of this research was strategically planned to ensure direct observation of teaching episodes throughout the study, including in-person researcher observation, collegial teacher peer observation, and videotaping to allow for reviewing and reflection of the teaching and all aspects of the lesson study professional development. Therefore, these observations of the varying teaching environments provided additional data and perspective to further inform the teacher self-reported data. The observations supported the teacher self-reporting with the MTEEBI survey and the journal responses providing triangulated evidence of the positive impact on self-efficacy and outcome expectancy through the lesson study professional development.

This research has contributed to the educational community because this study suggests that teachers who were afforded the opportunity to participate in lesson study professional development were found to have a positive increase in both their self-efficacy and outcome expectancy. Professional development opportunities that strategically address Bandura's four sources of self-efficacy, such as lesson study, provided a pathway to increased teacher self-efficacy. Teachers who have strong self-efficacy and outcome expectancy beliefs will foster greater academic strides in their students because they believe firmly in their ability to teach and their students' ability to learn. In the words of Plutarch, "What we achieve inwardly will change outer reality." Beliefs are an inward inspiration for changing the outward actions of instruction and achievement in students. The best a teacher can do for his/her students is to believe in them, believe in themselves, continue to grow as a teacher and teach profound lessons that provide challenge for students to be successful through mastery learning experiences. Teachers, don't stop believing!

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Appendix A - Teacher Participation Survey

Comfort level with dissertation research within the school, conducted by the principal, was ascertained with these questions:

_____ I am comfortable with Deb doing dissertation research on our prof dev at [school name] with Chepina Rumsey.

_____ I am not comfortable with Deb doing dissertation research on our prof dev at [school name] with Chepina Rumsey.

Willingness to participate in the professional development or preference for an alternate method of integrating CCSS mathematics instruction in the classroom was determined with these questions:

_____ I am willing to participate in prof dev with Dr. Rumsey on CCCSS.

_____ I prefer to prepare my own action plan for incorporating CCSS into my math instruction.

Appendix B - Teacher Informed Consent

Dear Elementary School Teacher,

As you recall, I conducted a survey earlier in the fall of our faculty's comfort level with me conducting doctoral research on our professional development with Dr. Chepina Rumsey. At that time, I stated if majority of the faculty was comfortable with me conducting research at our school, I would consider it. However, if majority of faculty was uncomfortable, I would not conduct the research at this or any other time. The results of the survey indicated a total survey return rate of 86%. Analysis of the surveys found that 100% of the participants responded they were comfortable with me conducting dissertation research within our school. In addition, 100% of the respondents said they preferred to participate in the professional development with Dr. Rumsey, as opposed to creating an independent action plan for incorporating CCSS into mathematics instruction. With your support, I will conduct a case study of our professional development this spring for my doctoral research with Kansas State University.

The proposed dissertation research is to gain a better understanding of the impact of the professional development on teacher self-efficacy. As part of this case study, I will collect both qualitative and quantitative data measures. I feel the qualitative data is important to accurately capture and reflect the voice and rich description of participant perspective of this experience.

Data will be gathered with a pre/post Mathematics Teaching Efficacy and Efficacy Beliefs Instrument (MTEEBI) survey, classroom observations of a math lesson before, during, and after the professional development, and a reflection journal. Classroom observations will be video and/or audiotaped to ensure accuracy of data analysis. Recording will be stopped upon request. Should you participate in this study, all data will be reported by a pseudonym or with a coded # to protect confidentiality.

Participation in this study is strictly based upon your volunteerism. If you agree to participate in the study, you may answer questions of your choosing and are free to withdraw from participation at any time. If you have any questions or concerns regarding this research project, please contact me at 785-556-2205 or debn@manhattan.k12.ks.us.

Name of Participant	Signature of Participant
Signature of Researcher	Date

Appendix C - Parent/Student Informed Consent

January 12, 2013

Dear Parent/ Guardian:

My name is Chepina Rumsey and I am a professor at Kansas State University in the department of Curriculum and Instruction. I am a former elementary school teacher interested in mathematics education. I feel grateful to have been welcomed to Woodrow Wilson Elementary School by Ms. Deb Nauerth to conduct professional development with the teachers. In addition to providing professional development, I am interested in learning more about how students in grades K-6 reason and justify in mathematics. I would like permission for your child to participate in my research, which has been approved by Ms. Nauerth. **This letter contains a description of the project followed by permission forms for you and your child to sign.**

In the new Common Core State Standards that Kansas has adopted, there is an emphasis on mathematical justifications and reasoning in order to help students develop a deeper understanding of mathematical concepts and greater procedural fluency. I will be conducting professional development with the teachers at Woodrow Wilson regarding instruction incorporating more classroom discussions and then will be observing in the classrooms when they implement three high-quality lessons that we develop as a group. I want to better understand how students in elementary school justify their mathematical ideas and to characterize mathematical arguments at the different grade levels. **I would like your permission to video-record the lesson that will take place in your child's classroom during regular mathematics instruction.** This will allow me to analyze and characterize the discussions that occur in the classrooms.

Additionally, if you agree to allow your child to be part of the video recordings of classroom interactions, please consider giving me permission to use selected video and audio clips in professional conference presentations and/or in professional development work with prospective and other practicing teachers. These video and audio clips would be available for your preview should you wish to see them prior to giving your approval. In the near future I would like to develop an online resource for teachers to view high-quality lessons being developed and see exemplar video clips. I would make the website resource password protected and limited to educators with a district email address. Please consider if you would be comfortable with this use of video exemplars that include your child.

In any publications associated with this research, pseudonyms will be used in place of your child's name, the teacher's name, and the name of the school. We understand that in some unavoidable cases video recordings could infringe upon your child's right to privacy, such as when your child's actual name is used by the teacher and other students during the lessons. Please know that children who choose not to be videorecorded will still be included in all classroom activities. The classroom will be arranged (and student groups will be rotated) so that the camera person will be able to avoid capturing their image but in a way that the children will not know who is and is not being recorded. The risks associated with this project relate to confidentially, but this will be limited by using pseudonyms for students, teachers, and the school.

If you choose not to have your child participate in any aspects of this study or if you choose to withdraw your permission at any time, there will be no penalty. Participation in the project will not affect your child's grades, participation in class, or placement for the following school year. Likewise, if your child chooses not to give permission or to withdraw his/her permission at any time, there will be no penalty.

If you have any questions concerning the research study or your child's participation in this study, please call me at 785-532-4516. If you have any questions about you or your child's rights as a participant in this research, or if you feel you or your child have been placed at risk, you can contact the IRB Office:

• Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

• Jerry Jaax, Associate Vice President for Research Compliance and University Veterinarian, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

To give consent for your child to participate in this study, please complete that attached form and have your child return it to me in the enclosed envelope. Also, please talk with your child about the study and have him or her complete the student assent form and return it as well.

Sincerely,

Chepina Rumsey, Ph.D.
Assistant Professor of Mathematics
Kansas State University
College of Education
(785) 532-4516
chepina@k-state.edu

Deb Nauerth
Woodrow Wilson Principal

Please complete these forms and return them to your classroom teacher.

Parent/Guardian Consent Form

I have read the information presented above and have had an opportunity to ask questions and receive answers pertaining to this research project. I am aware that my permission is voluntary and that I am free to withdraw my permission at any time without any penalties to my child or me.

I **give permission** for Chepina Rumsey to: (please check all that apply)

_____ Include my child in video recordings of classroom lesson.

_____ Use video clips and/or audio recordings that include my child during conference presentations or professional development sessions with prospective and practicing teachers.

_____ Use video clips that include my child in a password-protected online resource for teachers.

_____ I **do not give permission** for my child to participate in any aspect of the data collection for this study.

____
Child's Name (Please Print) Grade/Teacher

____
Signature of Parent/Guardian

Student Assent Form

Dear Woodrow Wilson Elementary School Student,

I am a professor at Kansas State University. There will be a mathematics lesson in the spring that will be video-recorded. I am asking your permission to include you in this video-recording that will take place during your regular math instruction.
Please complete the checklist below, place it with the form your parent/guardian filled out and return it to your classroom teacher.

I **give permission** for Dr. Rumsey to: (please check all that apply)

_____ Include me in video recordings of classroom lesson

_____ Use video clips and/or audio recordings that include me during conference presentations or professional development sessions with prospective and practicing teachers

_____ Use video clips that include me in a password-protected online resource for teachers.

_____ I **do not agree** to participate in any aspect of the data collection for this study.

____

Student's Name

____

Signature of Student

Appendix D - Professional Development Calendar

~ January 2013 WW Prof Dev~						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
When using iPad for videotaping be sure to practice & don't cover	**the mic, be sure to capture teacher & student voices.**	**1**	**2**	**3**	**4**	**5**
6	**7** 4:10 – Faculty Meeting	**8**	**9**	**10**	**11**	**12**
13	**14** Week 1: 4:00 – Prof Dev w/Dr. Chepina Rumsey - Intro to Lesson Study & Mathematical Argumentation	**15** Video 1st Math Lesson K-6 w/iPad – any math lesson is fine Do MTEEBI Pre-Survey	**16**	**17**	**18** MTEEBI Pre-Survey & Teacher Consents Due Place them in Deb's mailbox	**19**
20	**21** MLK, Jr. Day NO SCHOOL	**22** Video 1st Math Lesson K-6 w/iPad – any math lesson is fine	**23** K-2 – Lesson Topic Due Email Chepina at chepina@ksu.edu	**24**	**25** K-6 Student Informed Consents Due	**26**
27	**28** Week 2: K-2 & 4 Grade Plan Time & Review Resources w/Dr. Chepina Rumsey K - 2-3:30 4:00 – Test Training	**29** Plan Time & Review Resources w/Dr. Chepina Rumsey 1ST Grade – 2-3:30	**30** Plan Time & Review Resources w/Dr. Chepina Rumsey 2nd Grade – 2-3:30	**31** Plan Time & Review Resources w/Dr. Chepina Rumsey 4th Grade – 2-3:30	**Notes:** **Winter MAP: Jan. 15 – Feb. 1** **State Assess: Rdg Mar. 5- Mar. 15** **Math April 2 – April 12** **Science – April 9 – April 12** **Spring MAP: April 23 – May 9**	

~ February 2013 WW Prof Dev~						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
					1	**2**
3	**4** Week 3: **4:10 – Faculty Meeting**	**5** **4th Grade Lesson Study** DAY 1 – 2-3:30	**6** Remember to journal.	**7** **4th Grade Lesson Study** DAY 2 – 2-3:30	**8**	**9**
10	**11** Week 4: **Kindergarten Lesson Study** DAY 1 – 9-10:30	**12** P/T Conf Remember to journal.	**13** P/T Conf **Kindergarten Lesson Study** DAY 2 – 9-10:30	**14** P/T Conf	**15**	**16**
17	**18** Chepina Gone to Conf	**19**	**20**	**21**	**22**	**23**
24	**25** Week 5: 4:00 – Prof Dev w/Chepina Continue Planning/K & 4th Share	**26** **1st Grade Lesson Study** DAY 1 – 2-3:30	**27** Remember to journal.	**28** **1st Grade Lesson Study** DAY 2 – 2-3:30	**Lesson Study** **Day 1: Teach (45 min) & Tweak (45 min) for total 90 min session** **Day 2: Reteach (45 min) & Reflect (45 min) for total 90 min session**	

~ March 2013 WW Prof Dev~

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4 Week 6: **2nd Grade Lesson Study** DAY 1 – 9-10:30 **4:10 – Faculty Meeting**	5 Remember to journal.	6 **2nd Grade Lesson Study** DAY 2 – 9-10:30 **3-6 Lesson Topic Due Email Chepina at chepina@ksu.edu**	7	8	9
10	11 Week 7: **3 & 5-6 Grade** **Plan Time & Review Resources w/Dr. Chepina Rumsey** **Video 2nd Math Lesson K-2 & 4th Grade**	12	13 **3rd Grade – 2-3:30**	14 **5th/6th Grade – 2-3:30**	15	16
17	18 SPRING BREAK!	19 SPRING BREAK!	20 SPRING BREAK!	21 SPRING BREAK!	22 SPRING BREAK!	23
24	25	26	27	28	29	30
31	**Lesson Study** **Day 1: Teach (45 min) & Tweak (45 min) for total 90 min session** **Day 2: Reteach (45 min) & Reflect (45 min) for total 90 min session**					

~ April 2013 WW Prof Dev~						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
	1 Week 8: **5^{th}/6^{th} Grade Lesson Study** DAY 1 – 2-3:30 **4:10 – Faculty Meeting**	**2** Remember to journal.	**3** **5^{th}/6^{th} Grade Lesson Study** DAY 2 – 2-3:30 -	**4** **5^{th}/6^{th} Grade Lesson Study** DAY 3 – 2-3:30	**5**	**6**
7	**8** Chepina gone this week.	**9**	**10**	**11**	**12**	**13**
14	**15** **<u>Video 2^{nd} Math Lesson</u>** **<u>5&6^{th} Grade</u>** Chepina gone this week.	**16**	**17**	**18**	**19**	**20**
21	**22** Week 9:	**23** **3^{rd} Grade Lesson Study** DAY 1 – 2-3:30	**24** Remember to journal.	**25** **3^{rd} Grade Lesson Study** DAY 2 – 2-3:30	**26**	**27**
28	**29** **4:00 – Prof Dev w/Chepina Rumsey – Reflection & Post MTEEBI Handout** **<u>Video 2^{nd} Math Lesson</u>** **<u>3^{rd} Grade</u>**	**30**	**Lesson Study** **<u>Day 1</u>: Teach (45 min) & Tweak (45 min) for total 90 min session** **<u>Day 2</u>: Reteach (45 min) &Reflect (45 min) for total 90 min session**			

~ May 2013 WW Prof Dev~						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3 K-6 Post MTEEBI DUE Place them in Deb's mailbox	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	Notes:

Appendix E - MTEEBI

Teacher Name/ID#________________________ Date:______ Grade Level(s):________

Yrs of Teaching Experience (include this year):________ Highest Degree Earned:___________

Area(s) of Endorsement(s): ___________ Subject you feel most confident teaching:_________

Subject you feel least confident teaching: _______ Was teaching your first major in college? ___

If no, what was your first major? ___________ Why did you switch to education? ___________

____

Please **CIRCLE** the appropriate rating to describe your position to each statement in the table below. Your ratings should be focused only on mathematics throughout the survey. *Your responses will be kept secure to maintain confidentiality*.

Use the following ratings to describe your position on each of the items below.

SA= Strongly Agree

A= Agree

U= Uncertain

D= Disagree

SD= Strongly Disagree

1. When a student does better than usual in math, it is often because the teacher exerted a little extra effort.	SA	A	U	D	SD
2. Students almost always need the help of a teacher to make sense of complex problems.	SA	A	U	D	SD
3. Even when I try very hard, I don't teach math as well as I do other subjects.	SA	A	U	D	SD
4. I know how to prepare students to consider the meanings of units used in different contexts.	SA	A	U	D	SD
5. Regardless of the teacher's instruction, students won't use available tools to investigate problems on their own.	SA	A	U	D	SD
6. When a student commits an error in math, I am able to diagnose his/her conceptual errors.	SA	A	U	D	SD
7. If students are underachieving in math, it is most likely due to ineffective math teaching.	SA	A	U	D	SD
8. I have difficulty getting students to think about the meaning of variables.	SA	A	U	D	SD
9. The inadequacy of a student's math background can be overcome by good teaching.	SA	A	U	D	SD

10. With appropriate instruction, students can learn to use definitions to justify or refute mathematical statements (e.g. use the definition of a rectangle to justify or refute the statement “a square is not a rectangle.”)	SA A U D SD
11. Students at my grade level think concretely, and teachers can’t be expected to teach them to work with abstractions in mathematics.	SA A U D SD
12. I understand math concepts well enough to be effective in teaching elementary school math.	SA A U D SD
13. Increased effort in math teaching produces little change in some students' math achievement.	SA A U D SD
14. When students are given the opportunity to make their own generalizations, they end up more confused than if the teacher teaches the mathematics directly.	SA A U D SD
15. Students' achievement in math is directly related to their teacher's skills in math teaching.	SA A U D SD
16. If parents comment that their child is showing more interest in math at school, it is probably due to the performance of the child's teacher.	SA A U D SD
17. I find it difficult to explain to students why math procedures and problem-solving strategies work.	SA A U D SD
18. When the teacher includes a student’s ideas in a math lesson, the rest of the class understands the material better.	SA A U D SD
19. I wonder if I have the necessary knowledge and skills to teach math.	SA A U D SD
20. Even a very skilled teacher cannot expect English Language Learners to attempt to understand complex mathematics problems.	SA A U D SD
21. No matter how skilled the teacher, some students won’t understand what quantities mean, even if they can compute them.	SA A U D SD
22. When a student has difficulty understanding a math concept, I am usually at a loss as to how to help the student understand it better.	SA A U D SD
23. I feel comfortable addressing students’ questions about mathematical concepts and ideas.	SA A U D SD
24. I don't know what to do to turn students on to math.	SA A U D SD
25. Even a teacher with good math teaching abilities may not help some students learn math.	SA A U D SD
26. When an English language learner does better than expected in math, it is often because the teacher has had relevant training or skills, for example, in sheltered instruction and/or ESL techniques.	SA A U D SD
27. I am comfortable allowing my students to make their own approximations or simplifications when approaching a real-life problem.	SA A U D SD
28. I can easily integrate students’ strategies and ideas into my math lessons even if they are different from my lesson plan.	SA A U D SD
29. With appropriate instruction, a student can learn to make reasonable approximations.	SA A U D SD

30. I am more comfortable choosing materials/tools for my students to help them solve problems rather than having them choose tools on their own.	SA	A	U	D	SD
31. Students can learn to analyze and solve open-ended practical problems independently.	SA	A	U	D	SD
32. I know how to prepare students to plan their own approaches to solving problems.	SA	A	U	D	SD
33. I can develop students' ability to produce mathematics (e.g. a number sentence, expression or equation) to model their own interpretation of a situation.	SA	A	U	D	SD
34. I have a difficult time getting my students to use clear explanations when discussing their math thinking.	SA	A	U	D	SD
35. When my students struggle with seeing how patterns lead to generalizations, I don't really know how I might help them make the connections.	SA	A	U	D	SD
36. A teacher can be expected to help a student learn math despite his or her impoverished home environment.	SA	A	U	D	SD
37. Students who have low motivation for learning math can be turned on to learning by their math teachers.	SA	A	U	D	SD
38. Although my students can successfully do computations, I can't seem to get them to select appropriate calculations to use when they are given real life problems.	SA	A	U	D	SD
39. I am able to make sure my students can use materials to represent problems in multiple ways.	SA	A	U	D	SD
40. I can incorporate multiple representations into my lessons to improve student learning.	SA	A	U	D	SD
41. Most students are able to envision the mathematics that underlies a contextual problem.	SA	A	U	D	SD
42. Seeing many different approaches to solve one problem confuses many students and hinders their learning.	SA	A	U	D	SD
43. I don't know how to get my students to apply definitions in their math work.	SA	A	U	D	SD
44. When students do not make progress in their ability to communicate mathematical ideas, the teacher's instruction was inadequate.	SA	A	U	D	SD
45. I can help students learn to work on their own to gather appropriate evidence to support their mathematical ideas.	SA	A	U	D	SD
46. Students can be taught to find the logical flaws in a mathematical argument by themselves.	SA	A	U	D	SD
47. I can teach students to determine on their own which situations require an exact answer and which require an estimate.	SA	A	U	D	SD
48. I can teach my students to decompose and re-combine numbers and expressions in different ways depending on the context.	SA	A	U	D	SD
49. I feel comfortable teaching students to understand relationships between concepts of algebra and concepts of arithmetic.	SA	A	U	D	SD
50. No matter what the teacher does, students can't seem to determine when an approximate answer is appropriate.	SA	A	U	D	SD

51. I have difficulty helping my students attend simultaneously to the whole picture as well as the details while they solve a math problem.	SA A U D SD
52. I am comfortable helping my English language learners gain conceptual understanding of mathematics.	SA A U D SD
53. I am comfortable letting my students struggle with a problem for which there is no immediately obvious method of solution.	SA A U D SD
54. I can help students learn to see relationships between quantities.	SA A U D SD
55. I can teach students to make a habit of asking themselves whether their work makes sense.	SA A U D SD
56. I am comfortable analyzing and synthesizing different student approaches to a mathematics problem to bring closure to a mathematical discussion.	SA A U D SD
57. I know how to develop students' ability to use the math they know to solve problems in everyday life.	SA A U D SD
58. Even with appropriate instruction, most students rarely consider whether their math work makes sense.	SA A U D SD
59. I am able to help students from impoverished backgrounds excel in math.	SA A U D SD

Thank you for completing this survey!

Please fold and place the survey in the attached envelope, seal it, and sign on the seal.

Appendix F - Lesson Study Plan Template

Grade:

Topic:

CCSS:

Research Lesson Goals/Focus:

Lesson Objectives:

How will the lesson build on prior knowledge?

Resources: *Math In Focus* textbook

Materials:

Groupings:

Lesson Overview

Engage
Explore
Explain
Elaborate

Evaluate

Lesson Planning

Engage – Launching the lesson What is the teacher doing? What is the student doing? Possible guiding questions		
Possible solutions, questions, misconceptions, or errors	Possible teacher responses	What do students need to know/be doing to be successfully engaged in this part of the lesson?
Explore – Investigate, problem solve, hands-on exploration What is the teacher doing? What is the student doing?		

Questions we can ask to:

- help a group make progress
- focus students thinking on key mathematical ideas
- advance student understanding
- encourage all ideas

Possible solutions, questions, misconceptions, or errors	Possible teacher responses	What do students need to know/be doing to be successfully engaged in this part of the lesson?

Explain – Share understanding, new concepts and skills introduced.

What is the teacher doing? What is the student doing?

What solution paths do we want to have shared during class discussion? In what order? What specific questions can we ask to • encourage mathematical argumentation • help students make sense of mathematical ideas • helps students expand on, debate, question solutions being shared • make connections between strategies • look for patterns and make generalizations		
Possible solutions, questions, misconceptions, or errors	Possible teacher responses	What do students need to know/be doing to be successfully engaged in this part of the lesson?
Elaborate – Further activity allowing the students to put new knowledge into practice What is the teacher doing? What is the student doing? Guiding questions		
Possible solutions, questions, misconceptions, or errors	Possible teacher responses	What do students need to know/be doing to be successfully engaged in this part of the lesson?

Evaluate – Assess student understanding and lesson effectiveness What is the teacher doing? What is the student doing? What will you see or hear that indicates all students understand the mathematical ideas you intended for them to learn?		
How will you evaluate understanding?	Ideas for Next Steps	

What kind of evidence should we look for as observers?

Appendix G - Lesson Study Observation Protocol

Observation Guidelines

Remember that observers do not interact with the students.

<table>
<tr><td colspan="2">Evidence that the lesson objectives were met</td></tr>
<tr><td>Evidence of students' mathematical understanding and</td><td>Students' mathematical misconceptions</td></tr>
<tr><td colspan="2">Discourse and mathematical argumentation that occurred in the lesson</td></tr>
<tr><td colspan="2">Responses/reactions showing student engagement</td></tr>
<tr><td colspan="2">Additional Notes</td></tr>
</table>

Appendix H - Lesson Study Follow-Up Discussion Protocol

Debriefing, Reflecting, and Revising the Lesson

1. Teacher who taught the lesson comments on his/her reaction to what happened.

2. What evidence did we see of students meeting the lesson objectives? What parts of the lesson design helped to achieve the lesson objectives?

3. What evidence did we see of students' mathematical understanding?

4. What evidence did we see of students' mathematical misconceptions?

5. What discourse was planned and what discourse/mathematical argumentation occurred?

6. What examples of student responses/reactions show how they were engaged?

7. Was there anything that surprised you?

8. What could be added or changed in the lesson to better achieve the lesson objectives? How would you expect students to respond to these changes?

Appendix I - Journal Questions

Teacher Name/ID#______________________________ Date:_______________

Thank you for your participation in the lesson study professional development. The purpose of this case study is to gain a better understanding of the impact of the professional development on teacher self-efficacy.

Feel free to journal as often as you would like. However, the goal is for you to journal at least during the designated times, answering the prompts provided. Thank you for sharing your experiences with the lesson study professional development openly and honestly.

Planning Phase Questions (Before Lesson Study):

1. What were your own learning experiences like with math as a student (elementary, middle, high school and/or college)? As a student, how did you feel about your ability to do math? Has this experience influenced your teaching goals for teaching math? If so, how?

2. How comfortable do you feel with teaching math? Why do you feel this way?

3. How confident do you feel in your ability to affect student learning outcomes in math?

4. What helps you to persevere in helping a child understand a math concept?

5. Do you believe you will be able to implement the math CCSS in your math instruction? Why or why not?

6. Do you believe students will be able to understand and master the mathematical knowledge and skills represented in the math CCSS. Why or why not?

7. How prepared do you feel to teach the lesson study lesson? Why?

8. How are you feeling about the lesson study?

9. What would you like to see more of during this professional development?

Lesson Study Phase Questions (During Lesson Study – After you have taught the lesson):

1. Is your lesson study lesson one you have taught before?

If yes, are there any evident differences in this lesson compared to your previous teaching? If yes, what are they?

What reasons did your team have for modifying the lesson in this way?

2. Do you believe you can help your students think critically? What makes you believe this?

3. Did your students learn what your team intended them to learn? Why/Why not?

4. How has feedback from others impacted your belief in your ability to teach math?

Reflection Phase Questions (After Lesson Study):

1. What role did observing a colleague teach a lesson you prepared together have in changing your own beliefs about your ability to teach math and implement math CCSS?

2. What role did the team approach have in changing your own beliefs about your ability to teach math and implement math CCSS?

3. Do you believe the lesson study impacted your belief in your ability to teach math? Why or why not?

4. Do you believe your instruction led your students to perform the skills of mathematical argumentation effectively? What evidence is the basis for this belief?

5. What three things throughout the lesson study professional development most likely affected your belief in your ability to teach math and the Common Core State Standards?

6. What might we provide in future professional development to help improve your belief in your ability to teach math and implement math CCSS?

Finally, please share your any additional thoughts, feelings, discoveries, and insights from our professional development with lesson study in regard to your teaching practices, collaboration with others, self-efficacy as a teacher, or additional input you feel is relevant to this discussion.

Appendix J - Original MTEEBI with Final Items Retained & Scoring Coding

Please **CIRCLE** the appropriate rating to describe your position to each statement in the table below. Your ratings should be focused only on mathematics throughout the survey. *Your responses will be kept secure to maintain confidentiality*.

Use the following ratings to describe your position on each of the items below.
SA= Strongly Agree
A= Agree
U= Uncertain
D= Disagree
SD= Strongly Disagree

*Highlighted items are the items retained in the final MTEEBI. S = Self-Efficacy Items,

O = Outcome Expectancy Items, + = Positively Scored Items, - = Negatively Scored Items

1. O+ When a student does better than usual in math, it is often because the teacher exerted a little extra effort.	SA	A	U	D	SD
2. O- Students almost always need the help of a teacher to make sense of complex problems.	SA	A	U	D	SD
3. S- Even when I try very hard, I don't teach math as well as I do other subjects.	SA	A	U	D	SD
4. S+ I know how to prepare students to consider the meanings of units used in different contexts.	SA	A	U	D	SD
5. O- Regardless of the teacher's instruction, students won't use available tools to investigate problems on their own.	SA	A	U	D	SD
6. S+ When a student commits an error in math, I am able to diagnose his/her conceptual errors.	SA	A	U	D	SD
7. O+ If students are underachieving in math, it is most likely due to ineffective math teaching.	SA	A	U	D	SD
8. S- I have difficulty getting students to think about the meaning of variables.	SA	A	U	D	SD
9. O+ The inadequacy of a student's math background can be overcome by good teaching.	SA	A	U	D	SD
10. O+ With appropriate instruction, students can learn to use definitions to justify or refute mathematical statements (e.g. use the definition of a rectangle to justify or refute the statement "a square is not a rectangle.")	SA	A	U	D	SD
11. O- Students at my grade level think concretely, and teachers can't be expected to teach them to work with abstractions in mathematics.	SA	A	U	D	SD
12. S+ I understand math concepts well enough to be effective in teaching elementary school math.	SA	A	U	D	SD
13. O- Increased effort in math teaching produces little change in some students' math achievement.	SA	A	U	D	SD

14. O- When students are given the opportunity to make their own generalizations, they end up more confused than if the teacher teaches the mathematics directly.	SA A U D SD
15. O+ Students' achievement in math is directly related to their teacher's skills in math teaching.	SA A U D SD
16. O+ If parents comment that their child is showing more interest in math at school, it is probably due to the performance of the child's teacher.	SA A U D SD
17. S- I find it difficult to explain to students why math procedures and problem-solving strategies work.	SA A U D SD
18. O+ When the teacher includes a student's ideas in a math lesson, the rest of the class understands the material better.	SA A U D SD
19. S- I wonder if I have the necessary knowledge and skills to teach math.	SA A U D SD
20. O- Even a very skilled teacher cannot expect English Language Learners to attempt to understand complex mathematics problems.	SA A U D SD
21. O- No matter how skilled the teacher, some students won't understand what quantities mean, even if they can compute them.	SA A U D SD
22. S- When a student has difficulty understanding a math concept, I am usually at a loss as to how to help the student understand it better.	SA A U D SD
23. S+ I feel comfortable addressing students' questions about mathematical concepts and ideas.	SA A U D SD
24. S- I don't know what to do to turn students on to math.	SA A U D SD
25. O- Even a teacher with good math teaching abilities may not help some students learn math.	SA A U D SD
26. O+ When an English language learner does better than expected in math, it is often because the teacher has had relevant training or skills, for example, in sheltered instruction and/or ESL techniques.	SA A U D SD
27. S+ I am comfortable allowing my students to make their own approximations or simplifications when approaching a real-life problem	SA A U D SD
28. S+ I can easily integrate students' strategies and ideas into my math lessons even if they are different from my lesson plan.	SA A U D SD
29. O+ With appropriate instruction, a student can learn to make reasonable approximations.	SA A U D SD
30. S- I am more comfortable choosing materials/tools for my students to help them solve problems rather than having them choose tools on their own.	SA A U D SD
31. O+ Students can learn to analyze and solve open-ended practical problems independently.	SA A U D SD
32. S+ I know how to prepare students to plan their own approaches to solving problems.	SA A U D SD
33. S+ I can develop students' ability to produce mathematics (e.g. a number sentence, expression or equation) to model their own interpretation of a situation.	SA A U D SD

34. S- I have a difficult time getting my students to use clear explanations when discussing their math thinking.	SA A U D SD
35. S- When my students struggle with seeing how patterns lead to generalizations, I don't really know how I might help them make the connections.	SA A U D SD
36. O+ A teacher can be expected to help a student learn math despite his or her impoverished home environment.	SA A U D SD
37. O+ Students who have low motivation for learning math can be turned on to learning by their math teachers.	
38. S- Although my students can successfully do computations, I can't seem to get them to select appropriate calculations to use when they are given real life problems.	SA A U D SD
39. S+ I am able to make sure my students can use materials to represent problems in multiple ways.	SA A U D SD
40. S+ I can incorporate multiple representations into my lessons to improve student learning. SMP 1	SA A U D SD
41. O+ Most students are able to envision the mathematics that underlies a contextual problem.	SA A U D SD
42. O- Seeing many different approaches to solve one problem confuses many students and hinders their learning.	SA A U D SD
43. S- I don't know how to get my students to apply definitions in their math work.	SA A U D SD
44. O+ When students do not make progress in their ability to communicate mathematical ideas, the teacher's instruction was inadequate.	SA A U D SD
45. S+ I can help students learn to work on their own to gather appropriate evidence to support their mathematical ideas.	SA A U D SD
46. O+ Students can be taught to find the logical flaws in a mathematical argument by themselves.	SA A U D SD
47. S+ I can teach students to determine on their own which situations require an exact answer and which require an estimate.	SA A U D SD
48. S+ I can teach my students to decompose and re-combine numbers and expressions in different ways depending on the context.	SA A U D SD
49. S+ I feel comfortable teaching students to understand relationships between concepts of algebra and concepts of arithmetic.	SA A U D SD
50. O- No matter what the teacher does, students can't seem to determine when an approximate answer is appropriate	SA A U D SD
51. S- I have difficulty helping my students attend simultaneously to the whole picture as well as the details while they solve a math problem.	SA A U D SD
52. S+ I am comfortable helping my English language learners gain conceptual understanding of mathematics.	SA A U D SD
53. S+ I am comfortable letting my students struggle with a problem for which there is no immediately obvious method of solution.	SA A U D SD
54. S+ I can help students learn to see relationships between quantities.	SA A U D SD

55. S+ I can teach students to make a habit of asking themselves whether their work makes sense.	SA A U D SD
56. S+ I am comfortable analyzing and synthesizing different student approaches to a mathematics problem to bring closure to a mathematical discussion.	SA A U D SD
57. S+ I know how to develop students' ability to use the math they know to solve problems in everyday life.	SA A U D SD
58. O- Even with appropriate instruction, most students rarely consider whether their math work makes sense.	SA A U D SD
59. S+ I am able to help students from impoverished backgrounds excel in math.	SA A U D SD

Thank you for completing the survey.

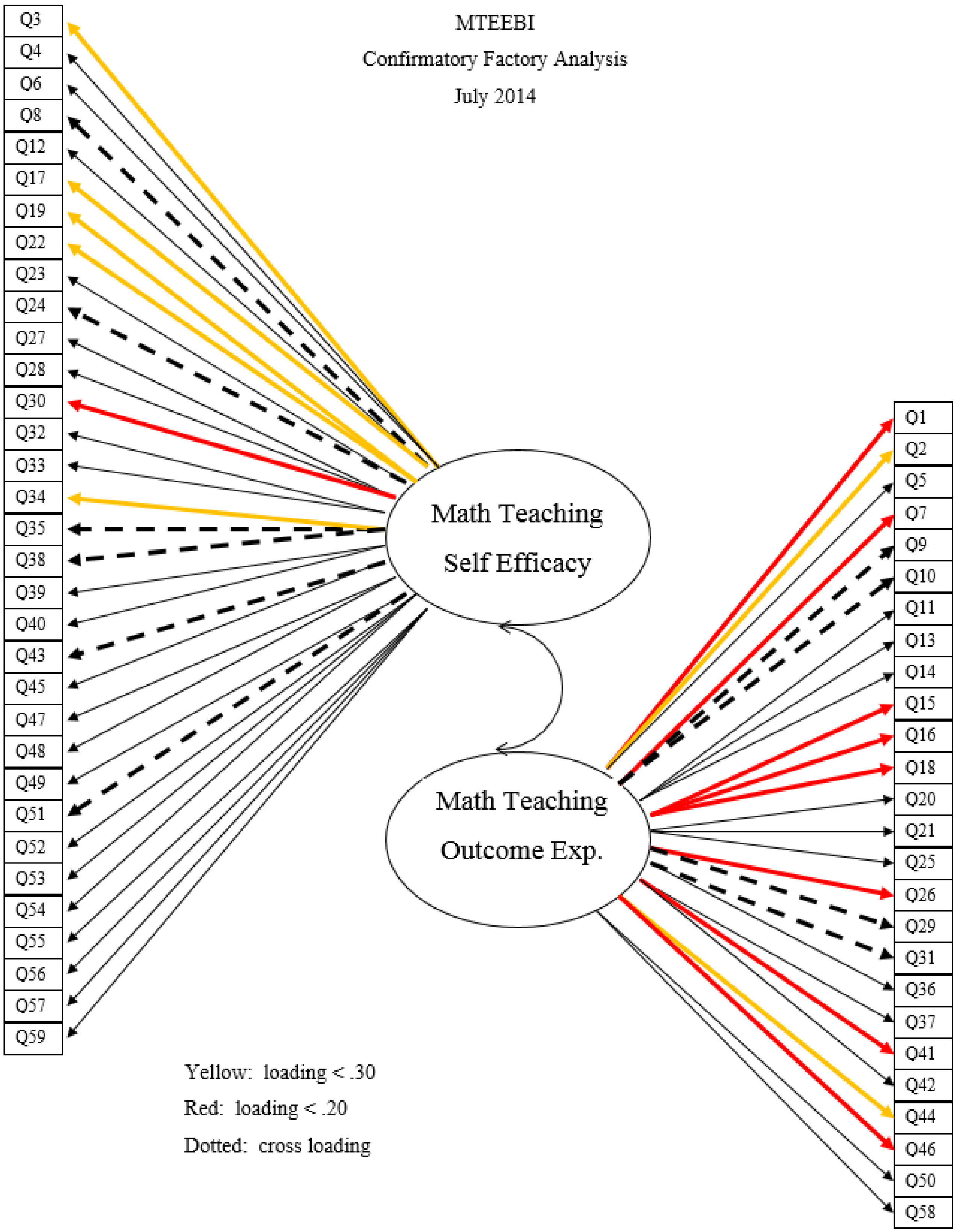
Please fold and place the survey in the attached envelope and seal it

Appendix K - MTEEBI Confirmatory Factor Analysis

MTEEBI

Confirmatory Factory Analysis

July 2014



Appendix L - MTEEBI Wording Clarification Changes

MTEEBI Item Word Changes	
Original Item as Used in this Research	Revised Item
#12: I understand math concepts well enough to be effective in teaching elementary school math.	#12: I understand math concepts well enough to be effective in teaching math.
#15: Students' achievement in math is directly related to their teacher's skills in math teaching.	#15: Students' achievement in math is directly related to their teacher's effectiveness in math teaching.
#36: A teacher can be expected to help a student learn math despite his or her impoverished home environment.	#36: A teacher can be expected to help a student learn math despite his or her impoverished home background.