AN EXPLORATORY STUDY OF THE POSSIBLE ALIGNMENT BETWEEN THE BELIEFS AND TEACHING PRACTICES OF SECONDARY MATHEMATICS PRE-SERVICE TEACHERS AND THEIR COOPERATING TEACHERS AND ITS EFFECTS ON THE PRE-SERVICE TEACHERS' GROWTH TOWARDS BECOMING REFORM BASED MATHEMATICS TEACHERS

Except where reference is made to the work of others, the work described in this dissertation is my own or was done in collaboration with my advisory committee. This dissertation does not contain any proprietary information.

_____
April C. Parker

Certificate of Approval:

_____	_____
W. Gary Martin Professor Curriculum and Teaching	Marilyn E. Strutchens, Chair Professor Curriculum and Teaching
_____	_____
Kimberly L. King-Jupiter Associate Professor Education Foundations, Leadership & Technology	Stephen Stuckwisch Assistant Professor Mathematics and Statistics

_____
Joe F. Pittman
Interim Dean
Graduate School

AN EXPLORATORY STUDY OF THE POSSIBLE ALIGNMENT BETWEEN THE BELIEFS AND TEACHING PRACTICES OF SECONDARY MATHEMATICS PRE-SERVICE TEACHERS AND THEIR COOPERATING TEACHERS AND ITS EFFECTS ON THE PRE-SERVICE TEACHERS' GROWTH TOWARDS BECOMING REFORM BASED MATHEMATICS TEACHERS

April C. Parker

A Dissertation

Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

Requirements for the

Degree of

Doctor of Philosophy

Auburn, Alabama
December 17, 2007

AN EXPLORATORY STUDY OF THE POSSIBLE ALIGNMENT BETWEEN THE BELIEFS AND TEACHING PRACTICES OF SECONDARY MATHEMATICS PRE-SERVICE TEACHERS AND THEIR COOPERATING TEACHERS AND ITS EFFECTS ON THE PRE-SERVICE TEACHERS' GROWTH TOWARDS BECOMING REFORM BASED MATHEMATICS TEACHERS

April C. Parker

_____
Signature of Author

_____
Date of Graduation

VITA

April C. Parker, daughter of Bobby and Penny Cook, was born January 20, 1975, in Phenix City, Alabama. She graduated from Central High School in 1993. She entered Judson College in 1993 and graduated with a Bachelor of Science degree in Secondary Mathematics Education in December, 1996. While working as a mathematics teacher at Central High School, she entered Graduate School, Troy State University, in January 1998, and graduated with a Master of Science degree in Secondary Mathematics Education in June, 1999. In July 2002, she became employed by Troy University teaching mathematics. While working at Troy University, she entered Graduate School, Auburn University, in August, 2002, and graduated with a Master of Science degree in Applied Mathematics in August 2006. She married Michael Shannon Parker on June 13, 1998 and they have one child, Michael Alexander Parker.

DISSERTATION ABSTRACT

AN EXPLORATORY STUDY OF THE POSSIBLE ALIGNMENT BETWEEN THE BELIEFS AND TEACHING PRACTICES OF SECONDARY MATHEMATICS PRE-SERVICE TEACHERS AND THEIR COOPERATING TEACHERS AND ITS EFFECTS ON THE PRE-SERVICE TEACHERS' GROWTH TOWARDS BECOMING REFORM BASED MATHEMATICS TEACHERS

April C. Parker

Doctor of Philosophy, December 17, 2007
(M.S., Auburn University, 2006)
(M.S., Troy State University, 1999)
(B.S., Judson College, 1996)

280 Typed Pages

Directed by Marilyn E. Strutchens

For the mathematics reform movement to continue, cooperating teachers as well as pre-service teachers must be well equipped to carry out the *Standards* set forth by The National Council of Teachers of Mathematics (NCTM). It becomes necessary to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approach to teach based on their preparation. Particularly, what beliefs and practices do cooperating teachers have that support or hinder the growth of a pre-service teacher immersed into reform-based teaching? What happens when there is a

misalignment of the beliefs and practices held by the cooperating teacher and the educational background of the pre-service teacher?

Case studies of four different cooperating teacher/pre-service teacher pairs were used. The cooperating teachers were all teachers that were currently involved in the university's mathematics reform initiative program. The pre-service teachers were all students that were completing requirements in a mathematics education program that immersed them in mathematics reform techniques. Throughout the study, the researcher used and collected various types of data to better understand the pairs. The forms of data included: a beliefs survey; classroom observations; interviews; and completed Reformed Teaching Observation Protocols (RTOPs) for each classroom observation.

One pre-service teacher was very much reform-minded as was her cooperating teacher. Because of the support she received from her cooperating teacher, the pre-service teacher was able to flourish in her internship. Another pre-service teacher was reform-minded and her cooperating teacher was not. Even so, the pre-service teacher was able to successfully implement the techniques she had learned in her methods courses. The other two pre-service teachers ended up imitating the more traditional practices that were carried out by their cooperating teachers. It is believed that the cooperating teachers' degree of belief in reform mathematics approaches impacted the actions of the pre-service teachers. All cooperating teachers were comfortable allowing the pre-service teachers to try the reform approaches; however, the more traditional cooperating teachers were not able to mentor the pre-service teachers in ways that would help the pre-service teachers. As a result, the traditional cooperating teachers' respective pre-service teachers succumbed to the teaching methods used by them.

ACKNOWLEDGEMENTS

I would first and foremost like to acknowledge my Lord and Savior, Jesus Christ. He has guided each and every step I have taken along this journey. When times got tough, He continually reminded me of his promise in Matthew 19:26 which states, "With man this is impossible, but with God all things are possible." None of this would have been possible without God.

Secondly, I would like to acknowledge my family and friends. Without their love, help, and support, this whole process would have been unbearable. To my husband, Shannon, thank you for believing in me and cheering me on when times were rough. Also, thank you for stepping in and doing the things I didn't have time to do. To my son, Alex, thank you for being my inspiration. To my parents, thank you for instilling in me the importance of a good education. Also, thank you for being there for Shannon and Alex when I couldn't be. Finally, to my friend, Paige, I would like to say thank you for listening and understanding. You'll soon be writing your own acknowledgements!

Last but not least, I would like to acknowledge my committee. Your support and guidance is truly appreciated. To Dr. Strutchens, thank you for being so patient with me and helping me grow through this experience. None of this would have been possible without you.

Style manual or journal used: Publication Manual of the American Psychological Association, Fifth Edition

Computer software used: Microsoft Excel, Version 11; Atlas.ti, Version 5.0; Microsoft Word 2000

TABLE OF CONTENTS

LIST OF TABLES

I. INTRODUCTION

In February 2005, the joint councils of the National Academy of Sciences and the National Academy of Engineering met to discuss how the United States was fairing in the global economy at that time (Committee on Science, Engineering, and Public Policy (CSEPP), 2006). Their conclusion was somewhat bleak. The participants agreed that a weakening of science and technology in the United States would ultimately lead to a degradation of the present social and economic conditions which in turn would inevitably mean that citizens of the United States would not be able to effectively participate in society or compete for high quality jobs (CSEPP, 2006). Additionally, Schoenfeld (2004) felt that a lack of access to mathematics was a barrier – a barrier that left people socially and economically disenfranchised. Schoenfeld (2004) also stated, "We are at risk of becoming a divided nation in which knowledge of mathematics supports a productive, technologically powerful elite while a dependent, semiliterate majority, disproportionately Hispanic and Black, find economic and political power beyond reach. Unless corrected, innumeracy and illiteracy will drive America apart" (Schoenfeld, 2004, p. 265). In response to all of this information, the joint councils determined that in order to counteract this existing decline, the United States workforce must be literate in mathematics and science as well as many other subjects (CSEPP, 2006).

The idea of a mathematically literate workforce was not a new one. In fact, it had been something that had eluded mathematicians and educators for more than a century. All parties agreed that a literate workforce was the desired outcome. The National Council of Teachers of Mathematics had even gone so far as to declare "math for all" (NCTM, 1989, 2000). The controversy had been over how to produce this outcome. The two opposing parties were the traditionalists and the reformists (Schoenfeld, 2004). The traditionalists claimed that the curriculum proposed by the reformists undermined classical mathematical values such as mastery of basic facts for all four operations, knowing and using formulas, counting to 100, etc. (Schoenfeld, 2004). On the other hand, the reformists claimed that their curriculum reflected a deeper and richer view of mathematics than that of the traditionalists (Schoenfeld, 2004). Schoenfeld (2004) further described the traditionalists as being content oriented while the reformists were seen as being more process oriented.

The traditionalists and reformists always argued that the issue was about what was best for the children. In essence, the argument always comes down to which is more important, content or process. The traditionalists argue that in order for our students to be successful in mathematics, they must first understand the skills involved in solving problems before they can ever employ these skills to solve problems (Van de Walle, 2005). Many people today are comfortable with this method of instruction because this is the way mathematics was taught back in the good old days. According to Reys (2002), however, performances over the past thirty years on the National Assessment of Education Progress and the International Mathematics and Science studies show that the methods of the good old days have not been effective. Unlike the traditionalists, the

reformists argue that in order for our students to be successful in mathematics as well as today's growing technological society, they must be able to solve problems, work cooperatively on mathematics and communicate mathematically, and make sense mathematically of the world around them. Van de Walle (2005) stated in his article that one of the only ways for this to be accomplished is by allowing students to construct their knowledge. In other words, the students must be allowed to build upon what they already know in order to understand the new concepts. By allowing this, the students make connections between ideas and concepts. This in turn leads to meaningful networks of ideas which means there are fewer details to remember, it is easier to recall ideas after extended periods of time, there is better application of ideas to newer problems, and there is a feeling that mathematics makes sense (Van de Walle, 2005). Reyes (2002) stated in his article that research is beginning to emerge that proves reform mathematics is indeed increasing student learning and producing the type of mathematical citizen that today's society demands.

Background Information

Throughout the decades, mathematics education has been and continues to be a topic of deep debate and controversy for many parties including but not limited to politicians, the general public, and mathematics educators (Hart & Keller, 2001). In essence, the big debate is centered on how to best educate our nation's children.

During the 1950s, the emphasis of mathematics education was on the learner. It was decided that it was more important to teach practical skills rather than technical content and theoretical mathematics. The justification was that the United States needed

more informed citizens (Hart & Keller, 2001). It was during this time span that enrollment in advanced high school mathematics courses decreased (Klein, 2003). Several things ultimately led to the demise of the way of thinking of the 1950s. The most important was the launch of Sputnik in the fall of 1957. Because Russia beat the United States into space, the Sputnik launch was perceived as a major humiliation for the United States (Klein, 2003). It was determined that the reason for this defeat was brought about by the large number of mathematically illiterate new recruits that were entering the military (Hart & Keller, 2001).

New Math was born in reaction to the dissatisfaction with the 1950s methods of teaching mathematics (Klein, 2003). According to Hart and Keller (2001), this approach to mathematics education was characterized by its emphasis on abstraction and formality. Klein (2003) also stated that during this period, there was very little attention given to basic skills or applications of mathematics. Instead, instruction emphasized topics such as number bases other than base ten, set theory, and various other exotic topics. During this period, teachers were expected to ask "the perfect questions" so that students could investigate and discover the various mathematical topics involved in calculating an answer (Herrera & Owens, 2001). Along with posing the questions, the teacher more or less facilitated the investigation process. This was different from the previous role, which had been telling the students the relevant concepts and then allowing them to practice the new skill of the day (Herrera & Owens, 2001). In the end, many parents ended up feeling confused and alienated because they did not know how to help their children. Another problem was that many teachers were not properly trained in working with this type of curriculum. As a result of parents feeling confused and alienated, teacher ineptness, and

less than satisfactory student performance, public criticism grew. This criticism ultimately led to the death of New Math (Klein, 2003).

In the 1970s, another pendulum swing occurred. This time, there was an outright rebellion against New Math. Instead of the abstractness and formality, the public wanted to go back to teaching students the basic skills of mathematics. This period in mathematics education was known as the Back to Basics movement. During this time, the major goal of the mathematics curricula was to train students to be proficient in computational procedures in the areas of algebra and arithmetic (Schoen, Fey, Hirsch, & Coxford, 1999). In order to accomplish this goal, much attention was given to the classroom instructional routine. This routine generally involved teachers explaining and illustrating the mathematical procedures. Then, the students mimicked the teacher by practicing the new skills on a plethora of similar exercises (Schoen et al., 1999). According to Herrera and Owens (2001), a class during this period was typified as follows: the teacher began class by going over the answer to the previous night's homework assignment; the more difficult problems were worked by the teacher or other students; a brief explanation, if one was given at all, of the new material; and finally, the students were assigned problems to work on until the end of class. Even though the emphasis on basic skills was extreme, national tests given at the time showed that student performance in basic skills either declined or stayed the same. Also, these tests showed that performance in the area of problem solving was very poor (Hart & Keller, 2001).

According to Klein (2003), during the 1980s the public began to realize that the quality of mathematics education had been deteriorating. In spite of the efforts of the Back to Basics movement, many students were not successful problem solvers (Hart &

Keller, 2001). Two important works were produced during the 1980s that greatly influence mathematics education. These two works were *An Agenda for Action* and *A Nation at Risk* (Klein, 2003). It was decided that students must have a certain level of proficiency in basic skills as well as the ability to understand more abstract mathematical concepts. Most important of all, the students needed to be able to apply their mathematical skills and conceptual understanding in order to become proficient problem solvers. The 1980s ended with the publication of The National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards for School Mathematics* (Hart & Keller, 2001).

The mathematics reform of the 1980's continued throughout the 1990s (Hart & Keller, 2001). During this time, NCTM published two more standards documents. *Professional Standards for Teaching Mathematics* was published in 1991, and *Assessment Standards for School Mathematics* was published in 1995.

Hart and Keller (2001) stated that it is believed that the three NCTM documents fueled the "standards-based" reform. The pivotal work of NCTM's standards came in 2000 with the publication of *Principles and Standards for School Mathematics* (PSSM) (Hart & Keller, 2001). The ultimate purpose of this work was to help communicate and implement the new vision for school mathematics (Hart & Keller, 2001). This new vision proposed that the classroom teacher should be more of a stimulant, sounding board, and guide throughout the student problem solving process (Schoen et al., 1999). As described by Herrera and Owens (2001), the teacher should be a facilitator of learning and an orchestrator of classroom discourse. Overall, the role of the teacher must change from one who is the transmitter of knowledge to one who orchestrates classroom discourse,

creates a learning environment that is mathematically empowering, and engages the students in mathematical investigation (Herrera & Owens, 2001; Manouchehri & Goodman, 2000). All of these characteristics typify reform based teaching.

Even after all of this, the debate over what mathematics should be taught throughout the school curricula is still ongoing (Van de Walle, 2006). Do we teach the "basics" or do we teach "reform" mathematics? In order to determine this, it is necessary to know what each method looks like. According to Van de Walle (2006), the "basics" approach consists primarily of arithmetic or computation. This method would include things such as the following: counting accurately to numbers higher than one hundred; solving problems involving formulas; mastery of basic computational skills such as addition, subtraction, division, and multiplication; pencil and paper computation skills; etc (Van de Walle, 2006). Ultimately, the "basics" approach suggests that children mindlessly mimic the things their teachers do. This, however, doesn't necessarily guarantee that they will understand what they are being taught (Van de Walle, 2006). On the other hand, "reform" mathematics focuses more on how students think and learn. According to Van de Walle (2006), reformers have five goals for students: value mathematics; be confident in the ability to do mathematics; become mathematical problem solvers; learn to communicate mathematically; and learn to reason mathematically (Van de Walle, 2006). As a result of these goals, manipulatives, cooperative group work, calculators, etc. have become the hallmarks of reform mathematics (Van de Walle, 2006).

The Issue

According to Curcio and Artzt (2005), one of the most difficult and challenging jobs for teacher educators is to prepare future teachers to support the reform efforts that ultimately lead to high-quality teaching; however, in order for the mathematics reform movement to continue, the existing teachers as well as pre-service teachers must be well equipped to carry out the standards set forth by NCTM (1989, 2000). As stated by Graham and Fennell (2001), over the years, change has been made in teacher education programs. From the early to mid-1900s, many of the teachers were produced by two-year normal schools. In the mid-1900's, these normal schools grew into four-year institutions. As the change to the four-year institutions was made, so were the course requirements for prospective teachers. These improvements were pertinent during the mid-1900s; however, recent studies have shown that not much has changed in teacher education programs since the mid-1900s (Graham & Fennell, 2001). Fortunately, the National Council of Teachers of Mathematics (NCTM) has initiated standards for changing what mathematics should be taught, how it should be taught, and how it should be assessed (Taylor, 2002).

One of the biggest challenges to NCTM's proposed change(s) has been changing teachers' views of mathematics. Up to this point, math has always been associated with following the teacher's rules and finally getting the "one right answer" (Taylor, 2002). Now, teacher educators and mathematics supervisors must "move teachers away from mathematics as teachers have most likely experienced it as students for over a decade and guide teachers toward a view of mathematics that is more consistent with the NCTM standards" (Taylor, 2002, p. 138). Ultimately, teachers must build a new image of

teaching and learning (Taylor, 2002). In light of this building process, it is necessary to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approach to teaching based on their preparation. In particular, what beliefs and practices do cooperating teachers have that support or hinder the growth of an intern indoctrinated into reform-based teaching? Also, what happens when there is a misalignment of the beliefs and practices held by the cooperating teacher and the educational background of the intern?

II. REVIEW OF THE LITERATURE

In order to fully understand the issue at hand, there are several areas that must be explored. First, the general internship experience is discussed. It is important to understand who the participants are during the internship experience as well as how each participant influences the other. Next, is a discussion concerning the beliefs about mathematics instruction. This section explores different ideas about what mathematics should be taught in the classroom. It also examines how mathematics should be taught. Then, it is necessary to explore the various views on the alignment of standards-based academic preparation with internship experiences. Here, the reader is exposed to various ideas about how what the pre-service teachers learn through their university classes either is or is not reinforced throughout their internship experience. Finally, the impact of the above mentioned concepts on the overall internship experience is discussed.

The Internship Experience

Borko and Mayfield (1995) stated that learning to teach is a complex process, especially in the field of mathematics education; however, despite its complexity, learning to teach is also considered to be one of the most important aspects of any educational program. There are several issues that come into existence whenever any educational program begins to try to place student teachers within school systems. The following are some of those issues: what student teaching model will be utilized; what

school system(s) will participate; who the cooperating teachers will be; what role will the cooperating teacher play; what role will the university supervisor play; what will be the responsibilities of the student teacher.

Over the past several years, much research has been conducted on internships in education (Mtetwa & Thompson, 2000). The consistent problem, however, is that a majority of the research that has been done up to this point is very generic. Hardly any of the research that has been conducted thus far has been subject-specific (Mtetwa & Thompson, 2000).

Frykholm (1998), reported that the student teaching experience is generally thought of as the most formative and significant element of the entire educational program. McIntyre, Byrd, and Foxx (1996) agreed, but also added that in the past few years, this practice has come under increased scrutiny. The reason for this is due in part to an increased desire by the educational community to produce new teachers who are capable of analyzing and reflecting on teaching practices (McIntyre et al., 1996). McIntyre et al. (1996) inferred that a possible remedy for this problem is to modify the current student teaching experience.

Under the current model, the tripartite model, there are three key players: the pre-service teacher, the cooperating teacher, and the university supervisor (Tsui, Lopez-Real, Law, Tang, & Shum, 2001). In this model, it is quite obvious that the role of the pre-service teacher is to learn how to teach (Borko & Mayfield, 1995). The cooperating teacher, in general, is thought of as the person that helps build and foster self-confidence rather than to give constructive criticism on instruction (Borko & Mayfield, 1995).

Giving constructive criticism on instruction is generally viewed to be the role of the university supervisor (Borko & Mayfield, 1995).

According to several sources, cooperating teachers are the most important influences within the student teaching experience (Beck & Kosnik, 2000; Drafall & Grant, 1994; Fueyo, 1991). One of the main jobs of the cooperating teacher is to try to help the pre-service teacher through various phases of thought development. Unfortunately, many cooperating teachers do not feel like they have been adequately trained to carry out this role (Drafall & Grant, 1994). According to Beck and Kosnick (2000), the reason for this is a lack of clarity and agreement about the role of the cooperating teacher. There appears to be two separate models for the role of the cooperating teacher. The first is the practical initiation model. In this model, described by Beck and Kosnick (2000), the role of the cooperating teacher is to initiate the pre-service teacher into the field of teaching. In other words, the internship is viewed more like an apprenticeship. According to Beck and Kosnick (2000), there are two approaches to this model. The cooperating teacher either takes the sympathetic approach or the sink or swim approach. The other model that Beck and Kosnick (2000) reported on is the critical intervention model. In this model, the role of the cooperating teacher is to encourage the pre-service teacher to become more reflective and analytical of the implemented teaching practices. This role seems to be one way to ward off some of the scrutiny that was previously mentioned by McIntyre et al. (1996).

Borko and Mayfield (1995) reported on a longitudinal study named Learning to Teach Mathematics (LTTM). In this study, four pre-service teachers were observed throughout their internship experience. All four pre-service teachers were interested in

teaching mathematics in grades six through eight. According to the authors, the cooperating teachers that were assigned to the four pre-service teachers had a varied range of teaching experience and mathematical knowledge (Borko & Mayfield, 1995). The university supervisors who participated in the study were three graduate students. Like the participating cooperating teachers, the university supervisors all had various amounts of mathematical knowledge and teaching experience (Borko & Mayfield, 1995). Throughout the study, various forms of data collection techniques were used. These techniques included the following: interviews with the cooperating teachers, pre-service teachers, and university supervisors; observations of pre-service teachers' mathematical instruction taking place in the classrooms; observations between pre-service teachers and cooperating teachers; and observations between pre-service teachers and the university supervisors (Borko & Mayfield, 1995). It was discovered that many of the conversations held between cooperating teachers and the pre-service teachers rarely included in-depth exploration of issues of teaching and learning mathematics. Likewise, conversations between the university supervisors and the pre-service teachers were frequently too rushed and based on insufficient data concerning the pre-service teachers' teaching. Borko and Mayfield (1995) ultimately concluded that the pre-service teachers involved in LTTM learned not to expect much out of their relationships with the cooperating teachers and university supervisors.

Based on their research, Borko and Mayfield (1995) proposed several reasons for the limitations and potential solutions for changing the situation involving student teaching experiences in the area of mathematics education. One reason involved the belief systems of all parties involved in the student teaching experience. All three parties

involved, the cooperating teachers, the pre-service teachers, and the university supervisors all reported that a person learns to teach by teaching. In other words, learning to teach is accomplished through experience, practice, and making mistakes (Borko & Mayfield, 1995). Based on this, the authors further concluded that it becomes too easy for the cooperating teachers and university supervisors to offer too few suggestions or challenges to the pre-service teachers. Also for the same reason, the pre-service teachers pay very little attention to the feedback that is given by the cooperating teachers and university supervisors. In essence, the status quo is maintained (Borko & Mayfield, 1995). Borko and Mayfield (1995) concluded that the student teaching experience should be considered as a beginning point rather than a culminating point of the pre-service teacher's learning instead of the other way around. Another factor that appeared to hinder the influence of the cooperating teacher and the university supervisor was the shared desire to maximize comfort and minimize risks. Borko and Mayfield (1995) suggested that the cooperating teachers and university supervisors should be supportive of the pre-service teachers, but they should also allow them to take the risks that are necessary for in depth learning. Finally, Borko and Mayfield (1995) reported that both the cooperating teachers and the university supervisors needed to have a more active role in the student teaching experience. In order to function in this more active role, tasks such as modeling new forms of pedagogy and challenging pre-service teachers' beliefs and practices through more frequent and more extensive conversations are expected of both university supervisors and cooperating teachers. In order to accomplish this, however, cooperating teachers and university supervisors alike needed to develop a sense of efficacy as teacher educators. For the cooperating teachers, this involves learning how to engage the pre-

service teachers in more in-depth discussions that focus on teaching and learning as well as how to be more reflective about their practice. For the university supervisors, this process entails shifting from a role of critiquing specific lessons to a role of enabling the cooperating teachers to become teacher educators. This means that the university supervisors would use their time helping the cooperating teachers learn ways to observe pre-service teachers as well as conduct meaningful conversations with the pre-service teachers that ultimately lead to self reflection on teaching practices (Borko & Mayfield, 1995).

Beliefs About Mathematics Instruction

According to Thompson (1992), there are four dominant and distinct views of how mathematics should be taught. One is the learner-focused or constructivist view. From this viewpoint, mathematics teaching focuses on the learner and the knowledge that he can construct. Here, the teacher is a facilitator and stimulator of student learning. Her job is to ask intriguing thought-provoking questions, pose situations for investigation, and challenge students to think (Thompson, 1992). Another of the four dominant views is content-focused with an emphasis on conceptual understanding also known as the Platonist view (Thompson, 1992). Here, mathematics teaching is driven by the mathematical content itself but emphasis is placed on conceptual understanding. This view emphasizes students' understanding of the logical relations among various mathematical topics and the logic underlying the mathematical procedures. The role of the teacher is very similar to that of the previous view (Thompson, 1992). The next view is content-focused with an emphasis on performance also known as the instrumentalist

view (Thompson, 1992). Here, the emphasis is on student performance particularly on the mastery of mathematical rules and procedures. The role of the teacher here is to demonstrate, explain, and define the mathematics the students need to know in an expository style. In this case, the role of the student is to listen, answer questions that have been asked by the teacher, and then complete exercises or problems using the procedures that have been previously demonstrated by the teacher (Thompson, 1992). It is important to note that this type of instruction does not actively engage the students in the process of exploring and investigating various mathematical ideas. Thus, mathematics is many times misrepresented to students when this view is utilized (Thompson, 1992). The final view is the classroom-focused view. Here, mathematics teaching is based on knowledge about effective classrooms. The teacher is portrayed as directing all classroom activities, clearly presenting the mathematical material to the whole class, and providing opportunities for the students to work individually. From this perspective, teachers who are effective can skillfully explain, assign tasks, monitor student work, provide feedback to students as well as manage the overall classroom environment while at the same time eliminate or prevent disruptions that might interfere with the flow of the planned activity. Playing off the role of the teacher, the students' job is to listen, answer questions when asked, follow directions, and complete tasks assigned by the teacher (Thompson, 1992).

Vacc and Bright (1999) reported on a study of pre-service teacher education programs at three sites that was carried out by the University of Wisconsin. In their report, Vacc and Bright focused on the site located at the University of North Carolina. At that site, the researchers explored changes in pre-service elementary school teachers' beliefs concerning teaching and learning mathematics along with their abilities to offer

mathematics instruction that was structured around the way children think. Throughout the study, the thirty-four participants were exposed to Cognitively Guided Instruction (CGI) as part of their mathematics methods courses. A CGI Belief Scale was used to help determine if significant changes in their beliefs and perceptions about mathematics instruction took place throughout the duration of their methods courses and internship experience. Observations were also used to explore how two participants in particular used their knowledge about their students' mathematical thinking in instruction throughout their internship. The two participants, Helen and Andrea, were chosen because their cooperating teachers both taught at the same school and both taught the same grade level. The difference was that one of the cooperating teachers had extensive CGI training while the other had only been briefly exposed (Vacc & Bright, 1999). Andrea was placed with the cooperating teacher that had only been exposed to CGI in a two-hour workshop (Vacc & Bright, 1999).

Helen was placed with the cooperating teacher that had extensive CGI training. Because of her placement, Helen was able to observe her teacher incorporating CGI principles into her mathematics instruction prior to taking over full instruction of the classes. Also, throughout her internship experience, Helen was constantly encouraged by her teacher to gather information about her students' thinking in order to adapt her instruction for the students (Vacc & Bright, 1999).

At the beginning of her program, Helen wrote she believed that the teacher's role was to model problem solutions for the students. She also stated that a teacher should question students to find out what they were thinking as they were solving problems. Throughout her internship experience, Helen consistently planned and implemented

instruction that was based on problem solving. Additionally, she facilitated critical thinking skills and student understanding by using high level questioning that extended beyond basic arithmetic problem types (Vacc & Bright, 1999). The authors commented that the instruction she provided her students appeared to be consistent with her beliefs about teaching and learning mathematics (Vacc & Bright, 1999).

Andrea was placed with the cooperating teacher that had only been briefly exposed to CGI principles. She reported that she received very little support from her teacher. Andrea also stated that most of the time, she taught straight from the textbook unless she knew her lesson was going to be video-taped, then, she taught a "CGI-type" lesson. From the way Andrea commented, her teacher encouraged her choice of when to incorporate the CGI principles (Vacc & Bright, 1999).

At the beginning of her program, Andrea stated that the framework of learning mathematics was the memorization of facts; however, by the conclusion of her internship experience, Andrea stated that children should be provided opportunities to explore and discover various mathematical concepts. She also commented that asking questions was more important than telling students what they needed to know. Vacc and Bright (1999) further commented that the questioning was important to Andrea as long as the students' responses to her questions matched up with what she expected them to say. In essence, her focus ultimately became more directed toward procedure building with the teacher being the ultimate authority on the concept being learned (Vacc & Bright, 1999).

As a result of the study, Vacc and Bright (1999) reported that teachers' beliefs about teaching and learning mathematics greatly influenced the form and type of mathematical instruction that was delivered. In particular, Vacc and Bright (1999) stated

that if teachers' beliefs were compatible with the underlying philosophy and materials comprising the mathematics curriculum they were utilizing, they were more likely to fully implement the curriculum. On the other hand, the same could not be said if the beliefs were not in alignment with the existing curriculum.

According to Vacc and Bright (1999), pre-service teachers are somewhat set in their ways when it comes to their beliefs about teaching and learning mathematics. In particular, many of these beliefs are derived from their own experiences as students. As a matter of fact, it was reported that because of these vivid personal experiences, "learning new theories and concepts may have little effect in changing pre-service teachers' general beliefs about teaching practices" (Vacc & Bright, 1999, p. 91). Cooney, Shealy, and Arvold (1998) also stated that these beliefs seldom change dramatically without significant intervention. In light of this information, it was suggested that in order for existing beliefs to be replaced or restructured, new beliefs must be intelligible and appear plausible (Vacc & Bright, 1999).

Mentoring

An internship experience can also be thought of as a mentoring relationship that exists between the cooperating teacher and the pre-service teacher. Nolder, Smith, and Melrose (1994) stated that the perceived success or failure of the internship experience hinges on the quality of the relationship formed and the expectations of both parties with regard to the roles to be played by the pre-service teacher and the cooperating teacher. These roles can be viewed as: supportive fellow professional; listening friend; supportive critic; gatekeeper and guide; and link agent (Nolder, Smith & Melrose, 1994).

When playing the role of the supportive fellow professional, the mentor treats the pre-service teacher not as a student or teacher's aide but as a novice professional. In this situation, both parties professionally contribute to the relationship. Everything the mentor does is perceived by the pre-service teacher as a model of professional practice (Nolder, Smith & Melrose, 1994).

During the course of the internship experience, the pre-service teacher just needs someone to listen. This is where the role of the listening friend comes into play. In this role, the mentor is there when the pre-service teacher needs to confide his/her fears, his/her joys, or his/her successes or failures in the classroom. Nolder, Smith and Melrose (1994) stated that in order to build this facet of the relationship, it is essential that regular times be set aside for meetings between the cooperating teacher and the pre-service teacher where privacy and confidentiality are respected. Nolder, Smith and Melrose (1994) also commented that availability and approachability seemed to be key features in encouraging the pre-service teachers to relate to their cooperating teacher.

When acting in the role of the supportive critic, the mentor is in essence acting like a critical friend. Being a supportive critic involves many tasks. One is observing pre-service teachers' lessons. Another is offering praise. Giving constructive criticism is yet another. Finally, a supportive critic is available to support the pre-service teacher in follow-up activities (Nolder, Smith & Melrose, 1994).

The role of gatekeeper and guide is another important aspect of a mentor. Here, the mentor is the one who assists the pre-service teacher in getting acquainted with the school and its functions. Some other responsibilities include: provide knowledge about the backgrounds and abilities of the children and what to expect from them; explain the

system within the school such as knowing about discipline, sanctions, and rewards; and know what is likely to work in mathematics classrooms within the school (Nolder, Smith & Melrose, 1994).

The final role of a mentor as discussed by Nolder, Smith and Melrose (1994) is the link agent. In this capacity, the cooperating teacher serves as a liaison. She provides opportunities that ensure the pre-service teacher is familiar with the school, the staff, the students, and other teachers such as English teachers or Special Needs teachers (Nolder, Smith & Melrose, 1994).

From the above descriptions, the roles of supportive fellow professional and supportive critic can be viewed as somewhat comparable roles. Both roles are viewed as ones that assist the pre-service teacher in improving teaching practices. The supportive fellow professional provides guidance for the pre-service teacher by modeling acceptable professional practice. The supportive critic provides guidance for the pre-service teacher by observing lessons, giving constructive criticism, supporting the pre-service teacher in follow up activities, and giving positive recognition when it is due. All of these tasks help the pre-service teacher grow inside the classroom.

Two other roles that can be viewed as comparable roles are those of gatekeeper and guide and the link agent. Both of these roles assist the pre-service teacher with things not directly associated with teaching a lesson. As mentioned above, the primary role of the gatekeeper and guide is to ensure that the pre-service teacher is familiar with the school and its functions. The link agent is similar in that he/she ensures that the pre-service teacher has opportunities to reach out and meet other support agents of the school

such as Special Needs teachers. All of these tasks help the pre-service teacher grow outside the classroom.

All of the above mentioned roles have the potential of being a friend; however, they are not the same as a listening friend. The role of the listening friend can be viewed as simply a sounding board. He/She is there when the pre-service teacher just needs to talk to someone. The things discussed may or may not always be directly related to teaching practices or the internship experience at all. Unlike the other mentoring roles, the listening friend is there for the emotional well-being of the pre-service teacher.

Philippou and Charambous (2005) reiterated that a mentor's role encapsulates a wide spectrum of responsibilities such as being considered as teaching models and critical friends who assist newcomers with planning, teaching, and evaluating students to simply being there to provide assistance to pre-service teachers only when requested. In particular, it has been determined that mentors affect pre-service teachers' teaching image by their teaching style, the feedback they provide to the pre-service teachers, and the underlying messages that their behavior and body language conveys (Philippou & Charambous, 2005). It was also stated that even though mentors are in a position to guide pre-service teachers' participation in practices of teaching and various pedagogical responses, they seldom take advantage of this position (Philippou & Charambous, 2005).

Teacher Efficacy

As defined by Smith (1996), a teacher's sense of efficacy is his/her belief in their ability to have a positive effect on student learning. This sense of efficacy can be viewed as one of two types. The first is teaching efficacy (Smith, 1996). Teaching efficacy refers

to general beliefs about teachers' ability to produce student learning in spite of various external challenges such as low motivation levels in the students, weak student ability, and etc. The other type of efficacy is personal teaching efficacy (Smith, 1996). This type is an individual teacher's own sense of his/her ability to take effective action in teaching. As a natural result, teachers with a strong sense of efficacy generally attribute the success of their students to things that they as teachers did to bring about the success. They disregard other factors that may have also influenced student success. On the other hand, teachers with a weaker sense of efficacy believe that other factors besides their teaching influence student success (Smith, 1996).

According to Smith (1996), a sense of efficacy is a self-attribution. In other words, a person must construct his/her beliefs about the connection between his/her actions and the consequences of those actions. This connection involves two things: beliefs about himself and herself and beliefs about the world. In general, a person must believe that he/she has the ability to have an effect on things along with the belief that the world will respond in a positive manner (Smith, 1996). There are various sources of these beliefs, however, as stated by Smith (1996), a history of perceived past successes plays the most important role. Based on this information, a strong sense of teaching efficacy requires the teacher to: conceptualize what is efficacious about his/her actions and find the positive results of those actions in student learning; reflect on, maintain, and draw upon a personal history of past teaching successes; and recognize that his/her effectiveness will vary from student to student and context to context (Smith, 1996).

Smith (1996) stated that teachers' sense of efficacy is an important influence on their practice as well as their students' learning. As reported by Smith (1996), teachers

who had a higher sense of efficacy: produced higher measures of student achievement; maintained learning environments that were responsive to students; persisted longer with struggling students; and orchestrated more productive small-group work. In general, these teachers knew that their authority in the classroom was a direct result of their competence and not their social position, were more committed to teaching, and were usually more willing to attempt new and innovative practices in their classrooms (Smith, 1996). Charambous, Philippou, and Kyriakides (2004) also stated that teachers with a strong sense of efficacy have more positive attitudes toward innovation and are more likely to implement it and regard the innovation as important and compatible with their usual way of working. Additionally, Charambous, Philippou, and Kyriakides (2004) commented that teachers with a strong sense of efficacy are generally more willing to experiment with new teaching approaches and materials and are usually less anxious about the reform and the possible limitations or complications deriving from it. On the other hand, teachers who have a lower sense of efficacy: attributed student failure to things that were beyond their control such as students' lack of ability, lack of student motivation, flaws within a student's character, or poor home environment; intentionally overlooked students who incorrectly answered questions; and maintained classrooms that were more rigid and controlling (Smith, 1996).

It is believed that efficacy beliefs are important for the success of any reform program. Charambous, Philippou, and Kyriakides (2004) addressed three levels of concerns that teachers have when it comes to reform. They are self concerns, task concerns, and impact concerns. Self concerns typically relate to the teacher's anxiety about his/her ability to take over new demands and responsibilities in the school

environment. Task concerns refer to the every day jobs associated with teaching, especially in relation to numerous limitations such as time constraints, teaching larger numbers of students, having fewer resources, etc. Impact concerns focus on teachers' anxiety concerning students' outcomes (Charambous, Philippou, & Kyriakides, 2004). In order to defuse some of these concerns and maintain a strong sense of efficacy, Charambous, Philippou, and Kyriakides (2004) stated that it was imperative that teachers receive ample information about the philosophy and aims of the reform.

Alignment of Standards-based Academic Preparation with Student Teaching Experiences

One of the biggest challenges to NCTM's proposed change(s) has been changing teachers' views of mathematics. Up to this point, math has always been associated with following the teacher's rules and finally getting the "one right answer" (Taylor, 2002). Now, teacher educators and mathematics supervisors must "move teachers away from mathematics as they have most likely experienced it as students for over a decade and guide them toward a view of mathematics that is more consistent with the standards" (Taylor, 2002, p. 138). Ultimately, teachers must build a new image of teaching and learning (Taylor, 2002).

Taylor (2002) reported that teachers can be categorized into one of two states of being. The first is the teacher in motion. These are the teachers that see themselves as learners. Because they view themselves as learners, they are more likely to evolve and grow in their teaching (Taylor, 2002). The second is the teacher that is at rest. These are the teachers who see themselves as having completed their fundamental learning upon

receiving their certification. These teachers tend to make only superficial changes to their teaching if they make any changes at all (Taylor, 2002). According to Taylor (2002), in order for any kind of significant change to occur, teachers must continually reflect on their teaching, reflect on how their teaching affects their students, seek professional development, and be willing to make changes based on the new understanding(s) they gain from the whole process.

Taylor (2002) recommended two strategies to help overcome the above mentioned challenges. He also noted that these strategies work especially well for pre-service teachers. The first strategy is immersion, and the second strategy is instillation.

The immersion strategy is designed to encourage pre-service mathematics teachers to implement standards-based teaching upon entering the field as a certified teacher. According to Taylor (2002), there are three key factors related to immersion. First, the teacher educator must have standards-based materials readily available for the pre-service teachers and use them on a regular basis with the pre-service teachers. Some materials that Taylor (2000) suggested are standards-based curricula, videotapes of standards-based teaching, and narrative cases of standards-based teaching. All of these are very effective for challenging the pre-service teachers' beliefs about mathematics education. The second key to immersion is to immerse the pre-service teacher in both theory and practice (Taylor, 2002). Bristor et al. (2002), stated that many times, "teacher preparation programs fail to link theory with practice, leave content area knowledge disconnected from methods, and do a poor job of relating instructional practices to learning and development" (p. 689). Taylor (2002) suggested that one way to immerse the pre-service teachers into theory and practice is to engage them as mathematical

learners with an inquiry approach. The third key of immersion is to transition the pre-service mathematics teacher into the real classroom. This can sometimes be an issue if there is inconsistency between the kind of teaching the pre-service teacher has been prepared for and the experience they have through their field experiences and student teaching. Taylor (2002) stated that if this type of inconsistency occurs, the teacher educator would then have to find a way to bring the two worlds closer together. According to Taylor (2002), the best way to do this is to make sure the pre-service teacher gets placed with a teacher whose teaching is in line with the standards. Taylor (2002) recommended that if no such teachers exist, professional development should be done to train the needed cooperating teachers. Peterson and Williams (1998) warn that if this does not occur, the pre-service teachers will be less inclined to utilize the standards-based strategies they have been taught throughout their teacher preparation program.

The instillation strategy is designed to instill some of the professional habits necessary to keep mathematics teachers and their students actively engaged (Taylor, 2002). According to Taylor (2002), there are three key factors involved in the instillation process. The first is to read and discuss practice articles as well as theoretical-research articles. The reasoning behind this is to form habits early and to reinforce the idea that this is a practice that needs to be continued even after they have been teaching for thirty years. Another factor for the instillation strategy is to unite pre-service teachers with other pre-service teachers. This process gets them used to the idea of acting professionally with other people. The purpose for uniting with other pre-service teachers is to get them to associate with other people who have similar experiences up to that point in their career (Taylor, 2002). The third factor is to network the pre-service teachers with

in-service teachers. Taylor (2002) cautioned here that pre-service teachers need to learn to interact with in-service teachers so that they don't get used to only associating with colleagues their own age.

Implications for the Student Teaching Experience

As stated by Pourdavood 1999), existing classroom norms and the cooperating teachers' methods of instructions have profound impact on pre-service teachers' beliefs and practices. According to the research, it seems that if pre-service teachers are to internalize coherent applications to teaching and learning mathematics, the environment in which they complete their internship and the support they receive need to be consistent with the principles being advocated in their professional preparation program (Vacc & Bright, 1999). As quoted by Vacc and Bright:

> Although we believe that providing pre-service teachers with a robust research-based model of children's thinking during a mathematics methods course changes their beliefs about teaching and learning mathematics, their abilities to incorporate these beliefs during student teaching may depend on the support pre-service teachers receive from the classroom teacher who supervises their student-teaching experiences. (1999, p. 109)

It seems that extensive field experiences and linkages between theory and practice are essential elements for changing pre-service teachers' beliefs (Vacc & Bright, 1999). The problem is finding field placements that support the philosophy of reform-based teacher preparation programs. According to the research, recent evidence suggests that incongruent field placements may be counterproductive and damaging in developing

open-minded attitudes toward reform among pre-service teachers (Curcio & Artzt, 2005). Curcio and Artzt (2005) further stated that in order for fieldwork to be most effective, it needs to take place in an environment in which the philosophy is aligned with that of the teacher preparation program. The bottom line is that the framework underlying the content presented in mathematics methods courses needs to be consistent with the framework of the mathematics education program that pre-service teachers observe and implement during field experiences. If the two frameworks are not in sync, the theories and concepts presented during the mathematics methods course may not seem plausible and may ultimately be rejected by the pre-service teacher (Vacc & Bright, 1999).

III. DESIGN OF THE STUDY

Overview

This study incorporated the input from cooperating teacher/pre-service teacher pairs. The purpose of the study was to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approach to teaching based on their preparation. The specific questions of research that were investigated using qualitative methods were:

1. What beliefs and practices do cooperating teachers have that support or hinder the growth of a pre-service teacher immersed in reform based teaching?
2. What happens when there is a misalignment of the beliefs and practices held by the cooperating teacher and the educational background of the pre-service teacher?

Theoretical Basis for the Study

Constructivism is a learning theory where people construct their own understanding of the world (Ishii, 2003; Telese, 1999); hence, the construction of their own knowledge (Ishii, 2003). In turn, constructivism is thought of as a lens with which to know or understand the world (Ishii, 2003).

Ishii (2003) pointed out that professional literature describes constructivism in several different forms. These forms include, but are not necessarily limited to, the following adjectives: contextual, dialectical, empirical, humanistic, information-processing, methodological, moderate, Piagetian, post-epistemological, pragmatic, radical, rational, realistic, social, and socio-historical (Ishii, 2003). Regardless, every form of constructivism incorporates the idea of individually constructed knowledge (Ishii, 2003).

Using constructivism as the lens, the classroom is viewed as a mini society or a community of learners, in particular, a group of learners that are engaged in activity, discourse, and reflection (Telese, 1999). In these classrooms, the teacher is responsible for providing concrete and contextually meaningful experiences in which the students feel comfortable asking questions as well as constructing models, concepts, and strategies (Telese, 1999). In essence, the students and teacher must know and be at ease with the community's language, customs, typical problems, and tools (Greenes, 1995).

Constructivism suggests certain classroom practices and social norms (Wheatley, Blumsack, & Jakubowski, 1995). Some of these social norms include the following: a task that requires time and investigation; students explaining their reasoning to their classmates; and collaboration among peers (Wheatley, Blumsack, & Jakubowski, 1995). These norms imply certain classroom practices associated with constructivist teaching. These practices are: the mathematics studied must be analyzed to determine the major concepts and relationships; it is important to build models of students thinking; tasks are designed that have potential learning opportunities; all activities must have the potential of being meaningful to the students; meaning must be negotiated; and a major

responsibility of the teacher is to facilitate classroom discourse (Wheatley, Blumsack, & Jakubowski, 1995).

In this study, all of the participants can be viewed as "students" who were engaged in utilizing the constructivist theory in some shape, form, or fashion. The cooperating teachers were all involved in the university's reform initiative program. This program was driven by the constructivist view. It was geared toward teaching teachers how to help their students build their own knowledge base in mathematics. By doing so, many of the teachers involved in the program had to take a serious look at the way mathematics instruction was being implemented in their own classrooms. At the same time, the pre-service teachers involved in this study were in the process of constructing their personal teaching style. In their methods courses, the pre-service teachers were exposed to multiple ways to help their students become engaged in meaningful mathematics. Throughout the internship experience, the pre-service teachers were also exposed to other ways to teach their students. Sometimes these methods coincided with what the pre-service teachers had learned in their college courses, and sometimes the methods were contradictory to what the pre-service teachers had been taught. Then, the pre-service teachers also had to contend with the methods they were exposed to in grade school. Which method or combination of methods would work best for them? This was the question that the pre-service teachers had to battle with throughout this study.

Methodology

In general, interpretative research practices were utilized to collect data for this study. According to Gubrium and Holstein (2003), these practices are defined as the

"constellation of procedures, conditions, and resources through which reality is apprehended, understood, organized, and conveyed in everyday life" (Gubrium & Holstein, 2003, p. 215). More importantly, interpretative research practices "engage both the *hows* and *whats* of social reality" (Gubrium & Holstein, 2003, p. 215). Furthermore, these practices focus on how people construct their worlds and experiences (Gubrium & Holstein, 2003).

More specifically, the researcher utilized case studies throughout the data collection process. According to Schwandt (2001), a case study is simply a strategy for doing social inquiry. By definition, a case study is preferred under the following conditions: when the researcher wants answers to how or why questions; when the researcher has little control over events being studied; when the object of study is a contemporary phenomenon in a real-life context; when boundaries between the phenomenon and the context are not clear; and when it is desirable to use multiple sources of evidence (Schwandt, 2001). More importantly, case studies seek to discern and pursue understanding of issues intrinsic to the case (Schwandt, 2001).

Researcher Biases

It is important to note here that the researcher is a graduate student that was exposed to many of the same teachings, philosophies, and techniques as the pre-service teachers. As a result, the researcher may have tended to pay more attention to certain details as opposed to others. For example, when completing the classroom observations, due to prior training, the researcher could have inadvertently dismissed important information for paying attention to other details. Also, by exploring the topic before ever

studying the subjects, the researcher formulated ideas about the outcome of the study. Being human, this means that the researcher naturally looked for things that would support those preconceived notions. Nonetheless, the researcher made a valiant effort to take all information into account when analyzing the data.

Population

Pseudonyms have been used for all students, teachers, and schools included in this study. The population for this study was comprised of cooperating teachers, pre-service teachers, and university supervisors. More specifically, the study focused on the cooperating teacher/pre-service teacher pairs.

Initially, there were six cooperating teachers and seven pre-service teachers that were chosen as potential candidates to participate in this study. During the Spring 2006 semester, when making initial contact with the principals and the cooperating teachers, it was discovered that three of the teachers that all taught for the same system could not be cooperating teachers because they didn't meet the system's criteria for doing so. It was made clear that in that particular school system, a teacher had to have taught in that system for at least three years before he/she could be considered as a cooperating teacher. The three teachers that were chosen by the university did not meet that qualification; hence, without consulting the university, the school system replaced them with three other teachers. One of those teachers chose not to participate in this study. In another situation, one of the teachers originally contacted reported back to the researcher that she would not be teaching mathematics at her present school the next school year because she was relocating as a school librarian in another school. Upon being asked, she did

recommend another teacher to act as her replacement. So, after all of that, there were five cooperating teachers that decided to participate in this study. Once all of the teachers had agreed to participate, the researcher conducted the initial three classroom observations. At the last observation with one of the teachers, he informed the researcher that he was relocating to a different school the next year. Due to various circumstances surrounding this situation, that particular teacher could no longer participate in the study. So, there were four cooperating teachers left to participate in this study.

As mentioned previously, there were initially seven pre-service teachers. They all agreed to participate, so the researcher commenced to observing them in their methods course in which they were all enrolled. At the completion of that course, there were two pre-service teachers whose participation in the upcoming internship was questionable due to their current grade point average. These two pre-service teachers had to take a class during the summer semester to help raise their grade point average so that it would be high enough to participate in the internship experience. Unfortunately, these two were not allowed to participate; therefore, there were five pre-service teachers left to participate in this study.

During the Spring 2006 semester the coordinator of the secondary mathematics education program carefully paired the cooperating teachers with the pre-service teachers. At that time, the pre-service teachers were strategically placed with cooperating teachers that were currently participating in the mathematics reform initiative program, Math Plus. When all of the above described changes began to occur, the cooperating teacher/pre-service teacher pairs changed as well. As an end result of the above described changes, there were four cooperating teachers and four pre-service teachers that were

utilized in this study. The four cooperating teachers all functioned in various capacities in the Math Plus program. One of the cooperating teachers was a Math Plus presenter, district teacher leader, and school teacher leader. Two of the teachers were school teacher leaders. The final cooperating teacher just attended professional development sessions that were provided by Math Plus.

Math Plus

Math Plus, the mathematics reform initiative program, is a partnership between Valley University's College of Education and College of Sciences and Mathematics, Cartersville University, and fifteen school districts located in the Eastern portion of the state. The purpose of the program is to improve mathematics throughout the Eastern portion of the state. Eventually, the program would like to accomplish the following: increase overall student achievement; address gaps in mathematical performance that can be found among the various demographic groups; improve professional development that is offered to practicing mathematics teachers; foster a group of knowledgeable teacher leaders; and enhance the preparation of pre-service teachers at the university level. The mission statement of the program involves enabling all students to understand, utilize, and communicate mathematics as a tool in everyday situations. The final goal is for all students to become life-long learners of mathematics as well as productive citizens. Math Plus hopes to accomplish this agenda by implementing the following: align the K-12 mathematics curriculum; ensure consistency in teaching mathematics throughout the state; provide quality professional development designed for practicing mathematics teachers; and improve the preparation of the pre-service teachers.

Math Plus would not succeed without the participation of the state's mathematics teachers. Besides the various partnerships that are incorporated within the program, the beauty of the program is that there are various levels in which the teachers can choose to participate. A teacher might be selected to become a presenter, a district teacher leader, or a school teacher leader. Other teachers involved in the program receive professional development specifically for their grade level and/or grade band.

A Math Plus presenter facilitates various professional development sessions that help demonstrate ways to achieve the above mentioned goals in today's mathematics classrooms. Not just anyone can be a Math Plus presenter. In order to be considered as a presenter, the participant must be active in Math Plus. This means that he/she regularly attends and actively participates in the various programs sponsored by Math Plus. Then, the teacher is nominated as a potential presenter. Next, he/she is asked to attend a workshop or meeting where his/her participation can be observed by the Math Plus staff. From that point, if the Math Plus staff believes the teacher would be a good presenter; he/she is invited to a presenter planning meeting. Finally, the participant is allowed to co-present at one of the next Math Plus meetings.

The principal of a school selects who will represent the school as a school teacher leader for Math Plus. School teacher leaders have the opportunity to acquire several hours of professional development. The amount that is acquired varies dependant upon the amount of participation by the school teacher leader. At a yearly minimum, a school teacher leader should have sixteen hours from attending the quarterly meetings; however, a school teacher leader could have many more hours than that if he/she attends all of the workshops and meetings that are sponsored by Math Plus. A school teacher leader has the

following responsibilities: coordinate activities at the school; act as a change agent for individual teachers; act as a change agent for groups of teachers; and act as a change agent for reform. In order to coordinate activities at the school, the school teacher leader should: work with individual teachers to improve their skills; plan and conduct school-based planning and inquiry groups; and develop a learning community at the school. In order to act as a change agent for individual teachers, the school teacher leader should incorporate some if not all of the following activities into his/her schedule: peer coach; co-teach; demonstrate lessons for other teachers; plan; advise; and debrief after classroom observations. In order to act as a change agent for groups of teachers, the school teacher leader should: design and/or deliver workshops; lead study groups; and facilitate meetings among mathematics departments at various grade levels. Finally, in order to act as a change agent for reform, the school teacher leader should: create an awareness of the Math Plus agenda; provide proof of reform work; engage teachers in discussions about mathematics reform; and demonstrate lessons that have been used with actual students.

The district teacher leaders are recommended by a representative from their school district. District teacher leaders have the opportunity to acquire several hours of professional development. The amount that is acquired varies dependant upon the amount of participation by the district teacher leader. At a yearly minimum, a district teacher leader should have twelve hours from attending the quarterly meetings; however, a district teacher leader could have many more hours than that if he/she attends all of the workshops and meetings that are sponsored by Math Plus. The responsibilities of a district teacher leader are the same as those of the school teacher leader except they are performed at the district level instead of at the school level.

The first year that a school participates in Math Plus, all teachers who teach mathematics are expected to participate in a two-week professional development program called the Summer Institute. The second year, the teachers are expected to participate in a one week follow up of Summer Institute. During the Summer Institute, the teachers are oriented to the goals and objectives of Math Plus. Additionally, they are provided opportunities to learn and practice many of the reform mathematics techniques. The teachers are also given a curriculum guide that will help them implement reform strategies in their classrooms throughout the academic year. Also at the Summer Institute, there are designated meetings for the school teacher leaders as well as the district teacher leaders. In addition to Summer Institute, the teachers of participating schools are encouraged to attend quarterly meetings. These meetings are designed to provide additional professional development for the teachers as well as opportunities for networking with other teachers who are implementing reform mathematics techniques.

The Mathematics Education Program

The teacher education programs in the university's College of Education are designed to ensure that program graduates have the knowledge, skills and dispositions to help all students learn. These programs maintain selective admission, retention and graduation requirements and are in compliance with the Alabama Teacher Certification Code. In addition, the university offers an assurance of competence that articulates its guarantee with regards to graduates of the teacher education programs.

All students desiring an undergraduate degree in education must meet certain eligibility requirements in order to enter any internship experience. First, the student must

complete and submit his/her internship application one year prior to participating in the internship. Next, the student must have satisfactorily completed all courses that are designated as prerequisites for internship. Also, the student must have a minimum 2.5 GPA on all college coursework that was attempted as well as all coursework attempted at the university, in the program, in professional studies, and in the teaching field. Additionally, the student must have a grade of "C" or better in all professional studies courses. In addition to regular general studies courses, the following are those that students in the mathematics education program complete: Calculus I; Calculus II; Calculus III; Differential Equations; Linear Algebra; Discrete Math; Applied Probability and Statistics I; Foundations of Math; History of Math; Analysis I; Abstract Algebra; Geometry I; Geometry II; Cryptography; Teaching Mathematics in the Middle School; Mathematics Curriculum and Teaching; and Technology in Teaching Secondary Mathematics. The student must also have a passing score on the state's prospective teacher subject assessment. Also, the student must have a clear background check. Finally, the student must demonstrate a potential for teaching and obtain departmental approval.

All students desiring a degree via the fifth year certification program must also meet certain eligibility requirements in order to enter an internship experience. First, the student must complete and submit his/her internship application form two semesters prior to participating in the internship. Also, the student must have a 3.0 GPA on all coursework carrying graduate credit. Additionally, the student must maintain a grade of "C" or better on all coursework carrying graduate credit. See above for a listing of the courses that are completed by students in the mathematics education program. The

student must also have a passing score on the basic skills assessments as well as the subject matter assessment. Also, the student must provide documentation of a clear background check. Finally, the student must demonstrate a potential for teaching and obtain departmental approval.

School Demographics

The cooperating teacher/pre-service teacher pairs were assigned to three different schools: Riverdale High School, Murphy High School, and Yorkshire High School. Two of the pairs were assigned to Riverdale High School while the other two were assigned to Murphy High School and Yorkshire High School respectively. Riverdale was housed within a city school system while Murphy and Yorkshire were housed within separate county school systems. Riverdale was the largest of the three schools and housed grades 9-12. Murphy was the next largest. Like Riverdale, it also housed grades 9-12. Yorkshire was the smallest of the three and housed grades 7-12. It was noted that Yorkshire and Murphy had similar racial background breakdowns with the student body being predominately White. On the other hand, Riverdale had a predominately African American student body. Also, unlike the other two schools, Riverdale had more of a racially diverse student population. Another difference in the three was seen in the socioeconomic background of the students. Yorkshire had the highest percentage of students that were eligible for the free or reduced-price lunch program. Riverdale had the next highest percentage. Murphy had the smallest percentage of students that were eligible for the free or reduced-price lunch program. A comparison of these schools can be found in Table 1.

Table 1

School Demographics

	System	Grades Serviced	Total Population	Student/ Teacher Ratio	Students Eligible for Free or Reduced-Price Lunch	Racial Background
Murphy High School	County	9-12	1003	20	39%	White – 61% African American – 36% Hispanic – 1% Asian – <1% American Indian – <1%
Riverdale High School	City	9-12	1312	16	49%	African American – 59% White – 38% Asian – 2% Hispanic – 1% American Indian – <1%
Yorkshire High School	County	7-12	703	18	58%	White – 60% African American – 40% Hispanic – <1% American Indian – <1% Asian – <1%

The Cooperating Teachers

As stated above, the cooperating teachers that were chosen for this project are currently involved in the mathematics reform initiative program, Math Plus. This, however, does not imply that all participants are performing at the same level of change. In fact, almost every cooperating teacher was functioning at a different level. As previously discussed in the Literature Review, there are four dominant and distinct views of how mathematics should be taught. The views are as follows: constructivist view which is thought of as learner-focused; Platonist view which is thought of as content-

focused with an emphasis on conceptual understanding; instrumentalist view which is thought of as content-focused with an emphasis on performance; and the classroom-focused view (Thompson, 1992). Refer to pages fifteen and sixteen of the Literature Review for further explanations of these four views on the teaching of mathematics. Because the cooperating teachers in this study were chosen from schools participating in Math Plus, the desire was that most of the teachers fell under the views of learner-focused instruction or content-focused instruction with an emphasis on conceptual understanding; however, some of the cooperating teachers fell under the views of content-focused instruction with an emphasis on performance. The desire was also that none of the cooperating teachers involved in the study fell under the view of classroom-focused instruction.

The Pre-Service Teachers

The pre-service teachers that participated in this study were all enrolled in the college of education. Specifically, they are all completing requirements in a mathematics education program that is focused on mathematics reform. Again, these pre-service teachers have been taught how to make mathematics education student-centered instead of teacher-centered. This is evident in the objectives of the internship experience, which is the culmination of their program. According to the internship syllabus, there are several objectives the pre-service teacher must accomplish by the end of the internship experience. The objectives are as follows: to use fundamental mathematical operations, algorithms, and measurements essential to teaching the full range of secondary mathematics; to use language and symbols of mathematics accurately in communications;

to use a variety of manipulative and visual materials to help students explore and develop mathematical concepts; to conduct and lead students in inquiry mathematics activities; and to use technology and other resources to enhance the teaching of mathematics and to promote students' understanding of mathematical concepts.

The University Supervisors

There were three university supervisors that were involved throughout this study. As mentioned previously, the major emphasis of this study was on the cooperating teacher/pre-service teacher pairs so the university supervisors were not formally included in the data collection process. It is important to note, however, that the university supervisors cannot be ignored altogether. University Supervisor A, a graduate teaching assistant, was responsible for Mrs. Franklin and Ms. Walters. University Supervisor B, a professor in the secondary mathematics teaching program, was responsible for Mrs. Windsor. Finally, University Supervisor C, a professor and program coordinator of the secondary mathematics teaching program, was responsible for Ms. Robinson.

Throughout the internship experience, all three university supervisors had the same responsibilities. First, they conducted an orientation meeting with all of the pre-service teachers. At this meeting, the pre-service teachers were familiarized with the course syllabus as well as assignments and other expectations for the internship experience. Second, the university supervisors met with the cooperating teacher/pre-service teacher pair to discuss the course syllabus and internship expectations with the cooperating teacher. Then, each pre-service teacher was observed a minimum of three times. After each observation, each university supervisor held a debriefing session with

his/her respective pre-service teacher. At these meetings, the university supervisor discussed things such as parts of the lesson that went well, parts of the lesson that needed improvement, suggestions for new techniques to try, etc. It should be noted that if the university supervisor felt that additional observations were needed, he/she could visit his/her pre-service teacher as many times as he/she saw fit. At the midpoint of the internship experience, all university supervisors and all pre-service teachers attended a debriefing meeting where progress of the pre-service teachers was discussed as a group. This same type of debriefing was held at the end of the internship experience as well. Also at the conclusion of the internship experience, the university supervisor met with the cooperating teacher/pre-service teacher pair one last time to finalize paperwork and discuss any other concerns any of the involved parties might have.

The Pairs

The following information is to serve only as a brief introduction of the pairs. More detailed descriptions of the pairs will follow in Chapter IV.

Case 1: Mrs. Smith and Mrs. Franklin

Mrs. Smith

Mrs. Smith, a teacher at Riverdale High School, has been teaching high school mathematics for thirty-four years. Her teacher certification is in grades seven through twelve. During the Spring 2006 semester, Mrs. Smith taught two blocks of pre-calculus and one block of remedial math. The Fall 2006 semester she taught one block of pre-calculus, one block of remedial mathematics, and one block of calculus.

Mrs. Franklin

Mrs. Franklin was placed at Riverdale High School and was paired with Mrs. Smith. During the Fall 2006 semester, she taught one block of pre-calculus, one block of remedial mathematics, and one block of calculus.

Case 2: Mrs. Johnson and Ms. Walters

Mrs. Johnson

Mrs. Johnson, a teacher at Riverdale High School, has been teaching high school mathematics for six years. Her teacher certification is in grades four through twelve because she also has a middle school endorsement. During the Spring 2006 semester, Mrs. Johnson taught two blocks of Algebra I and one block of Algebra II. The Fall 2006 semester, she again taught two blocks of Algebra I and one block of Algebra II.

Ms. Walters

Ms. Walters was placed at Riverdale High School and was paired with Mrs. Johnson. During the Fall 2006 semester, she taught two blocks of Algebra I and one block of Algebra II.

Case 3: Mrs. York and Mrs. Windsor

Mrs. York

Mrs. York, a teacher at Murphy High School, has been teaching high school mathematics for seventeen years. Her teacher certification is in grades seven through twelve. During the Spring 2006 semester, Mrs. York taught two blocks of advanced geometry and one block of Algebra 1B. The Fall 2006 semester, she only taught two blocks of geometry. Mrs. York was given two planning periods the Fall 2006 semester because she was the head of the school's SACS review committee.

Mrs. Windsor

Mrs. Windsor was placed at Murphy High School and was paired with Mrs. York. During the Fall 2006 semester, she taught two blocks of geometry. It is important to note that due to the fact that Mrs. York only taught two classes, Mrs. Windsor was placed with another teacher at Murphy High School for her third class. This third class was not used in this study.

Case 4: Mrs. Brown and Ms. Robinson

Mrs. Brown

Mrs. Brown, a teacher at Yorkshire High School, has been teaching high school mathematics for 18½ years. Her teacher certification is in grades seven through twelve. During the Spring 2006 semester, Mrs. Brown taught one period of Algebra I, three periods of Algebra II, and two periods of pre-calculus. It is important to note here that prior to the 2005-2006 school year, Yorkshire High School utilized block scheduling. The 2005-2006 school year was the first year for Yorkshire High School to have the seven period day. During the Fall 2006 semester, Mrs. Brown taught two periods of Algebra II, one period of remedial mathematics, two periods of pre-calculus, and one period of Algebra 1B which was an inclusion class.

Ms. Robinson

Ms. Robinson was placed at Yorkshire High School and was paired with Mrs. Brown. During the Fall 2006 semester, she taught 2 periods of Algebra II, one period of remedial mathematics, two periods of pre-calculus, and one period of Algebra 1B which was an inclusion class.

Table 2

Summary of Cooperating Teacher/Pre-Service Teacher Pairs

	School	Student Population	Classes Taught
Mrs. Smith and Mrs. Franklin	Riverdale	11th and 12th grade	Pre-Calculus Remediation Calculus
Mrs. Johnson and Ms. Walters	Riverdale	9th and 10th grade	Algebra I Algebra II
Mrs. York and Mrs. Windsor	Murphy	9th and 10th grade	Geometry
Mrs. Brown and Ms. Robinson	Yorkshire	10th, 11th,and 12th grade	Algebra II Remediation Pre-Calculus Algebra 1B

Instrumentation

Interviews

The initial interview was conducted in the Spring 2006 semester. Each participant, cooperating teachers and pre-service teachers, was asked questions from a predetermined list of questions. This was to ensure that all topics of interest were addressed as well as to ensure that all participants were asked the same questions. The second interview was conducted in the Fall 2006 semester. As before, each participant was asked questions from a predetermined list of questions. Refer to Appendix A for the following sets of interview questions: Spring 2006 Teacher Interview Questions; Spring 2006 Pre-Service Teacher Interview Questions; Fall 2006 Teacher Interview Questions; and Fall 2006 Pre-Service Teacher Interview Questions.

The Spring 2006 Teacher Interview Questions were chosen because they addressed the two topics of interest, the first concerning beliefs about teaching and learning mathematics, the second concerning the internship experience. Questions were asked to investigate what the teachers thought mathematics involved. The cooperating teacher participants were asked to describe the best way for students to learn mathematics as well as the most effective ways to teach mathematics. They were also asked to portray how they thought they had an impact on student learning. Also, the teachers were asked to analyze their teaching by explaining when they knew they had delivered a good mathematics lesson, depicting a typical lesson in their classroom, discussing the various tasks that were used in their classroom, and portraying the learning environment of their classroom. In addition, the teachers were also asked to expound upon what most influenced their beliefs and practices in the mathematics classroom. In conjunction with the above questions, the teacher participants were also asked to answer questions pertaining to the internship experience. They were asked to define the roles of the cooperating teacher and the university supervisor. Additionally, they were asked to discuss things they would expect from the pre-service teacher. The researcher also asked the teachers to talk about who would have the most influence on the pre-service teacher and why. Finally, the teachers were asked to discuss the problems they thought might arise if the pre-service teachers had differing beliefs about teaching and learning mathematics.

The Spring 2006 Pre-service Teacher Interview Questions were chosen because like the Teacher Interview Questions, they addressed the two topics of interest, the first concerning beliefs about teaching and learning mathematics, the second concerning the

internship experience. Questions were asked to investigate what the pre-service teachers thought mathematics involved. The pre-service teacher participants were asked to describe the best way for students to learn mathematics as well as the most effective ways to teach mathematics. They were also asked to describe how they thought they had an impact on student learning. Also, the pre-service teachers were asked to analyze their teaching even though by this point, their actual teaching time in a real classroom had been somewhat limited. They were asked to explain when they knew they had delivered a good mathematics lesson, describe what they thought a typical lesson would look like in their classroom, discuss the various tasks they imagined would be used in their classroom, and portray the ideal learning environment for their classroom. In addition, the pre-service teachers were also asked to discuss what most influenced their beliefs and practices in the mathematics classroom. In conjunction with the above questions, the pre-service teacher participants were also asked to answer questions pertaining to the internship experience as a whole. They were asked to define their role as a pre-service teacher along with the roles of the cooperating teacher and the university supervisor. The researcher also asked the pre-service teachers to talk about who they thought would have the most influence on them and why. Finally, the pre-service teachers were asked to discuss the problems they thought might arise if the cooperating teachers had differing beliefs about teaching and learning mathematics than they had.

The Fall 2006 Teacher Interview Questions were used to see if any perceptions had changed at the end of the internship experience. They were first asked to discuss any changes in the way they felt about teaching and learning mathematics. Following that discussion, the teacher participants were once again asked to define the roles of the

cooperating teacher, the pre-service teacher, and the university supervisor. Additionally, they were asked to elaborate on who they thought influenced the pre-service teacher the most. Concerning the internship experience as a whole, the teacher participants were asked to talk about whether or not they thought the internship experience turned out the way they initially envisioned it. They were also asked to expound upon the most beneficial part or parts of the internship experience along with any changes they would recommend. Finally, the teacher participants were asked to discuss whether or not they and their pre-service teacher had differing beliefs about mathematics learning and teaching and then to elaborate on any issues that may have come about because of these differing beliefs.

The Fall 2006 Pre-service Teacher Interview Questions were used to see if any perceptions had changed because of the internship experience. The pre-service teachers were asked to discuss what they thought mathematics entailed, the best way for students to learn mathematics, and the most effective ways of teaching mathematics. The researcher asked the pre-service teachers to analyze their teaching by asking them to describe how they knew they had taught a successful lesson, how they knew they had taught an unsuccessful lesson, what their typical mathematics lesson looked like, the types of tasks that the students engaged in during a mathematics lesson, and the overall learning environment of their classroom. Like the teacher participants, the pre-service teachers were asked to define the roles of the cooperating teacher, the university supervisor as well as their role as a pre-service teacher. Additionally, they were asked to discuss who had the most influence on them throughout the internship experience and why. Concerning the internship experience as a whole, the pre-service teacher

participants were asked to talk about whether or not they thought the internship experience turned out the way they envisioned it in the beginning. They were also asked to elaborate on the most beneficial part or parts of the internship experience along with any changes they would recommend. Finally, the pre-service teacher participants were asked to talk about whether or not they and their cooperating teacher had differing beliefs about mathematics learning and teaching and then to elaborate on any issues that may have come about because of these differing beliefs.

Reformed Teaching Observation Protocol (RTOP)

The Reformed Teaching Observation Protocol (RTOP) is an observational instrument that was designed by a participant of the Arizona Teacher Excellence Coalition (AzTEC), the Evaluation Facilitation Group (EFG) of the Arizona Collaborative for the Excellence in the Preparation of Teachers (ACEPT), to provide a standardized means of determining to what degree mathematics instruction reform had taken place (AzTEC, 2002). The instrument is comprised of twenty-five items that focus on reform. These items are organized into five categories containing five questions each. The categories are as follows: lesson design and implementation; content: propositional pedagogic knowledge; content: procedural pedagogic knowledge; classroom culture: communicative interactions; and classroom culture: student/teacher relationships (AzTEC, 2002). Each question is scored on a five point Likert scale where 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). A copy of the RTOP can be found in Appendix C.

Prior to utilizing the RTOP as an observational instrument, the researcher along with several other Math Plus participants engaged in training to learn how to effectively

use the instrument. The training took place in two segments. During the first segment, the participants watched a recording of a teacher teaching a mathematics lesson. Then, the participants used the RTOP to determine at which level of reform the teacher was performing. Next, the group discussed the "scores" that were given. At this point, any discrepancies in the scores were resolved. Finally, this process was repeated using another recorded lesson. The purpose of this activity was to eventually get all RTOP users to score the same lesson similarly. This would ultimately ensure reliability among observers. The second segment of the training involved the same process. The difference was that this segment was completed a couple of weeks after the initial training. The purpose here was to ensure that observers were still utilizing the things that were learned at the initial training.

Beliefs Survey Used by Math Plus

The beliefs survey consisted of five components. They were as follows: the teacher's beliefs about teaching and learning mathematics; information about the mathematics classes being taught; background information; and involvement in Math Plus. The components that were the most relevant to this project were: beliefs about teaching and learning mathematics, and information about the mathematics classes taught. With the exception of the questions pertaining strictly to demographic information, each component contained questions that were to be answered in the following manner: strongly agree, agree, neutral, disagree, or strongly disagree. A copy of this survey can be found in Appendix D.

Procedure

At the beginning of the Spring 2006 semester, principals were contacted and then provided information letters explaining the intent and design of the study; see Appendix B for a copy of the information letter that was provided to the principals. Once the principals had given permission for their teachers to be included in this study, the participating cooperating teachers were contacted and provided information letters explaining the intent and design of the study. Additionally, the participating cooperating teachers were asked to sign a consent form in order to participate. A copy of the information letter in addition to the consent form can be found in Appendix B. Simultaneously, the participating pre-service teachers were also given information letters explaining the intent and design of the study. Just like the cooperating teachers, the participating pre-service teachers were asked to sign a consent form in order to participate in the study; refer to Appendix B for a copy of the information letter as well as the consent form.

Once consent had been obtained by all participating parties, the formal data collection process began. This process began by administering the mathematics beliefs survey to all participating cooperating teachers and pre-service teachers; refer to Appendix D for a copy of the beliefs survey. Then, during the last half of the Spring 2006 semester, each cooperating teacher was observed three times. The Reformed Teaching Observation Protocol (RTOP) was used in conjunction with these observations; a copy of the RTOP can be found in Appendix C. Also, during the last half of the Spring 2006 semester, each cooperating teacher was interviewed; refer to Appendix A for a listing of the Spring 2006 Cooperating Teacher Interview Questions. All interviews were audio-taped and then

transcribed at a later date. When the researcher was not observing the cooperating teachers, she was observing the pre-service teachers in their mathematics methods course. These observations continued until the end of the Spring 2006 semester. Additionally, there were at least seven of these types of observations. At the beginning of the Summer 2006 semester, each pre-service teacher was interviewed; see Appendix A for a listing of the interview questions. As with the cooperating teachers, all interviews were audio-taped and then transcribed at a later date. Also at the beginning of the Summer 2006 semester, the researcher observed the cooperating teachers while they attended the two-week long summer training sessions provided by the university sponsored mathematics reform initiative program. At the onset of the Fall 2006 semester, the researcher observed the cooperating teachers one more time. As before, the RTOP was utilized. Next, each pre-service teacher was observed on three separate occasions throughout the Fall 2006 semester. As with the cooperating teachers, the RTOP was utilized. At the end of the Fall 2006 semester, each participating cooperating teacher and pre-service teacher was administered the same mathematics beliefs survey they had been given in the Spring 2006 semester. Finally, the participants were asked some follow up interview questions. A copy of the Fall 2006 interview questions can be found in Appendix A. As before, these questions were transcribed at a later date.

Table 3

Summary of Instrumentation Used for Study

	Cooperating Teachers	Pre-Service Teachers
Spring 2006 Interview	√	√
Fall 2006 Interview	√	√
Spring 2006 Beliefs Survey	√	√
Fall 2006 Beliefs Survey	√	√
Spring 2006 RTOP Observations	√	
Fall 2006 RTOP Observations	√	√

Analysis of Data

The researcher utilized Atlas.ti software to assist in the coding of the data. The coding process suggested by Strauss and Corbin (1990) was used. In this process, there are three main types of coding: open coding; axial coding; and selective coding (Strauss & Corbin, 1990). It is important to note that these are analytic types of coding; therefore, the researcher may or may not move from open coding to axial coding to selective coding in a strict consecutive manner. As defined by Strauss and Corbin (1990), open coding is the portion of data analysis that involves labeling and categorizing the phenomena as indicated by the data. In open coding, the researcher must ask questions and make constant comparisons about the data. Initially, the data are broken down by asking simple questions such as what, where, how, when, how much, etc. Then, data are compared and

similar incidents are grouped together and given the same conceptual label. This process of grouping concepts at a higher, more abstract, level is called categorizing (Strauss & Corbin, 1990). Axial coding takes the coding process to another level. Unlike open coding which separates the data into concepts and categories, axial coding puts the data back together in new ways by making connections between a category and its sub-categories; therefore, axial coding is the process of developing main categories and their sub-categories (Strauss & Corbin, 1990). Finally, selective coding involves the integration of the categories that have been developed to form the initial theoretical framework (Strauss & Corbin, 1990).

Fine, Weis, Weseen, and Wong (2003) define triangulation as a method of adding layers to the data source by using multiple items to measure the same construct. In an effort to achieve triangulation, as defined above, a plethora of data was analyzed for this study. The researcher utilized the Reformed Teaching Observation Protocol (RTOP) form to help gather information from classroom observations. The researcher also used the beliefs survey that is used by the university's mathematics reform initiative program. This survey assisted the researcher in analyzing each participant's beliefs about learning and teaching mathematics. In addition to these sources of data, the researcher also used course syllabi as well as interviews to help gather information for this study.

IV. RESULTS, ANALYSIS, & INTERPRETATION OF THE DATA

Borko and Mayfield (1995) stated that learning to teach is a complex process, especially in the field of mathematics education; however, despite its complexity, learning to teach is also considered to be one of the most important aspects of any educational program. Frykholm (1998) further elaborated that the student teaching experience is generally thought of as the most formative and significant element of the entire educational program. In light of this, Pourdavood (1999) stated that existing classroom norms and the cooperating teachers' methods of instructions have profound impact on pre-service teachers' beliefs and practices. According to the research, it seems that if pre-service teachers are to internalize coherent applications to teaching and learning mathematics, the environment in which they complete their internship and the support they receive need to be consistent with the principles being advocated in their professional preparation program (Vacc & Bright, 1999).

As stated earlier, the purpose of this study was to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approach to teaching based on their preparation. Interviews, beliefs surveys, and classroom observations were all utilized to help explore: what beliefs and practices cooperating teachers have that support or hinder the growth of a pre-service teacher indoctrinated in reform based teaching; and what happens when there is a misalignment

of the beliefs and practices held by the cooperating teacher and the educational background of the pre-service teacher.

Chapter Organization

In order to best relay the details of the study in a logical manner, the researcher determined that it would be best to combine the results of the data, the analysis of the data, and the interpretation of the data into one chapter. In this chapter the reader can expect to find the following information about each case: demographic information about the school; background information about the participants; beliefs about teaching and learning mathematics; expectations of the internship experience; vignettes from classroom observations; information about lesson design and implementation; information about communicative interactions in the classroom; information about procedural knowledge; information about propositional knowledge; and information describing the student/teacher relationships.

Analysis of the Data

Analysis and interpretation of observations and interviews with the four cooperating teachers and four pre-service teachers was completed using a qualitative computer software program called Atlas.ti (Scientific Software Development GmbH, 2003). At the conclusion of the data collection process, all taped interviews were transcribed and all observation notes were typed up so that they could be loaded into the aforementioned software for analysis. As a result of this process, each document was linked to Atlas.ti and was then accessed through that link. By having the document linked

to the program instead of using the program to create the document, the document could not be changed by the program. Atlas.ti allows the researcher to code text and organize it into hermeneutic units, which is a way to name a single unit of text documents. When using the software, a single word, multiple words, sentences, or even paragraphs from several documents can be coded with a word or phrase which refers back to the meaning that is associated to the words. For example, cooperating teachers and pre-service teachers discussed various ways to design and implement their lessons; therefore, the code "lesson design and implementation" was utilized. It should be noted here as well that identical phrases or portions of phrases could be coded with multiple codes. For example a phrase coded with "lesson design and implementation" could also be assigned to the code "communicative interactions". Ultimately, any selected code can be used to sort the text so that the researcher can see all text that is associated with that particular code along with identifying information to tell the researcher from which document the phrase or phrases originated.

After reading through each of the documents, various patterns and similarities emerged. These patterns and similarities along with the headings from the RTOP were used to generate the list of codes. For example, even though responses were as varied as the responders, all interviews followed a defined set of questions, so that similar response categories were more apparent. The list of codes follows in Table 4 with the number of times each code was used after all of the documents had been coded.

Table 4

Utilized Code Words and Frequency

Code	Frequency
Lesson Design and Implementation	293
Procedural Knowledge	122
Propositional Knowledge	75
Communicative Interactions	258
Student-Led Discussion	78
Teacher-Led Discussion	145
Student/Teacher Relationships	145

Utilizing Atlas.ti permitted an accurate and efficient method of recording and tracking selected codes so that major areas could readily be identified. For example, with "lesson design and implementation" resulting in 293 responses, it is evident that this was a major category. At the same time, however, it is obvious that with 75 resulting responses, "propositional knowledge" was the least of the categories.

As mentioned previously, the researcher used the coding process suggested by Strauss and Corbin (1990). In the initial phase of coding, the process of open coding as defined by Strauss and Corbin (1990) was utilized. In order to generate the overall categories that were used for the open coding, the researcher used the categories from the RTOP. The categories used for the open coding process were: Lesson Design and Implementation; Communicative Interactions; and Student/Teacher Relationships. Once

the open coding had been completed, the researcher divided the larger groupings into smaller subsets using the process of axial coding as defined by Strauss and Corbin (1990). Lesson Design and Implementation was divided into two subsets: Propositional Knowledge and Procedural Knowledge. Both of these subset categories were derived from the RTOP. The other large category, Communicative Interactions, was divided into two subsets as well: Student-Led Discussion and Teacher-Led Discussion. Both of these subset categories were generated by the researcher. The third category of Student/Teacher Relationships was not subdivided.

When coding the data, any information that had anything to do with lesson design or lesson implementation was placed in the category Lesson Design and Implementation (293 occurrences). Then, that information was further subdivided into the subset categories of Propositional Knowledge (75 occurrences) and Procedural Knowledge (122 occurrences). Propositional knowledge was considered as anything in the lesson design or implementation that allowed the students opportunities to explore mathematical concepts for themselves. Procedural knowledge was considered as anything in the lesson design or implementation that focused only on the procedures involved in solving mathematical problems. It should be noted that the occurrences of the subsets Propositional Knowledge and Procedural Knowledge do not add up to the total number of occurrences of Lesson Design and Implementation. That is because there were things that were placed in the Lesson Design and Implementation category that were strictly about the lesson and had nothing to do with either subset.

When coding the data, any information that had anything to do with communicative interactions was placed in the category Communicative Interactions (258

occurrences). Then, that information was further subdivided into the subset categories of Student-Led Discussion (78 occurrences) and Teacher-Led Discussion (145 occurrences). Student-led discussions were considered any type of discussion where the students either initiated the conversation or were presenting some type of mathematical information. Teacher-led discussions were considered any type of discussion where the teacher dominated most or all of the conversation. It should be noted that the number of occurrences of the subsets Student-Led Discussion and Teacher-Led Discussion do not add up to the total number of occurrences of Communicative Interactions. That is because there were instances of conversations that were neither student-led nor teacher-led.

Finally, when coding the data, any information that had to do with student/teacher relationships was placed in the category Student/Teacher Relationships (145 occurrences). These occurrences were things such as a teacher's actions toward a student or group of students. The occurrences were also things such as a student's or group of students' actions toward the teacher.

Case 1: Mrs. Smith and Mrs. Franklin

Mrs. Smith is the White female cooperating teacher discussed throughout Case One. She is a veteran teacher that has been teaching mathematics for thirty-four years. Mrs. Franklin is a White, devout Muslim, female, pre-service teacher discussed throughout Case One. Mrs. Franklin is working on her degree in Secondary Mathematics Education.

The internship experience discussed throughout Case One takes place at Riverdale High School. Riverdale High School is a city school that services students in grades nine through twelve. Its total population is 1312 students. The student-teacher ratio for the

school is sixteen to one. Forty-nine percent of the student body is eligible for the free or reduced-price lunch program. The student body has the following racial components: African American, White, Asian/Pacific Islander, Hispanic, and American Indian/Alaskan Native. Fifty-nine percent of the students are African American. Thirty-eight percent of the students are White. Two percent of the students are Asian/Pacific Islander. One percent of the students are Hispanic. Finally, less than one percent of the students are American Indian/Alaskan Native.

Table 5

Demographic Summary of Riverdale High School

System Type	Grades Serviced	Total Population	Student/ Teacher Ratio	Students Eligible for Free or Reduced-Price Lunch	Racial Background
City	9-12	1312	16	49%	African American – 59% White – 38% Asian/ Pacific Islander – 2% Hispanic – 1% American Indian/ Alaskan Native – <1%

Mrs. Smith

Mrs. Smith is a White female in her mid fifties with at least two adult children. She is very tall and has a very dominant presence in the classroom due to her stature, loud voice, and no nonsense attitude. Mrs. Smith has been teaching high school mathematics for thirty-four years. Twenty of those thirty-four years have been spent teaching at Riverdale High School. She has a bachelor's degree in mathematics and a master's degree in mathematics education.

Mrs. Smith is also the Math Plus School Teacher Leader at her school. Refer to pages 37 and 38 for more detailed information about the role and responsibilities of a school teacher leader. Mrs. Smith reported that over the past year, she has spent approximately forty-one to eighty hours involved in some type of professional development. Of those hours, she stated that six to ten of those hours were spent in professional development settings that specifically focused on mathematics. Additionally, she reported that over twenty of her professional development hours were spent in association with Math Plus. It should be noted here that Mrs. Smith really acted as a school teacher leader in name only. As far as the researcher could tell, the most Mrs. Smith did in the way of mathematics reform was attend some of the professional development opportunities that were provided by Math Plus. She also attempted to implement a few activities in her own classroom, but it was apparent that she was not comfortable at all with implementing any of the reform initiatives that she was supposed to be advocating. Mrs. Smith was not observed fulfilling the above listed responsibilities of a school teacher leader.

When asked to give a description of mathematics in general, Mrs. Smith stated that mathematics was "looking at patterns, looking at numbers, looking at various steps and processes whether it's solving equations, logarithms, whatever." She also commented that mathematics was "realizing that there is a pattern, there is logic to things." When asked to discuss what she thought was the best way for students to learn mathematics, Mrs. Smith responded by saying that "not all students learn the same way." She further elaborated by saying that "there are some who need constant repetition; there are some who need hands-on; and there are some who say show me what works, how it works, and then leave me alone." In addition, Mrs. Smith replied that "while a lot of them these days do need hands-on, I don't think everybody does." Upon being asked to discuss her feelings about the most effective way to teach mathematics, Mrs. Smith immediately responded that it depended on what was being taught. She also commented, "I try to relate to something that they know something about." When Mrs. Smith was asked to describe a typical mathematics lesson in her classroom. She answered,

> Again, it depends on what level we're talking about. Some days, it will be lecture. Some days it will be getting together to work on some problems to practice some topic we've done. Occasionally, it will be a lab or some kind of hands-on. Probably, there's more lecture with the calculus and pre-calculus than there is anything else, but they do, when they're practicing a new topic or whatever, they will sit together and do some group work and some teaching each other kinds of things with those.

Since Mrs. Smith specifically addressed her upper level classes, the researcher probed further by asking her to describe a typical mathematics classroom in her remediation class. She responded,

> A lot of that is practice and drill. Positive slope looks this way. Negative slope looks this way. How can you remember that? Those kinds of things. It is a real skill because that's what they have to do to pass the graduation exam. So it is very intense, what I would call, drill on a particular skill, and we pull in any kind of thing that we can to help them remember things for the graduation exam.

According to her responses on the beliefs survey, Mrs. Smith believed mathematics is an important subject that should be available to all students because it is something that will continue to be used even once the students are out of school. Mrs. Smith agreed that students need good mathematical problem-solving skills in order to be successful in the future. She also agreed that in order to formulate these problem-solving skills students must be able to follow directions. Additionally, Mrs. Smith agreed that students should not only be able to obtain correct answers, but they should also understand the mathematical concepts involved in getting to that right answer. She also felt that students should understand important mathematical concepts before they ever attempt to memorize definitions and facts. Finally, Mrs. Smith responded that students should be allowed to figure things out on their own rather than depending on demonstrations/explanations given by their teacher. Refer to Appendix D Table 21 to view all of Mrs. Smith's responses to the beliefs survey.

When asked to discuss her anticipated role as the cooperating teacher, Mrs. Smith responded,

> Well, I see my role as helping them not make mistakes, especially in front of the students. Helping them prepare and to be prepared when they stand up in front of the students. Helping them to have a good plan and to have a good idea, a good understanding of our student population.

She further elaborated by saying

> I don't think it is my job to tell them how to teach because what works for me might not work for them. Because to me, your teaching is also a function of your personality. Ultimately, to guide them as best I can, but never to tell them this is the way it is to be done.

Upon being asked to discuss the anticipated role of the university supervisor, Mrs. Smith replied that she felt that the university supervisor should be more up to date on the research and the theory on what should work in the classroom. She also described the university supervisor as a supervising teacher; one who could give guidance and help.

When questioned about her expectations of the pre-service teacher, Mrs. Smith immediately stated, "I expect the intern, to first of all, obey the school rules because that gets us into trouble quickly." Then, she added, "I expect them to be on time, and prepared with the lesson. I don't expect them to be perfect because sometimes you don't realize that something won't work until you try it." Additionally, she commented, "So, be well prepared for your students. And be open to suggestions. I wouldn't necessarily say criticism because I don't think that's my role, but be open to suggestions for how things might improve from me or other teachers."

Finally, Mrs. Smith was asked to talk about if she thought there would be problems if she and her pre-service teacher had different beliefs about teaching and learning mathematics. Her reply was,

> No, because I don't claim to have all of the answers. And I will admit that I guess age and fatigue can be a factor in some of the things that I do or don't do. And I will have all of the admiration in the world to somebody that comes in and is enthusiastic and energetic who wants to try other things because even with my students I don't say "This is the way to work the problem, and it must be worked this way." If you discovered something else that works, and it is mathematically correct, I don't want anything that is not; then go for it. And I feel that way. I don't claim to have all the answers. What works for me may not work for someone else.

Spring 2006 and Fall 2006 Classroom Observations

During the Spring 2006 semester, Mrs. Smith taught two blocks of pre-calculus and one block of remedial math. The Fall 2006 semester, she taught one block of pre-calculus, one block of remedial mathematics, and one block of calculus.

Throughout the Spring 2006 semester, Mrs. Smith was observed on three separate occasions. These three observations were spread out over a period of a month. The first observation was of a Pre-Calculus class. The second observation was of a remediation math class. The third observation was of a Pre-Calculus class.

Based on the classroom observations, a typical Pre-Calculus class looked something like the following:

At the beginning of the class, the students were expected to work three review problems involving simplifying trigonometric expressions such as (tan x / sec x). As the students worked, Mrs. Smith walked around and gave the students "hints" about how to handle the problems. As the students started finishing up, she asked individual students to work the problems on the board. Once this had been completed, Mrs. Smith told the class that they would have a test in two days covering fundamental trigonometric functions, solving equations over the set of complex numbers, and rectangular and coordinate form. The teacher provided the students with several examples of problems that the students could expect to see on the test. Some of the problems, Mrs. Smith worked on the board and other problems were worked by individual students. Throughout this whole process, Mrs. Smith was constantly asking questions such as, "Are you really going to leave your answer that way?" and "What's the next step?". Apparently, the students were not completely simplifying their answers, and this was a big deal with the teacher. Also, it appeared that her emphasis was on the students completing all of the steps to solve a problem. She never really asked them to explain to her why things worked the way they did.

A typical remediation class resembled the following:

The lesson began by reviewing how to simplify ratios. For the class, the teacher took the students through problems step-by-step. She did not skip steps when working through the problems. She also said things like, "First, we do…Then we do…". Also, she approached each problem solving process like the students had

never seen these problems before. Again, everything was very procedural in nature.

Once the teacher was satisfied that the students could simplify simple ratios, she moved on to solving proportions. She worked through some basic proportion problems and then moved on to some more complicated problems where the distributive property was required. Then, she gave the students some proportional word problems that required the students to find things such as the number of gallons of punch needed for a party with a certain amount of people attending. This appeared to be Mrs. Smith's attempt to make these problems apply to the students' lives. These problems also gave Mrs. Smith the opportunity to discuss reasonable answers with the students. In this discussion, they talked about the possibility of getting answers that involved half of a person, etc. After working through a few of these problems, the students went to lunch.

At the conclusion of each of the above mentioned observations, the researcher completed the Reformed Teaching Observation Protocol (RTOP) for each respective lesson. The RTOP is an observational instrument that was designed to provide a standardized means of determining to what degree mathematics instruction reform had taken place (AzTEC, 2002). The researcher averaged the scores for the five questions in each section to determine an average score for each section of the RTOP. The researcher then determined the median score of the three observations for each section of the RTOP. When looking at the scores in Table 6, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). Upon reviewing the RTOP results in Table 6, it can be concluded that Mrs. Smith does not exhibit qualities indicative of a teacher who is enthralled in reform mathematics practices. As indicated by the

descriptions above, most of the lessons were very procedural in nature. The focus was on getting the right answer and not necessarily the understanding behind getting the right answer. The only thing that mattered was that the students could work through the problems to obtain the desired outcome. Additionally, it appeared that there was no real application for the problems. The problems were just that, problems that were to be worked while in math class. No relevance was given to the material.

Table 6

RTOP Averages and Median for Mrs. Smith's Spring 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/ Teacher Relationships
Observation 1	1.2	2	0.2	0.6	0.6
Observation 2	0.4	2	0	0	0
Observation 3	0.4	2	0.8	0.4	0.4
Median	0.4	2	0.2	0.4	0.4

At the beginning of the Fall 2006 semester, Mrs. Smith was observed one more time just to see if any major changes in teaching style had occurred since Spring 2006. The observation was of a Pre-Calculus class. Similar to the Spring 2006 observations, this particular Pre-Calculus class occurred as follows:

> The lesson focused on quadratic functions. Mrs. Smith wanted them to be able to find all of the following things for parabolas: direction of opening; equation of

axis of symmetry; coordinates of vertex; x-intercepts; y-intercept; and a sketch. The teacher worked through one example with the class. During this time, they discussed various ways to accomplish the above tasks. Then, she gave them one to work on their own. As the students worked, Mrs. Smith walked around and looked to see how the students were working the problem. She commented that about half of the class chose to find the intercepts first and half of the class chose to use the transformation method. After the students worked the problems, Mrs. Smith asked for volunteers to work the problem. She specifically asked for a person who found the intercepts first. No one really volunteered. Rather than calling on someone, she worked the problem herself. Once the work had been done, Mrs. Smith asked the people who worked the problem with transformations if they got the same thing. They all said yes except one boy. She began working the problem, but they realized that his problem came from a mistake in completing the square. Mrs. Smith then asked them if they wanted a problem with a negative or one with a fraction. They chose the one with the negative.

At this point, Mrs. Smith gave the class another problem to work. She asked the students to see how much they could fill in before she started working. As the students worked, she again walked around and answered questions. Mrs. Smith only let the students work for a few minutes before she began working it on the board. As she was going through the problem, she periodically asked questions such as, “What is the y-intercept?”. A majority of the time, the students didn’t respond, but she kept on working.

After completing this problem, she asked the students to find a partner. She explained to the students that they were going to have a contest. Then, she gave the students a piece of paper. The page that they were given was blank on one side and had numbers on the other side. The numbers were all out of order, had no pattern, were different fonts and sizes, etc. For this exercise, Person #1 had to find numbers one through thirty in order. Then, Person #2 had to find numbers forty through sixty in order. Once this had taken place, each person had to tally how many numbers had been found. Mrs. Smith took up the pages they had worked on and told them that they may do more with this activity later on in the week. Then, the class went back to working on parabolas.

At this time, Mrs. Smith assigned the class one more problem to work. She asked if anyone had a question. No one did, so she also assigned them problems to work on for homework. Then, she passed back tests that the students had taken the previous week.

At the completion of the observation, the researcher again completed the RTOP for that observation. In the same fashion as the Spring 2006 observations, the researcher averaged the scores for the five questions in each section to determine an average score for each section of the RTOP. The scores can be found in Table 7. As with the Spring 2006 observations, upon reviewing the RTOP results in Table 7, it can be concluded that Mrs. Smith still did not exhibit qualities indicative of a teacher who was enthralled in reform mathematics practices. As with her other lessons, the one described above was very teacher centered. Likewise, the emphasis was on being able to answer the questions

correctly and not necessarily looking at why or how the problems were worked in the manner they were worked.

Table 7

RTOP Averages for Mrs. Smith's Fall 2006 Classroom Observation

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/ Teacher Relationships
Observation 4	0.8	2	0.4	0.4	0.2

Lesson Design and Implementation

Mrs. Smith utilized a very traditional lesson design and implementation style. She generally began class by going over homework problems from the night before. Then, she moved on to the new content for the day. The lesson itself involved her working various examples of the problems for the students. Then, once she felt like the students had seen enough examples, she gave them a problem to work independently. While they worked, she walked around and observed their progress and sometimes commented about the mistakes they were making. Once she felt like they had had sufficient time to complete the example problem, she worked the problem on the board. After she felt confident that the students knew the new material, she assigned additional problems for homework. Then, the students worked on those problems until the end of class.

Communicative Interactions

Student-Led Discussions

As is evident from the scenarios above, there were hardly any student-led discussions in Mrs. Smith's classroom. Every now and then, she allowed a student to work a problem for the class, but she always went back in and re-worked or added to it rather than allowing the student to explain his/her work.

Teacher-Led Discussions

Due to her traditional teaching style as described above, most of the discussions held in the classroom were teacher-led discussions. Most of the class period involved Mrs. Smith showing the students how to work various problems. Periodically, she posed a question to the class, but she rarely gave anyone a chance to answer before she answered the question herself. Also, most of the questions referred to procedures for answering the question and not about why the answer came out to be what it was. This was apparent in the Fall 2006 Pre-Calculus class description provided above.

Procedural Knowledge

Knowing the steps to solving a particular problem was extremely important to Mrs. Smith. Other than her working through every example step-by-step, most of her discussion with the class was posed as "First we do….and then we do…". Then, if she did ask the students a question, it was usually phrased as "What do we do next?". She never really asked them to elaborate on their answers or to explain how they arrived at their conclusion if it was different than the rest of the class. Again, it all went back to the fact that Mrs. Smith believed that there is one right answer to every problem.

Propositional Knowledge

From the lessons that were observed, propositional knowledge was not a big priority in Mrs. Smith's class. It was as if she just assumed that because the students could follow the steps to get to the answer she was looking for, that they truly understood what they had done to get that answer. The few times she asked about why an answer had to be the way it was, the students froze up and looked everywhere but at Mrs. Smith. It appeared that they did not know how to respond. Additionally, when Mrs. Smith did ask these types of questions, she rarely gave the students any think time. She just asked the question and then proceeded to answer it herself. For the researcher, this did nothing but prove that Mrs. Smith had the propositional knowledge, but couldn't really get her students to relay the same information.

Student/Teacher Relationships

It appeared that Mrs. Smith was all business when it came to her classroom. She was more concerned about getting her lesson taught than she was about trying to get to know her students on a more personal level. This was particularly true with the remediation classes. It was presumed by the researcher that the reason for this was because Mrs. Smith felt solely responsible for these students being able to pass the graduation exam. Every once in a while, Mrs. Smith attempted to phrase a problem so that it was appealing to the students; however, they just snickered because the example she gave was dated. To them, she appeared to be out of touch. Another thing that the researcher noticed was that when Mrs. Smith helped an individual at his/her desk, she spoke loud enough so the rest of the class could hear her whether they wanted to hear the conversation or not. There were times when this was appropriate, but from what the

researcher could tell, there were many times it was not because the student was seeking one-on-one attention. Respect for Mrs. Smith never really seemed to be an issue; however, the same could not be said for Mrs. Smith's respect for her students.

Mrs. Franklin

As mentioned earlier, Mrs. Franklin was the pre-service teacher placed with Mrs. Smith. Mrs. Franklin is a White female in her early to mid twenties working on her degree in Secondary Mathematics Education. Like Mrs. Smith, Mrs. Franklin is tall in stature; even so, her presence in the room was somewhat apologetic. She came across as being very self-conscience, guarded, anxious, and cautious. Mrs. Franklin is also a devout Muslim. Her daily attire consisted of the traditional Muslim attire of hijab which means that she wore clothing that covered all of her features except her face and hands. On her head, she wore a headscarf that covered her hair, ears, neck, and upper chest. Her clothing covered her all the way from her throat to her wrist and ankles so that her figure was obscured. Also, she wore socks and shoes so that her feet were not exposed. The issue of dress was an area of concern for Mrs. Franklin. In the Spring 2006 interview, she revealed to the researcher that she was not only anxious about her internship experience just because it was her internship experience, but she was also concerned how her students would accept her because of her appearance. Obviously, she looked different from her students. This concern definitely came out in her demeanor in the classroom. As described above, she was very guarded and cautious when it came to things such as classroom management, taking charge of the room, etc.

When asked to give a description of mathematics in general, Mrs. Franklin responded, "It's about problem-solving and about how you can solve problems and

something we do everyday and something really important in our life even in our daily lives." When asked to describe the best way students learn mathematics, Mrs. Franklin commented,

> Based on my experience, I think hands-on activities and visual things help us to learn…really learn math when they see it. Also, connecting the things they are learning to something they are interested in and something they do everyday, it really helps them understand. Unless they know what they're going to use it for, they don't really care about it. So, when you show them that they're going to use it more than one time in their classroom, they'll be interested in learning it.

Upon being asked to discuss her feelings about the most effective way to teach mathematics, Mrs. Franklin stated,

> I think that students should take an active role in their learning, and the teacher should not be a person that comes in and lectures the whole time and gives homework. I think that students should do activities where they can discover the concept that we are about to teach.

Based on her responses from the beliefs survey, Mrs. Franklin strongly agreed that students should be allowed to figure out how to solve mathematics problems for themselves. She agreed this could be done by the students applying their own personal experiences to solving the problem at hand. Mrs. Franklin also strongly agreed that teachers' demonstrations/explanations were the best way for students to learn. Additionally, she strongly agreed that teachers should demonstrate and model mathematical procedures prior to expecting their students to use them. She agreed this could be done by the students applying their own personal experiences to solving the

problem at hand. In addition, Mrs. Franklin strongly agreed that teachers should allow students to communicate their mathematical processes in ways that are relevant to them. In the area of problem-solving, Mrs. Franklin strongly agreed that students should be provided with informal experiences to explore mathematical concepts prior to them being expected to master that concept. She also strongly agreed that students should have to work with mathematical concepts in various contexts; therefore, the teacher should provide varied and multiple experiences for students to work through problems. Additionally, Mrs. Franklin strongly agreed that students must be able to follow directions in order to sharpen their problem-solving skills. Concerning statements pertaining to various mathematical procedures and understanding, Mrs. Franklin disagreed that time should be spent practicing mathematical procedures before students spend much time solving mathematics problems. She also strongly disagreed that students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept. Refer to Appendix D Table 22 to view all of Mrs. Franklin's responses to the beliefs survey.

When Mrs. Franklin was asked to define the role of her cooperating teacher, she stated,

> I think she will not be my boss but more like my advisor. I know I'll be the one teaching, but I'm expecting her to always give me her feedback. I'm expecting her to help me with all of my lessons in the sense of approving the lessons and knowing if these lessons are going to work or not. I'm also hoping that she will support me in the way that I want to teach even if hers is different.

When Mrs. Franklin was asked to elaborate on the role of the university supervisor, she replied,

> I would expect them to tell me if something is majorly wrong with my lesson plans before so that I can change my plans ahead of time and make sure everything is right. I also expect them, when they come observe me, especially for the first time, I know I'm not perfect, and this is my first ever experience at teaching, I'm hoping that they're not going to, I know I'm going to be doing stuff wrong, so I hope they don't just tell me that in a way that will make me hate what I'm doing, but that they will encourage me to change to the right thing and do the right thing…that will make me want to do it right. I think they are the ones, after my cooperating teacher, I will go to if I have problems. I hope they will be a help to me.

When asked to discuss her anticipated role as pre-service teacher, Mrs. Franklin answered,

> I believe that interns are teachers. When I had interns in school, I treated them just like the regular teacher. I know that I don't have the full power of the teacher in the classroom. I don't know if I can write up students or tell someone to go out in the hall, I don't know all of that yet, but I hope that I will be just like a teacher. I hope that I will have the respect of a teacher that way I will give just like a teacher. Feel like a teacher. Act like a teacher.

Finally, Mrs. Franklin was asked to talk about if she thought there would be problems if she and her cooperating teacher had different beliefs about teaching and learning mathematics. Her reply was,

> I don't think it's going to be a problem until she doesn't allow me to teach the way that I know how to teach. The way I know how to teach is the way I believe, and I think that this is the best way I can teach. Maybe she can teach in a better way, but it's not the way I can teach. So, I don't think if we have different beliefs that it's going to be a problem, but it's going to be a problem if she expects me to teach her way. I don't know, and I have never used it. So, I think that would be the problem. But, if she just has different beliefs and lets me do whatever I want as long as it is right, and she approves of it, I think we'll be fine.

Fall 2006 Classroom Observations

During the Fall 2006 semester, Mrs. Franklin taught one block of pre-calculus, one block of remedial mathematics, and one block of calculus. Throughout the course of the Fall 2006 semester, Mrs. Franklin was observed on three separate occasions. These three observations were spread out over a period of three months. All three observations were of Pre-Calculus classes. The first two observations resembled the following scenario:

> At the beginning of class, Mrs. Franklin had the groups go over their work from the previous class meeting. It was apparent to the researcher that the students had a worksheet that they were supposed to have worked on over the weekend. The purpose of today was to get them to go over their work and help each other with their problems they couldn't work. As the students worked in groups, Mrs.

Franklin walked around to make sure the students were working. For the most part, the students remained on task; however, there were a few times Mrs. Franklin had to say something to them.

After the students had time to work through their homework problems, Mrs. Franklin had one group member from each group work one of the problems. During these presentations, Mrs. Franklin placed herself at the back of the room. Also, during the presentations, Mrs. Franklin asked questions such as: “How do you know that?”; “Why does that work?”; “How do you get to the next step?”; and “Can you explain that?”. As they were working through these problems, problem #2 seemed to be an issue for the students. Even though the group was unsure of their work, they agreed to work through the problem as far as they could get. It took about four people, but they finally got it. Instead of Mrs. Franklin doing the work, she got the students to work through the problem by helping each other. The researcher noted that during the presentations, Mrs. Franklin had to call the groups down several times. This activity didn’t hold their attention at all. The researcher speculated that it was because many of them were still confused about it. The homework discussion took an hour. They were going over six induction proofs, two of which didn’t hold for the first step. So, they really only had to work four problems. At the end of the homework discussion, Mrs. Franklin eventually ended up working the final problem because no one in the class could do it. Then, Mrs. Franklin gave each group a copy of an activity that they were to complete as a group. There were four different activities, so each group had a different problem. While the groups worked on their problem, Mrs. Franklin walked

around and monitored group progress and answered questions. Presentations of these problems were planned, but due to time constraints, the presentations had to be done in the following class meeting.

The final observation was different from the first two. It was interesting to the researcher to see just how close to Mrs. Smith's style this particular lesson was. It occurred as follows:

Mrs. Franklin began class by asking the students to graph $y = \sin x$. She specifically wanted them to find the amplitude, the period, the x-axis interval, the maximum point and/or the minimum point. As the students worked on the given problem, Mrs. Franklin walked around and encouraged the students to work the problem. She also encouraged them to do it without using their notes; however, she didn't tell them they couldn't use their notes.

After the students had time to complete the above problem, Mrs. Franklin asked the class questions like: "What is the amplitude?"; "Where do you find it?"; "What is the definition of amplitude?"; "What is the period?"; etc. Sometimes Mrs. Franklin questioned specific students. Sometimes she didn't. Either way, she didn't really ask for explanations. This questioning continued until they had completed the graph.

Then, she asked them to work on $y = 2\sin 2x$. As with the other problem, Mrs. Franklin asked the students the same questions until they had completed the graph. Then, she asked them to work on $y = -2\sin 4x$. As with the previous problems, Mrs. Franklin asked the students the same questions until they had

completed the graph. She asked them what the negative did to the points on the graph. The students said that it "flipped" the graph.

Next, Mrs. Franklin drew a sin graph with an amplitude of 1 and divisions $\frac{\pi}{2}$, π, $\frac{3\pi}{2}$, and 2π. The students automatically said that it was the graph of $y = \sin x$. Then, she drew a sin graph with an amplitude of 2 and divisions $\frac{\pi}{6}, \frac{\pi}{3}, \frac{\pi}{2}$, and $\frac{2\pi}{3}$. The students said it was $y = 2\sin 3x$. Next, Mrs. Franklin asked the following questions: "What is the maximum point?"; "What is the minimum point?"; "What is the amplitude?"; and "What is the period?". She asked her questions pretty quickly. There wasn't much wait time at all. This seemed to frustrate some students. The researcher kept hearing "Could you please slow down?". The researcher wasn't sure if Mrs. Franklin heard them or not because she never really slowed down. Finally, Mrs. Franklin brought in some discussion about shifts in the graphs. She related this back to what the student already knew about shifts in parabolas. Then, she walked them through $y = \sin(x + \pi)$.

It should be noted that during these exercises, some students seemed engaged; mainly the ones at the front of the room. Still, however, several students were losing interest very quickly; mainly the students at the back.

Next, Mrs. Franklin asked the students to work through $y = 2\sin\left(x - \frac{\pi}{4}\right)$ on their own. As the students worked, Mrs. Franklin walked

around and helped the students. Once the students had time to complete the graph, they went over it as a class.

At this point, Mrs. Franklin gave the students a short break. During the break, the students played a game. When they were called on, the students had to come up with a 4-letter word that begins and ends with the same letter. They couldn't repeat what someone else had already said. If they did, they were out. They kept going around the room until only one person was left.

After the game had been completed, Mrs. Franklin brought the class back together and got them to work $y = 3\sin(2x - \pi)$. This discussion was just like the rest. Finally, Mrs. Franklin asked the students to work a few more problems with a partner. Mrs. Franklin also made an attempt to summarize the day's lesson. Even though she summarized somewhat, several students were not paying attention. As the students worked, Mrs. Franklin walked around and tried to keep the students on task until the end of the period. Before the bell, Mrs. Franklin also told the students about upcoming quizzes and tests.

At the conclusion of each of the above mentioned observations, the researcher completed the RTOP for each respective lesson. When looking at the scores in Table 8, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). It should be noted that for Mrs. Franklin, the first two observations had scores that were somewhat higher than the last observation. In the first two observations, Mrs. Franklin attempted to incorporate many of the techniques she had learned throughout her methods courses. Even though the lessons may not have been implemented in the manner Mrs. Franklin envisioned, the techniques were still present. Throughout this process, Mrs.

Franklin's university supervisor attempted to help many times. In addition to the three required observations, Mrs. Franklin's supervisor visited on several different occasions. Even with the additional help, Mrs. Franklin gave in and ultimately implemented lessons that were more in line with Mrs. Smith's teaching style. It is my belief that even though Mrs. Franklin received additional assistance from her university supervisor, Mrs. Franklin eventually gave in and succumbed to a more traditional style of teaching that was very similar to Mrs. Smith's because Mrs. Smith did not encourage her to teach in a reform manner. Overall, the scores indicate that Mrs. Franklin cannot be depicted as a reform minded teacher.

Table 8

RTOP Averages and Median for Mrs. Franklin's Fall 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/ Teacher Relationships
Observation 1	1.6	2.2	1.2	1.6	1.6
Observation 2	1.8	2.4	1.8	2	2.6
Observation 3	0.8	1.6	0.8	1	0.6
Median	1.6	2.2	1.2	1.6	1.6

Lesson Design and Implementation

Mrs. Franklin attempted to utilize many of the reform mathematics techniques throughout her lesson design and implementation. The students were usually seated in groups of three, four, or five as opposed to the rows that Mrs. Smith always had them sitting in. This configuration, however, didn't always guarantee that the students were engaged in group discussions. There were times, especially in the last observation, when it appeared that they were only seated that way for looks. Many times, Mrs. Franklin had trouble with the positioning of the groups. Because she did so much work at the front of the room, the groups should have been arranged so that all students could see; however this was not the case. There were several times when students had their backs to the board. During the times when Mrs. Franklin was doing most of the talking, these configurations ultimately led to disengagement for those students.

In addition to different seating arrangements, Mrs. Franklin also allowed her students to work through various examples on the board. During these discussions, she also asked higher order thinking questions such as "How did you know that?", etc. The only problem with these types of discussions was that more times than not, the lesson moved much slower than it should have. Mrs. Franklin had a difficult time with pacing. She just wasn't getting the material covered fast enough to suite Mrs. Smith. It is believed by the researcher that this is the reason that Mrs. Franklin's style changed so drastically during the last observation.

Communicative Interactions

Student-Led Discussions

There were many times that Mrs. Franklin attempted to facilitate student-led discussions. Most of these were initiated by allowing students to work problems on the board. After working the problem, Mrs. Franklin then expected the student to explain the work he/she had done. At this time, either other students or Mrs. Franklin asked questions for further clarification. At this point, Mrs. Franklin had to be conscience of her role as facilitator because there were many times she wanted to take over the discussion. When the students were working in groups, there was not much discussion unless Mrs. Franklin went to each group and asked the students in that group specific questions. Otherwise, the students really preferred to work independently which was the way they were accustomed to conducting class.

Teacher-Led Discussions

As stated previously, Mrs. Franklin really tried to get her students to carry the conversation when problems were being discussed; however, there were times when she struggled with getting the discussions to "move along" in a timely fashion. This caused frustration for both her and Mrs. Smith. As a result, by the end of the internship, Mrs. Franklin had reverted to teaching the way Mrs. Smith taught which was very traditional. At the beginning of the internship experience, Mrs. Franklin tried to pull the students into the lesson and to get them to do most of the work. By the end, however, Mrs. Franklin was working all of the example problems without asking for any discussion from her students. It was strictly "First we do….then we do…". So, Mrs. Franklin went from lessons that were somewhat student oriented to lessons that were strictly teacher oriented.

Procedural Knowledge

There was no doubt that Mrs. Franklin had no problem comprehending the material that she was teaching. Her problem was making her students understand. Mrs. Smith stated many times in many conversations that Mrs. Franklin just couldn't get down on the students' level. This was very frustrating for Mrs. Smith to watch and very frustrating for Mrs. Franklin to endure. It was obvious that she didn't understand why the students weren't picking up on the information she was giving them. Part of the problem is because she was giving them the information and not allowing them to figure things out on their own. This was evident more toward the end of the internship experience than it was at the beginning. At the beginning, Mrs. Franklin attempted to let the students explore some topics, but when things didn't move as fast as Mrs. Smith liked, Mrs. Franklin began teaching the concepts very procedurally. Her style became very similar to what Mrs. Smith had been doing.

Propositional Knowledge

As indicated previously, Mrs. Franklin made a valiant attempt to unleash her students' propositional knowledge. Initially, she asked students to work problems on the board and then explain their work. Then, she allowed students to ask questions for further clarification. It was clear that her desire was for the student to provide the clarification, but many times, she had to intervene because the student didn't know how to precede with his/her explanation. It is presumed that part of the reason for this is because Mrs. Franklin appeared to be unsure about what questions to ask to get the student to analyze the work that had been presented. As long as Mrs. Franklin was asking questions such as "How did you arrive at your answer?", "What does your answer mean?", etc, things were

fine. Her breakdown seemed to occur during student presentations. One of the biggest problems that was observed by the researcher was that Mrs. Smith didn't know how to help Mrs. Franklin with her questioning. Because of this, Mrs. Franklin's university supervisor stepped in and tried several times to help Mrs. Franklin revise her lessons so that she could successfully implement the techniques she had learned and practiced in her methods courses. Despite the additional help from her university supervisor, Mrs. Franklin ended up teaching very procedural based lessons instead of pursuing exploration techniques.

Student/Teacher Relationships

Mrs. Franklin genuinely seemed to care about her students; however, her self confidence issues interfered with her getting too close to them. This was evident in her classroom management skills. She wanted to be assertive with her students, but it seemed to go against her nature. It appeared as though she didn't like taking a stern tone of voice with them or confronting them when they were misbehaving. It didn't take her students long to pick up on this. Her classroom management was something she had to work on all semester. Other than that, it appeared as though the students liked having Mrs. Franklin as a teacher. Of course, this could be because she was the "nice" teacher compared to what they were used to with Mrs. Smith.

Similarities and Differences Between Mrs. Smith and Mrs. Franklin

Upon analyzing all of the information pertaining to Mrs. Smith and Mrs. Franklin, it appears that they were very similar in many ways. The main difference that was seen by the researcher was that while Mrs. Franklin was more open to trying techniques she had learned in her methods courses, Mrs. Smith was more hesitant. Mrs. Smith was more

like the content-focused teacher described by Thompson (1992). She saw her role as demonstrating, explaining, and defining mathematics for her students. She definitely maintained an expository style. Mrs. Smith's idea of attempting reform based instruction was having her students play a game where they had to recall basic trigonometric information. Mrs. Franklin began the internship experience more in line with the Platonist view described by Thompson (1992): she attempted to emphasize students' understanding of the logical relationships among various mathematical topics and the logic underlying the mathematical procedures. At the conclusion of the internship experience, however, she more like the content-focused teacher described by Thompson (1992); hence, more like Mrs. Smith. Even though Mrs. Franklin attempted many new techniques, when things didn't go according to plan, she eventually ended up teaching the class the same way Mrs. Smith always had done. It should be noted here that even though Mrs. Smith and Mrs. Franklin were similar in many ways, their similarities didn't promote reform based teaching.

Outcome of the Internship Experience

At the conclusion of the internship experience, Mrs. Smith stated that as a cooperating teacher she felt like she had many different roles such as: instructor in the art of teaching; mother, after one of her observations; cheerleader, "Yes, you can do this"; coach "Try this play and see if it works"; timekeeper, "We can't take that many days on that topic". In redefining her description of the role of the pre-service teacher, Mrs. Smith commented,

> At times she was the TEACHER, and every decision was hers. Other times I would teach and then she would act as tutor and help and answer questions. She

was busy most all the time. I especially liked and appreciated it when she acted as aide and graded papers.

One final comment Mrs. Smith made was about whether or not she and her pre-service teacher had differing beliefs about teaching and learning mathematics. She confidently stated that she felt there was not a difference of opinion; however, she also made the following comment:

> I think the problem we did have was one of experience. In high school and college, her experience was with upper level students and over-achievers like herself. I had to constantly remind her that "once" was not enough for most of my students. They needed review and restating before they were locked in on a concept.

When asked to discuss the role of her cooperating teacher, Mrs. Franklin commented that she felt Mrs. Smith had a good effect on her. She explained that Mrs. Smith was helpful in developing her lessons by discussing things that were good and things that were bad. Additionally, Mrs. Franklin stated that Mrs. Franklin helped her connect different mathematical topics to previous topics in an effort to maximize learning and to insure that all students were learning. Mrs. Franklin also elaborated on her role as pre-service teacher by stating, “I was first an observer then slowly I became a full time teacher. I planned and executed many lessons using different activities and different tools.” When the researcher asked who influenced her most throughout her experience, Mrs. Franklin responded, “My cooperating teacher. She helped me so much in all phases of my development as a professional. When I felt that everything was going wrong she was always there to support me. I felt that she was always there for me.” When asked to

discuss whether or not she and her cooperating teacher had different beliefs about teaching and learning mathematics, Mrs. Franklin responded, "I think we had different beliefs. My teacher is very traditional and does not like to use new ways because her ways proved great success throughout all her years of teaching. I like to use and explore new tools and activities in my teaching." She further commented that this difference in beliefs really did not cause a problem because they had good communication between them.

Case 2: Mrs. Johnson and Ms. Walters

Mrs. Johnson is the White female cooperating teacher discussed throughout Case Two. She has been teaching mathematics for almost seven years. Ms. Walters is the White female pre-service teacher discussed throughout Case Two. She is working on her degree in Secondary Mathematics Education.

The internship experience discussed throughout Case Two takes place at Riverdale High School. Refer to Case One for a detailed description of Riverdale High School. Table 9, which contains a demographic summary of Riverdale High School, has been repeated here for the reader's convenience.

Table 9

Demographic Summary of Riverdale High School

System Type	Grades Serviced	Total Population	Student/ Teacher Ratio	Students Eligible for Free or Reduced-Price Lunch	Racial Background
City	9-12	1312	16	49%	African American – 59% White – 38% Asian/Pacific Islander – 2% Hispanic – 1% American Indian/ Alaskan Native – <1%

Mrs. Johnson

Mrs. Johnson is a White female in her mid thirties. She has two children; one in elementary school and one in pre-school. She is somewhat of an average height, but her personality is huge. Her bubbly, cheerleader-like personality makes her classroom an inviting and fun place to be. Mrs. Johnson has been teaching high school for 6 ½ years. Six of those years have been spent teaching at Riverdale High School. She has a bachelors degree in mathematics education.

Mrs. Johnson reported that over the past year, she has spent approximately twenty to forty hours involved in some type of professional development. Of those hours, she stated that six to ten of those hours were spent in professional development settings that specifically focused on mathematics. Additionally, she reported that none of her

professional development hours were spent in association with Math Plus. Even so, Mrs. Johnson commented that she had been involved in implementing various aspects of Math Plus at Riverdale High School.

When asked to discuss her views about mathematics, Mrs. Johnson stated, "First of all, the world is getting so technology based now that the kids have got to have it (mathematics). They've got to know the algebra. They've got to know the geometry. They've got to know those skills." She further elaborated by saying, "We show a lot of skill and drill, and then we take it to some of the technology ways it's used and all." When asked to talk about her idea of the best way for students to learn mathematics, Mrs. Johnson replied,

> Oh, it's got to be a variety of ways. There is no set way for them to learn. There are days that we do lecture. There are days we're counting M&M's. There's no one way for any student to learn math. A lot of it, they've got to see the skill so lecture must be a part of mathematics, but I do believe that you have to incorporate the real world.

When asked to discuss the most effective way to teach mathematics, Mrs. Johnson responded by saying, "Again, I think it is a combination of…you've got to have the skill and drill, lecture, and then you've got to have the hands-on." Mrs. Johnson agreed that students should not only be able to obtain correct answers, but they should also understand the mathematical concepts involved in getting to that right answer. Additionally, she felt that students should understand important mathematical concepts before they ever attempt to memorize definitions and facts.

Upon being asked to describe a typical mathematics lesson in her classroom, Mrs. Johnson's response was

> Typically in my classroom, we focus a majority of the time on a lot of skill and drill. We have special occasions where we pull out our labs and break away from the lecture. Normally, we start our class sometimes with a pop quiz to focus a lot on those graduation exam objectives because they're required by the state. We do a lecture. We assign work. And, then a lot of times, I allow my kids to do the group work. Now, you haven't been able to see that because I've been left with the two longest lessons in the book to teach. But, normally, we do a lot of group interaction because I like…I'm not one of those teachers that makes them just stay quiet the whole time and not breathe a sound because I like hearing the interaction between them because a lot of times that lets me know what I've done right and wrong with in the lesson. And by letting them have the group work, and really listening to them talk about it, is where I get my feedback from more than I do assessments I would say. I like groups.

Mrs. Johnson further described the learning environment in her classroom as "part traditional, part hands-on." Mrs. Johnson responded that students should be allowed to figure things out on their own rather than depending on demonstrations/explanations given by their teacher.

As indicated by her responses on the beliefs survey, Mrs. Johnson strongly agreed that students need good mathematical problem-solving skills in order to be successful in the future. She also strongly agreed that in order to formulate these problem-solving skills students must be able to follow directions. According to her responses, Mrs. Johnson felt

like mathematics is an important subject that should be available to all students because it is something that will continue to be used even once the students are out of school. Refer to Appendix D Table 23 to view all of Mrs. Johnson's responses to the beliefs survey.

In defining what she anticipated as being her role as cooperating teacher, Mrs. Johnson replied,

> I almost think of being a counselor or just being there to give them the motivation to say "It's OK to try this, to try that". And, then if they have any questions, just to ask. I'm not the one to bite somebody's head off, you know. And if you see something wrong, let them know about it. That's the one thing I am. I'm blunt. You know, if something, and I'm not saying it's in their teaching methods because to each his own, I'm fine with that, but if there is a mistake, if they should have dealt with something discipline-wise, or this or that, letting them know to not be afraid to beat around the bush because here's their learning experience before they get thrown into the real world.

When asked about the role of the university supervisor, Mrs. Johnson stated that she really wanted the university supervisor to come in and tell her and her pre-service teacher exactly what was expected in terms of what the university wanted. Her comment was, "I want to know what they want to see in the classroom."

When asked to elaborate on her expectations of a pre-service teacher, Mrs. Johnson replied,

> Willingness to try anything. I think the biggest thing they need to do is to be willing to, you know, they might have worked all night on a lesson and be willing to throw it out if need be because sometimes you have planned this whole lesson

and you're up there teaching and it's not working worth a flip. You've got to be willing to just throw it out. Even though you do all this planning, you have got to be willing to go on the fly if need to. So, just that willingness to be able to not stick to a regiment. You've got to be kind of free out there.

Finally, when asked if she thought it would be a problem if she and her pre-service teacher had different beliefs about teaching and learning mathematics, Mrs. Johnson's response was

> No. Each person can do something different and still be able to convey that message. We're individual teachers just like the students are individual learners. Different types for different types.

Spring 2006 and Fall 2006 Classroom Observations

During the Spring 2006 semester, Mrs. Johnson was observed on three separate occasions. These three observations were spread out over a period of a month. All three observations were of Algebra I classes. A typical lesson looked like the following:

> Mrs. Johnson began class by giving back a test. The test was on factoring. There was some discussion about the test, but not very much. After the teacher took up the test, she gave them a pop quiz on material that was covered two weeks ago (multiplication of polynomials). The quiz had five multiple choice questions. It didn't take the students long at all to complete the quiz.
>
> Once the students completed the quiz, the teacher began the discussion on Chapter 10.1 (Graphing Quadratic Functions). Mrs. Johnson began the discussion by reminding the students that quadratics have x^2 in them. She then asked the class what kind of graph they would get from the equation $y = 3x + 1$. A student

responded and said that the equation is that of a line. Mrs. Johnson then explained that at this point they would begin to add degrees to the equation of a line. She also stated that when you add degrees, you add curves to the graph. At this point, Mrs. Johnson related doing arithmetic to passing a bill through Congress. She said that it may or may not pass. Then, she reassured her students that working with quadratics was not hard. She told them that working with quadratics was just long and dangerous. At this point in the lesson, Mrs. Johnson began discussing the various components of parabolic graphs such as axis of symmetry, symmetry, minimum point, maximum point, etc.

Next, Mrs. Johnson began leading the class through the steps of generating an accurate graph for a quadratic function. Here, she stated, “Now we’re going to look at all of the steps. Don’t try to skip steps. Don’t do your arithmetic in your head! These must go in order.”. She then proceeded to demonstrate her order of steps by working through a problem with the students. After she worked through one problem with the class, she posted another problem for them to work. The students were not overly excited. Mrs. Johnson just said, “Practice makes perfect.” With the second problem, Mrs. Johnson told the students, “Now on this problem, you tell me the steps.” From here, the class began working. Throughout the whole process, the teacher asked very procedural questions. Once the class had completed the second example, Mrs. Johnson assigned a problem for the students to work individually. After the class discussed this last problem, Mrs. Johnson assigned homework problems for the students to work on. As they worked, she passed out progress reports.

Throughout the class, all of the notes Mrs. Johnson used were typed on an overhead transparency. All Mrs. Johnson had to do was uncover the various parts of the transparency as she went through the notes. She did, however, work the problems on a separate transparency or on the board.

At the conclusion of each of the above mentioned observations, the researcher completed the Reformed Teaching Observation Protocol (RTOP) for each respective lesson. When looking at the scores in Table 10, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). Most of the emphasis in Mrs. Johnson's lessons was placed on getting the steps correct. She was extremely strict about not allowing her students to skip steps when working the problems. Throughout the lessons, there were hardly any discussions about why the problems worked the way they did. Even though she allowed her students to demonstrate their work for the various problems, it was apparent to the researcher that the lessons were very much teacher centered. As indicated by the median scores listed in the table, Mrs. Johnson's lessons do not indicate that she is designing lessons that would be considered reform based.

Table 10

RTOP Averages and Median for Mrs. Johnson's Spring 2006 Classroom Observations

	Lesson Design and Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	0.6	2.4	0.4	1	1
Observation 2	1.2	2.2	0.6	1.2	1.6
Observation 3	0.6	2.2	0.4	1	1
Median	0.6	2.2	0.4	1	1

At the beginning of the Fall 2006 semester, Mrs. Johnson was observed one more time just to see if any major changes in teaching style since Spring 2006 had occurred. As with the Spring 2006 observations, this observation was of an Algebra I class. Unlike the Spring 2006 observations, this lesson was somewhat different just because Mrs. Johnson made an honest attempt to incorporate more student centered activities. One of the things that she added was the Problem of the Week (POW). This was a problem/situation that was given to the class at the beginning of the week. They had all week to work through the problem individually or with a classmate. At the end of the week, they had to turn in all work along with a written explanation of what had been done. After discussing the problem of the week, Mrs. Johnson gave the students a handout that guided them through the content for the day. They were supposed to work with a partner to work through the information on the sheet. After sufficient time had passed, they discussed the work as a class. At this point, the lesson began looking more like the three that had been observed

in the Spring. Everything was very procedural. Again, the focus was on the steps. As displayed in Table 11, even though the scores are higher, they still don't indicate that Mrs. Johnson plans lessons that are indicative of reform based teaching.

Table 11

RTOP Averages for Mrs. Johnson's Fall 2006 Classroom Observation

	Lesson Design and Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 4	1.6	2.2	1.2	2	2.4

Lesson Design and Implementation

The lessons designed by Mrs. Johnson were very structured. In general, the class began with a small quiz that was supposed to act as a review for graduation exam objectives. Then, there was some discussion of the previous night's homework problems. After that, Mrs. Johnson spent the remainder of the class time discussing at least one if not two new sections from the textbook. The word discussion is somewhat deceiving in this situation because the discussion was generally one-sided. Mrs. Johnson did most of the talking, and the students did all of the listening. While going over the new concepts, Mrs. Johnson worked through an example problem and then gave the students a problem to work individually. When Mrs. Johnson thought the students had enough time to work through the problem, she worked through it with the class. At times, she asked various students to tell her what they had done. All throughout the lesson, Mrs. Johnson was very

concerned with the step-by-step processes. She was very adamant that the students follow the proper steps for working the problems. This pattern of working an example problem, giving an individual problem, and discussing the problem continued until class was almost over. At that time, Mrs. Johnson assigned homework problems for the students to work through until the bell rang.

In the Fall 2006 semester, after participating in a two week summer institute hosted by Math Plus, Mrs. Johnson changed some of her lessons. It appeared that she tried to incorporate some Math Plus approaches in her class by including a Problem of the Week (POW) for the students to work on throughout the week. It also appeared that she tried to incorporate more group work in her class; however, the tasks were very rote in nature. As with her previous lessons, she continued the pattern of working an example problem, giving the students an individual/group problem to work, and then discussing the problem. The only difference was that the students had a worksheet to write down all of the things they discussed. It was very guided.

Communicative Interactions

Student-Led Discussions

As is evident from the above scenario, the student-led discussions in Mrs. Johnson's classroom were few and far between. The few times she did allow students to verbally participate in the lesson, she focused strictly on the steps to solving the problem. There was very little discussion about how the student(s) arrived at the answer.

Teacher-Led Discussions

Even though Mrs. Johnson made her lessons appear student-centered, they were mainly teacher-centered. Most of the period involved Mrs. Johnson working examples of

the various problems from the new sections. Several times throughout her lessons, Mrs. Johnson asked questions, but she didn't really intend for the students to answer her. As a matter of fact, most of the questions referred to procedures for answering the questions and not about the mathematics involved in working through the problems. Even though Mrs. Johnson made an attempt to incorporate more Math Plus techniques in her classroom during the Fall 2006 semester, the lessons were still very much teacher-centered.

Procedural Knowledge

Knowing the steps to solving the various problems appeared to be imperative to Mrs. Johnson. This was very apparent in her questioning techniques. Most of her discussion with the class was spent asking questions such as "For step one we do…" and "For step two we do…". When she did ask the students a question, it was generally phrased like "What do we do next?". She never really asked them to elaborate on their answers or to explain how they arrived at their conclusion if it was different from the rest of the class. When Mrs. Johnson allowed a student to "work" through a problem in front of the class, skipping steps was not allowed. All steps had to be shown or Mrs. Johnson did not allow the student to continue working the problem.

Propositional Knowledge

From the lessons that were observed, propositional knowledge took a back seat to procedural knowledge. As stated above, knowing the steps to solving a problem was imperative in this class. It appeared to the researcher that Mrs. Johnson assumed that because the students could follow the steps to get to the answer she was looking for, that they also understood the methods they had used to arrive at that particular answer. At the

beginning of the Fall 2006 semester, it seemed that Mrs. Johnson had made an effort to incorporate more thought provoking, exploratory type activities into her lesson by adding in the POW and more group activities. After further inspection, however, the group work more or less turned into a guided activity where the students simply completed a worksheet by filling in the blanks and the POW was more of the "First we do…", "Then we do…" type of discussion.

Student/Teacher Relationships

Mrs. Johnson had a wonderful rapport with her students. It didn't matter if they enjoyed math class or not, the students loved coming to her room. As mentioned previously, Mrs. Johnson had a very bubbly attitude that could be quite contagious. She was very much like a cheerleader. All throughout her lessons, she reassured the students that everything was going to be alright, especially if they followed her prescribed steps for solving the problem. Even if a student did something that was incorrect, she always seemed to find a way to correct the student without embarrassing him or her. She also had incentives for students who performed well on assignments such as allowing them to write their name on the "A Board" when making an "A" on a test. This was a big motivation for her students.

Ms. Walters

As mentioned earlier, Ms. Walters was the pre-service teacher placed with Mrs. Johnson. Ms. Walters is a White female in her early twenties working on her degree in Secondary Mathematics Education. Like Mrs. Johnson, Ms. Walters has a very bubbly and energetic personality. In addition to her cheerful personality, Ms. Walters could also be described as somewhat easy going. She always took things in stride, so it didn't appear

that many things bothered her. She also appeared to have a positive attitude about most things. Because of this, she fit in well with her students, and the students really enjoyed being around her.

When asked to define mathematics, Ms. Walters responded, "It is about learning about numbers and how they operate. And not even just numbers, different functions that can be related in the classroom and outside. I feel that mathematics is about everything in life." Ms. Walters stated that her experiences throughout school helped shape her beliefs about mathematics. She further commented, "I think my beliefs about it have come from experiences throughout my school and through me just sitting down and doing problems and trying to understand myself."

Upon being asked to discuss her feelings about the most effective way to teach mathematics, Ms. Walters commented,

> The best way I feel is through communication, talking out the problems and stuff like that. But, I also feel that there does need to be some structure for students to go by. But for them to really get the concept and understand it, talking to each other and talking about it, even if it's at home with their parents, is where it really gets embedded in their knowledge.

When asked to elaborate on the best way to teach mathematics, Ms. Walters stated,

> This is hard because of all the Math Plus stuff I'm learning. I think, like I said before, with communicating and having structure. I think it is a combination of group work and even individual work out of the book because I do feel that the students need that structure of practicing, but I also feel that they need group work

to get other students' ideas and to learn what other people are thinking. So, I think it is a combination of both. I don't think that one way is necessarily better.

As indicated by her responses on the beliefs survey, Ms. Walters strongly agreed that students should be allowed to figure out how to solve mathematics problems for themselves rather than depending on teacher demonstrations/explanations. She agreed this could be done by the students applying their own personal experiences to solving the problem at hand. Additionally, Ms. Walters agreed that teachers should allow students to communicate their mathematical processes in ways that are relevant to them. Furthermore, Ms. Walters disagreed that students learn best by teacher demonstrations and explanations. She also disagreed that teachers should demonstrate and model mathematical procedures prior to expecting their students to use them. Refer to Appendix D Table 24 to view all of Ms. Walters' responses to the beliefs survey.

When Ms. Walters was asked to define the role of her cooperating teacher. she stated,

> I feel that her role is going to be to show me different ideas and different ways of teaching and to really show me what it's like to be a teacher in a school everyday. So, I feel that she is sort of my guide to show me what could be expected in my own classroom.

When Ms. Walters was asked to elaborate on the role of the university supervisor, she replied,

> I guess I see her as a kind of, this may sound weird, but as a parent to make sure that I'm on the right track. To make sure what I'm learning is what she hopes for

me to learn. And to make sure that I feel comfortable in what I'm trying to do. So, I guess kind of as a parent looking over me to make sure I'm on the right track.

When asked to discuss her anticipated role as pre-service teacher, Ms. Walters answered,

> Well, I see myself still as a student, you know learning, but hopefully once I get in there, I'll see myself as hopefully becoming a professional. Not a professional teacher, but becoming someone who is getting into their career. While I'm still learning, hopefully, I'll see myself as a teacher which is scary. I just hope…because I'm scared to death, but really excited about it…hopefully when I get in there, I'll be even more excited, and I'll be a teacher.

Finally, Ms. Walters was asked to talk about if she thought there would be problems if she and her cooperating teacher had different beliefs about teaching and learning mathematics. Her reply was,

> I don't think it will be a problem as long as we are tolerant of each other's different opinions. And if I have a cooperating teacher that isn't willing to listen to my opinions and what I'm hoping to do, that might be a problem if you can't be somewhere where your opinion is respected or just listened to, you can't grow from that. As long as they listen to me and are open to it, they don't necessarily have to let me do every single thing I believe in, but as long as they let me explore what I believe then that's fine if they have different beliefs and vice versa. I have to respect what they believe in.

Fall 2006 Classroom Observations

During the Fall 2006 semester, Ms. Walters was observed on three separate occasions. These three observations were spread out over a period of three months. All three observations were of Algebra I classes. A typical lesson looked like the following:

> Ms. Walters began class by giving the students a homework check. She called out certain problems and all they had to do was write down their final answer. They had very little time to write, so they had to have the problems worked ahead of time. As soon as the students finished, three minutes tops, they turned them in and Ms. Walters went over the answers.
>
> It seemed that the class worked on 1-step inequalities during the previous class meeting because Ms. Walters began the discussion by asking the students for their "rules"/"definitions" for adding, subtracting, multiplying, and dividing with inequalities. She then asked the students for some specific examples. A student gave $8-7<8-2$. Ms. Walters said this was true, but in order for the rule to hold they had to subtract the same number from both sides, so another student changed the original response to $8-7\le 8-7$. They had a little more discussion about this, and then moved on to a similar discussion about multiplying and dividing with inequalities.
>
> Following this discussion, Ms. Walters had the students move into groups of four. She asked each group to name two team captains. After the students had gotten in their groups, Ms. Walters gave them the worksheet that had the various examples on it. She then walked around with a pumpkin and had the team captains pull a problem to work and present to the class. She told them to be

prepared to support their answers. As the students worked, Ms. Walters walked around and monitored the student's work and worked with the various groups by giving hints and asking questions to answer their questions.

Each group was given a transparency to write their work on. After working on the worksheet for about twenty to twenty-five minutes, Ms. Walters started the group presentations. During the group presentations, there was one group that kept talking, about their problem, but talking. They were not very discrete about it either. Ms. Walters never seemed to notice the commotion. Finally, the researcher and another observer told them to stop talking.

During the presentations, Ms. Walters asked the groups questions but they were mainly procedural questions such as: "What happens when you add 20 to -20?"; "Why didn't they shade in the circle on the graph?"; and "Why did you distribute?". The class did these group presentations for approximately forty-five minutes. It was apparent to the researcher that after about the first twenty minutes of presentations, the students lost interest.

Finally, Ms. Walters concluded the group presentations. All groups had not presented, but she had test papers she wanted to hand out prior to the students' leaving. The researcher noted that the lesson was never really summed up. It was more or less cut off.

At the conclusion of each of the above mentioned observations, the researcher completed the RTOP for each respective lesson. When looking at the scores in Table 12, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). According to the scores, even though reform based teaching doesn't always occur,

Ms. Walters is moving more in that direction. Her scores indicate that sometimes she has reform based lessons and other times she does not.

Table 12

RTOP Averages and Median for Ms. Walters' Fall 2006 Classroom Observations

	Lesson Design and Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	2.2	2	1	1.8	2.4
Observation 2	2.2	2.2	1.2	2	2.8
Observation 3	1	1.6	0.2	1.2	1.8
Median	2.2	2	1	1.8	2.4

Lesson Design and Implementation

Based on the reaction of the students, the lessons that Ms. Walters designed were somewhat predictable. The students knew that they would begin class with some type of quiz or homework check. Then, they would move on to the new material which would be covered by completing a worksheet, working example problems as a class or individually, or working through some sort of guided discussion. Finally, they ended class by working on assigned homework problems.

Throughout the lesson implementation process, Ms. Walters made an attempt to utilize many of the reform mathematics techniques that she had learned during the methods courses she had taken in college. Many times, the students were seated in groups

of four or five. This, however, didn't always ensure that the students worked together as a group. Oftentimes, the students worked independently until Ms. Walters approached their group. Then, they worked collectively. Other times, the students discussed extra curricular topics until Ms. Walters approached the group. One thing the researcher noticed about the group work was that more times than not, the activity took too long. The students finished much earlier than Ms. Walters anticipated and rather than moving on to the next part of the lesson, Ms. Walters prolonged the group activity until it had taken as much time as she had originally allotted for the work. By that point, however, most of the students had lost interest in what they had been doing.

Another technique that Ms. Walters worked on throughout the semester was her questioning. In general, she did quite well with answering the students with a question and trying to get them to think for themselves when the students were working in groups. One thing she struggled with, however, was wait time. Many times, Ms. Walters would fire off questions one after the other without really allowing time for the students to answer them. Usually when this occurred, she was asking very procedural type questions such as "What step do we do first?", etc.

The combination of very guided discussions, poorly planned group activities, and an abundance of procedural type questions sparked concern in Ms. Walters' university supervisor. Numerous times, Ms. Walters, the university supervisor, and Mrs. Johnson discussed alternate plans so that the lessons were smoother and more mathematically productive; however, it didn't appear that the suggestions were taken seriously. Because of this, the university supervisor ended up having to intervene much more than usual.

Communicative Interactions

Student-Led Discussions

When there were student-led discussions, they usually occurred while the students were working in their groups. During that time, the students generally seemed engaged in the activity as long as Ms. Walters carefully monitored their progress. While working with the groups, Ms. Walters was clever to answer their questions with another question. This approach in turn caused the students in that particular group to discuss the mathematics more in depth. Most of the activities were supposed to conclude with some type of presentation from each group. Ideally, the students were to discuss the problem they had worked as a group. Instead, the discussion usually turned into a very procedurally oriented one. Rather than discussing why they decided to work a problem a certain way and discuss the mathematics involved in solving their particular problem, the groups generally said, "For step one we did…For step two we did…etc.". Instead of spurring on further discussion, Ms Walters generally told the group they had done a good job and then called on the next group.

Teacher-Led Discussions

Most of the discussions carried on in the classroom were very guided teacher-led discussions. When Ms. Walters did address questions to the students, they were more procedural type questions such as "What do we do first?". She really didn't spend a lot of time trying to get at the deeper meaning behind most of the mathematics. Many times while covering new material, the students had to complete fill-in-the-blank type worksheets that Ms. Walters worked through with them. On these worksheets, the students were asked to fill in definitions of words that Ms. Walters provided for them,

copy down example problems that Ms. Walters worked through in class, etc. Again, the activities of the period were very teacher-guided. Time for student exploration was generally not provided.

Procedural Knowledge

It was obvious that Ms. Walters understood the material that she was trying to present to her students. The problem was that she was almost consumed by the steps of working through a problem. Also, like Mrs. Johnson, Ms. Walters placed quite a bit of emphasis on not skipping steps. Most of the discussions that took place throughout the semester were focused on the steps for working a problem and not why those steps worked. The same could be said for the various group activities that were assigned throughout the semester.

Propositional Knowledge

As indicated previously, Ms. Walters attempted to get at her students' propositional knowledge about the mathematics that was being discussed. The problem was that her activities were not necessarily designed to accomplish that task. Rather than asking the students to explore various mathematical concepts, Ms. Walters asked them to work through extended problems that followed the steps previously discussed that day. Then, when the presentation of the various problems occurred, the focus of the discussion was the steps and not the process that was used to arrive at the answer. It is believed that if Ms. Walters had asked higher order questions during the presentations, the propositional knowledge that she intended for the students to learn would have come out. Instead, the students were left with following the steps.

Student/Teacher Relationships

It was obvious that Ms. Walters cared about her students. Like Mrs. Johnson, her bubbly personality was contagious. It seemed like it was hard for any student to be in a bad mood while in Ms. Walters' class. Ms. Walters was very much the cheerleader type who never really seemed to get frustrated about much of anything. She always seemed to know how to reassure the students even when working through some very difficult material; albeit, the reassurance was "Follow the steps I give you and everything will be fine". Additionally, she seemed to have a way of getting a student "back in line" without really embarrassing the student or interfering with the overall tone of the room. Also, she carried on many of the motivational incentives that Mrs. Johnson already had in place, such as the "A Board".

Similarities and Differences Between Mrs. Johnson and Ms. Walters

Upon analyzing all of the information pertaining to Mrs. Johnson and Ms. Walters, it appears that they were very similar in many ways. They both cared tremendously for the students. This was apparent in the conversations they had with their students. Both were also more than willing to try new things to get concepts across to the students. Depending on what component of a lesson was being analyzed, Mrs. Johnson and Ms. Walters could be described as maintaining a Platonist view or an instrumentalist view. According to Thompson (1992), a teacher with a Platonist view emphasizes students' understanding of the logical relations among various mathematical topics and the logic underlying the mathematical procedures. This was apparent in the intention of activities that were incorporated in the classes even if the intentions didn't always come to fruition. When Mrs. Johnson and Ms. Walters weren't making a conscience effort to

incorporate new techniques into their lessons, they exuded the characteristics of the instrumentalist view. According to Thompson (1992), a teacher with an instrumentalist view placed an emphasis on students gaining the mastery of mathematical rules and procedures. Additionally, the role of the teacher is to demonstrate, explain, and define mathematics for the students in an expository manner (Thompson, 1992). The RTOP scores indicate that even though Mrs. Johnson and Ms. Walters don't always exude qualities that are indicative of reform based teaching, they are definitely striving to incorporate more of these things into their lessons. The main difference between the two is the amount of experience Mrs. Johnson has compared to Ms. Walters.

Outcome of the Internship Experience

In a follow up discussion about the outcome of the internship experience, Mrs. Johnson defined her role as cooperating teacher as one that was "to help the student teacher develop the skills needed to convey mathematical knowledge to the students in a way that fits the students' learning ability." Mrs. Johnson stated that the university supervisor was "to make sure the student teacher understands how to develop lesson plans that fit the mathematical content taught in the classroom and see that the lesson plans are carried through." In clarifying her previous definition of the role of pre-service teacher, Mrs. Johnson replied that the pre-service teacher was "to develop lessons according to the Alabama state course of study, execute the lessons, and assess the students learning of those lessons. And not be afraid to fail at a lesson and learn how to correct it for the future." When Mrs. Johnson was asked whether or not she and Ms. Walters had different beliefs about teaching and learning mathematics, she stated, "We seemed to have a lot of the same beliefs about the way to present information to the

students and how they learn the material. We really did not have any beliefs that differed."

In a follow up discussion similar to the one with Mrs. Johnson, Ms. Walters commented on the role of the cooperating teacher by stating, "My cooperating teacher was a friend and a role model throughout my internship." When mentioning the university supervisor, Ms. Walters said, "I do not know what my university supervisor's role was. I guess to make sure that I was doing what I was supposed to do during the internship." Commenting on her role as pre-service teacher, Ms. Walters said, "My role was to be a learner through my internship. I was there to learn as much as I could about this profession. I was to learn about different situations and how to conduct and control a classroom." When the researcher asked who influenced her most throughout her experience, Ms. Walters responded,

> My cooperating teacher and the other teachers at the school influenced me the most. They were the people that were with me everyday and were very encouraging throughout my internship. They were the people who really gave me an idea of what it is like to be a teacher. Also I was able to see how they conducted their classes and gave me ideas about what to do.

Finally, when asked to discuss whether or not she and her cooperating teacher had different beliefs about teaching and learning mathematics, Ms. Walters responded, "No. I believe that my cooperating teacher and I had basically the same beliefs about teaching and learning mathematics."

Case 3: Mrs. York and Mrs. Windsor

Mrs. York is the White female cooperating teacher discussed throughout Case Three. She is a veteran teacher that has been teaching mathematics for seventeen years. Mrs. Windsor is the White female pre-service teacher discussed throughout Case Three. She is working on her degree in Secondary Mathematics Education via the fifth year certification program.

The internship experience discussed throughout Case Three takes place at Murphy High School. Murphy High School is a county school that services students in grades nine through twelve. Its total population is 1003 students. The student teacher ratio for the school is twenty to one. Thirty-nine percent of the student body is eligible for the free or reduced-price lunch program. The student body has the following racial components: White, African American, Hispanic, Asian/Pacific Islander, and American Indian/Alaskan Native. Sixty-one percent of the students are White. Thirty-six percent of the students are African American. One percent of the students are Hispanic. Less than one percent of the students are Asian/Pacific Islander. Finally, less than one percent of the students are American Indian/Alaskan Native.

Table 13

Demographic Summary of Murphy High School

System Type	Grades Serviced	Total Population	Student/ Teacher Ratio	Students Eligible for Free or Reduced-Price Lunch	Racial Background
County	9-12	1003	20	39%	White – 61% African American – 36% Hispanic – 1% Asian Pacific Islander – <1% American Indian/ Alaskan Native – <1%

Mrs. York

Mrs. York is a White female in her mid forties with a son who is in high school. She can best be described as the mom from next door. She's very warm-hearted, tender, caring, and can fix almost anything. This demeanor, however, does not mean that she doesn't have the ability to be stern. She's just stern in a quiet kind of way. Mrs. York has been teaching high school mathematics for seventeen years. Eight of those seventeen years have been spent teaching at Murphy High School. She has a bachelor's degree in mathematics education and a master's degree in mathematics education. Additionally, Mrs. York is National Board Certified.

Mrs. York is the Math Plus School Teacher Leader at her school and the Math Plus District Teacher Leader for her school district. She is also a Math Plus presenter. Refer to pages 37 – 39 for more information about her role responsibilities in these positions. Mrs. York reported that over the past year, she has spent over 160 hours involved in some type of professional development. Of those hours, she stated that over twenty of those hours were spent in professional development settings that specifically focused on mathematics. Additionally, she reported that over fifty of her professional development hours were spent in association with Math Plus. From what was observed, Mrs. York fulfilled her Math Plus responsibilities to the highest degree. It appeared that Mrs. York personally owned all of the ideas she discussed and demonstrated. She not only talked about the reform initiatives implemented by Math Plus, but she also utilized them in her own classroom on a daily basis. The ideas were not something she used every now and then. Instead it appeared that her students expected nothing less than the various activities that she designed for them.

When asked to discuss mathematics, Mrs. York stated, "Mathematics is all about measuring the things in your life and taking care of your business. Math is really the way we make sense of the things that go on around us." According to her responses on the beliefs survey, Mrs. York felt like mathematics is an important subject that should be available to all students because it is something that will continue to be used even once the students are out of school.

When asked to describe how students best learn mathematics, Mrs. York didn't hesitate when she said, "I think that it varies by the student. What is the best way for one student to learn is not the best way for the other." She went on to say, "I think that there

are multiple levels of understanding. So, if you can do things in several different ways to get at the strengths of that student, then they can learn that way." She concluded by saying, "I don't really think there is one best way to learn mathematics." As indicated by her responses on the beliefs survey, Mrs. York strongly agreed that students should not only be able to obtain correct answers, but they should also understand the mathematical concepts involved in getting to that right answer. Additionally, she felt that students should understand important mathematical concepts before they ever attempt to memorize definitions and facts.

Upon being asked to elaborate on the most effective way to teach mathematics, Mrs. York stated

> I think that they need to…the kids do need to interact. They need to talk about math. They need to write about math. They need some way to make sense of it. It's not all about working equations. So, anything that you can do to help them make sense of it is what is going to be the most important thing.

When asked to describe the learning environment in her classroom, Mrs. York enthusiastically responded, "NOISY!" She also commented, "They talk a lot. I think it's kind of safe." She continued, "I try to make it safe for them to say anything and not be criticized for not knowing." When Mrs. York was asked to describe a typical mathematics lesson in her classroom, she just laughed. She stated that the students never know what she is going to make them do. Also in response, she commented that her students do a lot of group work. In addition, she stated, "They also do some independent work, but I do stress collaboration. I want them to collaborate." Additionally, as indicated by the beliefs survey, she responded that students should be allowed to figure things out

on their own rather than depending on demonstrations/explanations given by their teacher. Refer to Appendix D (Table 25) to see all of Mrs. York's responses to the beliefs survey.

When asked to define her upcoming role as cooperating teacher, Mrs. York replied,

> I really believe that my role should be to try to show them how to manage a classroom. How to take what they've got…you know, because you never know what kind of schedule you're going to get…and make the most of it. Make it to where you can feel good about what you're doing even though there are times when you don't feel like what you're doing is impacting the students. It will. I really think they need to see the students as learners before mathematicians and then try to take their strengths and work from their strengths to help them become better at what they can do, more proficient…especially with the skills that they are required to know for graduation.

Upon asking her to define the role of the university supervisor, Mrs. York commented, "Communication is the biggest thing." She also said, "Being sure that their expectations are being met." In addition, she further elaborated by saying, "Be supportive. Be encouraging." Additionally, "I really think that communication and making sure that you see the big picture and not just the small part."

When asked who would have the most influence on the pre-service teacher, Mrs. York commented, "That's a loaded question. I think on one level the supervisor from the college has the most influence because they're giving the grade for it." She went on to

explain that she also thought the cooperating teacher would have a great influence. She concluded that the cooperating teacher would have most of the influence.

Upon asking about expectations of the incoming pre-service teacher, Mrs. York stated,

> I expect my intern to know the mathematics. I expect them to be familiar with a lot of the technology, probably more familiar than me simply because usually they're younger, and they've had to make all of these presentations, and it's not necessarily on the job training. I really expect them to know probably more about working with manipulatives than I do. More about making connections and modeling, and I really do think the intern will help me do that because for so many years I was analytical and so not that way, that I think it will be a big help to me to see some more of the newer things that they're doing. Although, I'm trying to do those, it will help me to have a different perspective on things.

Finally, Mrs. York was asked to talk about what she thought would happen if she and her pre-service teacher had different beliefs about teaching and learning mathematics. She stated,

> Everybody has different beliefs about things. As long as they're not big philosophical differences. As long as they're small things like what you call instructional freedom. If I think something needs to be taught this way, but the intern thinks it needs to be taught the other way, I can't say that I'm right because it's all a matter of philosophy, and I might be wrong. So, I think that the intern deserves the opportunity to do it their way. The only thing that I would have a problem with is if they were not willing to work with the students because I think

that anyone who loves the students and really wants to work with them and really genuinely wants to teach them, I would get along with.

Spring 2006 and Fall 2006 Classroom Observations

During the Spring 2006 semester, Mrs. York was observed on three separate occasions. These three observations were spread out over a period of a month. The first observation was of a Geometry class. The second observation was of an Algebra 1B class. The third observation was also of an Algebra 1B class. The Geometry class occurred as follows:

> As the students entered, they were instructed to take out a worksheet they had done for homework and discuss their answers with their group members. As the students discussed the worksheet, Mrs. York walked around and handed out transparencies and overhead markers. She also monitored the activities of the groups. Each group was assigned a problem to present to the class. The presentations were done from their seats with Mrs. York in the back of the room. Throughout the presentations, Mrs. York was very persistent in making the students use correct vocabulary such as median and base. Also throughout the presentations, Mrs. York asked questions such as, "Is that enough information to answer the question?" and "How do you know the diagonals are equal?".
>
> After the groups finished presenting, Mrs. York called on the group that had been exploring kites. Apparently, each group in the class had a different quadrilateral to explore and present to the class. All of the students had a "notes" page for each shape. Also, at this point in time, all groups had presented their

shape except the group working on kites. Again, throughout the presentation, Mrs. York positioned herself in the back of the classroom.

At the conclusion of the shape presentation, Mrs. York told the class to write an essay comparing and contrasting the various shapes they had been studying. She told them to specifically focus on things they had in common and things that were different. She also told them that they could use their "notes" page to help them with this assignment.

As the students worked on their essay, Mrs. York caught some students up on a quiz that had been missed. She also walked around and answered various questions the students had. Additionally, Mrs. York walked around to make sure the students were on task. As the teacher answered individual questions, she spoke directly to the individual and only to where the individual could hear.

As Mrs. York walked around, she noticed one student studying for another class instead of working the problems on the board. Instead of reprimanding the student, she asked the student if she understood the work they had done. Mrs. York also asked the student if she had had a ball game the night before. The student answered yes. Because of this, the teacher allowed the student to continue studying instead of making her do the math problems.

Mrs. York appeared to be interested in what the students did outside the classroom. She asked about their ballgames, etc. She also used this as leverage to get the students to work. She said things such as "Tell me about your hit, but only after your other group members have finished."

Towards the end of class, Mrs. York had a variety of students pass back assignments such as quizzes, etc. She also passed out folders for each student. The students kept graded work in these folders. Then, the class looked at the solution to the Problem of the Week (POW). Apparently, they had already seen the answer so the point of today's discussion was to look at another way to do the problem. After this discussion, Mrs. York answered questions about the quiz that had been returned.

The POW was about finding the area it would take for 5.5 billion people to occupy if they were each allowed a 2 ft by 2 ft patch of ground. It asked if these people would fit in Alabama. It asked if America should control the population in China.

A typical Algebra 1B class had the following format:

Mrs. York attempted to put the class in groups today, but after spending at least five minutes trying to get them in a seat and quiet, she told them to get back in their rows. She asked certain students to sit with certain groups. Some of the students outright refused to move. This also contributed to part of the reason Mrs. York put them back into rows.

After the class had finally settled down and was ready to work, Mrs. York drew a line on the board. She asked the students to write down five facts they knew about the line. She also reminded them, "As you write your facts, you might want to include some of those "fancy" math words that we've been using.". As the students worked, the teacher walked around and monitored student progress. One student suggested the line was vertical. Mrs. York asked her what it meant

for a line to be vertical. Many of the students wanted to incorporate the words "parallel" and "perpendicular". As she walked around, Mrs. York asked questions such as "Parallel to what?" and "Perpendicular to what?". After the students had sufficient time to think about the question at hand, Mrs. York asked some of the students to share their thoughts. This led to a discussion about the x-intercept and the y-intercept. Another student suggested that the line had a positive slope. Mrs. York asked this student to get up and explain/demonstrate why the line had a positive slope. As other students demonstrated their ideas, many other students were loud and disruptive. Mrs. York reminded the class that they needed to respect the presenter.

After all of this discussion, Mrs. York passed out a worksheet for the students to do. Throughout the class, she ended up moving a few students in order to deal with the discipline problems. It appeared to help somewhat, but the students still were not on task. As the students worked, the teacher walked around to help. It almost appeared that in order for Mrs. York to get the students to work, she almost had to stand over them. The minute she moved on to someone else, the student she had been helping got off task again. The purpose of the worksheet was to act as a review; however, many of the students acted as if they had never seen the material. At this point, Mrs. York pulled the class back together to go over some of the problems together as a class. She also had a discussion with them that emphasized how important they were to her, but that they had to do their part as well. She told them, "I guess I should just do what all of your other teachers in the past have done…put you out for misbehaving and just let you fail. It sure would

make my life easier because then I wouldn't have to deal with any discipline problems. I'm not willing to do that though because you are too important to me. I know it took some of you a few times to get through Algebra 1A and that hurts me because I know you are smart. This just tells me that you weren't doing what you were supposed to do in your other class. You're smart and you can do this.".

After this, they started working the problems on the worksheet as a class. In this discussion, they talked about the different approaches to working the problems (i.e., counting for slope or using the formula). Then, they had the problem $x + 2y = 4$. There was some discussion about this. They knew it wasn't in the correct form, but they disagreed on how to get it in the correct form. One student wanted to divide everything by 2 and then move the *x*. Another student wanted to move the *x* first and then divide through by 2. Mrs. York worked the problem both ways to show that it didn't matter and that actually both students were correct.

After the class worked this problem, Mrs. York told them they needed to complete the worksheet and turn it in before leaving class. Many of the students were extremely loud and disruptive. They were also off-task. Mrs. York then began walking around to get each student on task. As she walked around, she also encouraged certain students to work together. This type of interaction occurred until the end of the class.

At the conclusion of each of the above mentioned observations, the researcher completed the Reformed Teaching Observation Protocol (RTOP) for each respective lesson. The researcher averaged the scores for the five questions in each section to

determine an average score for each section of the RTOP and then determined the median score of the three observations for each section of the RTOP. When looking at the scores in Table 14, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). Based on the RTOP scores, Mrs. York definitely designs and implements lessons that are indicative of reform based teaching. This was very apparent in the Geometry classes. The lessons were always designed in a manner that allowed the students to explore the objectives that were covered that day. Additionally, there was always an emphasis on explaining the concepts and processes and not just stating the correct answer. Even though this didn't always play out in the algebra classes, the intentions were still there for the students to explore and discover mathematical concepts. The approaches Mrs. York may have had to use to get them to that point were just different than those employed in her Geometry classes.

Table 14

RTOP Averages and Median for Mrs. York's Spring 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	4	3.2	4	4	4
Observation 2	4	3.2	2.8	3.6	3.8
Observation 3	4	3	2	3.4	3.8
Median	4	3.2	2.8	3.6	3.8

At the beginning of the Fall 2006 semester, Mrs. York was observed one more time just to see if any major changes in teaching style since Spring 2006 had occurred. The observation was of an Honor's Geometry class. It was very similar to the typical Geometry class described from the Spring 2006 observations. At the completion of the observation, the researcher again completed the RTOP for that observation. As with the Spring 2006 observations, the researcher averaged the scores for the five questions in each section to determine an average score for each section of the RTOP. The scores can be found in Table 15. It is obvious from these scores that Mrs. York is definitely reform minded when it comes to her teaching.

Table 15

RTOP Averages for Mrs. York's Fall 2006 Classroom Observation

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 4	4	3.2	4	4	4

Lesson Design and Implementation

The design of Mrs. York's lessons most definitely encouraged exploratory behavior on the part of the students. Very little of Mrs. York's time was spent in the front of the classroom lecturing. As a matter of fact, when she wasn't circulating among groups, she was standing in the back of the room because student presentations were taking place. Mrs. York later conveyed to the researcher that this was where she felt the most comfortable. She didn't like being in the front of the room and being the center of

attention. It is the researcher's opinion, that Mrs. York's role in the classroom was that of a facilitator as opposed to a giver of knowledge.

In the Geometry class described above, it was obvious to the researcher that the students were accustomed to working in groups. This was not an unusual concept for them. As a matter of fact, it appeared that they expected to work that way. Out of the ordinary to them was sitting in rows and working independently. Most if not all of the activities in that class were designed to be a collaborative effort. In addition to that, all of the work was presented in such a way so that the students had to explore mathematical concepts in order to come up with ways to deal with different types of problems. While the students worked on their activities, Mrs. York always circulated around the room to offer her assistance; however, assistance only came in the form of hints. Mrs. York refused to tell the students what to do to solve the problems. Instead, she would offer suggestions to get them on the right track, and then she left the group to work on the problem some more. For some, this technique was frustrating because Mrs. York never outright answered the question. For the rest of the class, this appeared to be the expected response.

Mrs. York attempted to use the same techniques with the algebra class; however, the students were not as accustomed to her style. As a matter of fact, the word resistant can best be used to describe her students' behavior in that class. Even so, other than utilizing a different seating arrangement, Mrs. York carried on as the facilitator. She resisted the urge to give in to the class's desire for a more traditional teacher. Even when they tried to sabotage the discussion by answering with the most basic of responses, Mrs. York continued to prod them and encourage them to think deeper. Also, when the

groupings that she had originally planned for that class didn't work out as she had liked, Mrs. York modified her plans and utilized the students in the class that knew what they were doing. By doing this, she allowed herself the time to circulate around the room and help the students that were having serious problems. It was a great way to maximize her use of time as well as tap in to the additional resource of her students.

Communicative Interactions

Student-Led Discussions

A majority of Mrs. York's lessons were designed to facilitate student-led discussions. As a matter of fact, when asked to describe her classroom, Mrs. York stated it in one word, "NOISY". She then elaborated that the reason for this is because the students are generally always working together in groups or pairs to explore mathematical concepts. This can't be done if the students don't talk to one another. Additionally, the exploration phase was always followed up by group presentations. The students not only had to complete the assignment, but they also had to be ready to present their findings to the rest of the class. The climate of the room was one of inquisitiveness. The students were not afraid to question one another. There were many occasions during the group presentations that comments such as "I didn't do it that way" or "How did you come to that conclusion?" could be heard from students in the class. If Mrs. York felt like the students were misguided, or she wanted to point out something else about the problem, she interjected a comment every now and then; however, for the most part, Mrs. York did very little talking because the students covered it all for her.

Teacher-Led Discussions

As stated previously, Mrs. York did very little talking because the students did most of it for her. It was neat to watch the interaction of the class and see just how little Mrs. York had to interject. The times she did intervene, she was usually asking prompting questions such as “Why did it work that way?”, “Could we work the problems a different way?”, “Is that the same or different from what we just did?”.

When she wasn’t questioning the students, Mrs. York was reassuring them that they could do the assignment she had given them. This generally took place on an individual basis. If she saw a student struggling, she made it a point to encourage that student in some way.

Procedural Knowledge

Even though the lessons weren’t implemented in a procedural manner, in order to facilitate the lessons she had planned, Mrs. York had to have a tremendous amount of procedural knowledge. Knowing the procedures needed to solve the problems involved throughout the lesson allowed Mrs. York to derive the questions that got the students to think about the mathematics on a much deeper level.

Propositional Knowledge

Mrs. York displayed a tremendous amount of propositional knowledge. She constantly asked questions such as “Why did it work out that way?”, “How do you know your answer is correct?”, “What would happen if we did this instead of that?”. Her propositional knowledge was also apparent in the activities she chose to assign her students. Rather than being cookie-cutter lessons where all the students had to do was fill in some blanks on a worksheet, the lessons that Mrs. York utilized were designed to

allow exploration of mathematical concepts. In essence, the lessons were designed so that the students could learn and own the mathematics for themselves.

Student/Teacher Relationships

Mrs. York had an outstanding rapport with her students. Even students who didn't like mathematics couldn't help but like coming to Mrs. York's class. The care, concern, and respect she showed her students were genuine and the students knew it. There is no doubt that everything Mrs. York did was done with the best interest of her students in mind. Not only was Mrs. York interested in her students' mathematical lives, she was also interested in their personal lives. This was evident in the above scenario when Mrs. York knew that the student had not studied for her other class because she had been involved in a ballgame the night before. This interest seemed to go a long way with the student. Additionally, Mrs. York commented to the researcher that she liked to know the things her students liked because knowing this information allowed her to customize problems they were interested in working.

Mrs. Windsor

As mentioned earlier, Mrs. Windsor was the pre-service teacher placed with Mrs. York. Mrs. Windsor is a White female in her early to mid twenties working on her master's degree in Secondary Mathematics Education via the fifth year certification program. Mrs. Windsor is very cute and has a very neat and professional appearance. In addition to her appearance, she had a very natural demeanor with the students. It was as if she had been in the classroom for years.

When asked to define mathematics, Mrs. Windsor responded, "Mathematics is all about problem solving. It's just about real world…you know…it's got real world implications that some people don't realize. It's just about problem solving."

In her response to the best way students learn mathematics, Mrs. Windsor commented, "I think it's really good for them to learn…like they can learn through investigations. Just learn for themselves. That way, there's meaning behind the concepts rather than just learning facts and rules." This idea of student-centered learning is apparent in her responses on the beliefs survey as well. Mrs. Windsor strongly agreed that students should be allowed to figure out how to solve mathematics problems for themselves rather than depending on teacher demonstrations/explanations. She agreed this could be done by the students applying their own personal experiences to solving the problem at hand. Additionally, Mrs. Windsor strongly agreed that teachers should allow students to communicate their mathematical processes in ways that are relevant to them. When asked to elaborate on the best way to teach mathematics, Mrs. Windsor stated,

> Let them explore a lot themselves. There are some things that you just have to like tell students, but a lot of things they can explore for themselves. Find things out for themselves. That way, they'll learn it better I think. Let them work through problems and help each other out. Like I was saying, when you teach someone else, you learn it a lot better than if they just hear it from somebody.

Mrs. Windsor further indicated on the beliefs survey that she strongly agreed that students should be provided with informal experiences to explore mathematical concepts prior to them being expected to master that concept. She also agreed that students should have to work with mathematical concepts in various contexts; therefore, the teacher

should provide varied and multiple experiences for students to work through problems. Refer to Appendix D (Table 26) to view all of Mrs. Windsor's responses to the beliefs survey.

When Mrs. Windsor was asked to define the role of her cooperating teacher, she stated,

> Well, I hope that she'll be very…like a mentor because like I said, I do not know everything for sure now, and I'm not sure that I'll know it when I'm done interning, but if she'll just give me that advice, like good experienced teachers can give you, I hope I can…I plan on taking notes. A lot of people have good ideas for first days of school. You know, good things to implement. So, I hope that she's just a really good mentor, and I can take away great ideas because teaching is just using everybody's ideas. That's the best way to do it. So, I hope that she'll work with me and tell me if I'm doing something that I'm not supposed to do. I won't learn otherwise. So, just help me through it.

In describing her expectations of the university supervisor, Mrs. Windsor replied,

> Well, I'm sure that they will be there telling me what I'm doing right or wrong. I hope that they'll be, you know, not as critical as they could be because, you know, I'm not perfect. I wouldn't even proclaim that I'm anywhere near perfect. I hope that they'll see the effort and see that I'm trying and learning. That way, they can give me good advice and constructive criticism. I guess you could say, just help me along as well. Give advice as needed. Not be too harsh. Don't scare me to death.

When asked to define what her role as the pre-service teacher will be, Mrs. Windsor stated,

> Well, I see it as just trying to be a better teacher. Trying to get prepared to be on my own. That's kind of like scaffolding I guess you would say. I know that at first you don't have as big of a role as you do when you start actually taking over the class. I see it just picking up and just getting closer and closer with the students and just really not taking charge of the class, but it should be. But I guess that in a way, it should be because its like taking on the whole day, so I've got to take charge if … you know that class is a lot of responsibility. It's a huge responsibility. I don't want to mess up these students. And here's this teacher who's letting me come in so…It's a big role. You've got to do a good job and work hard.

When asked if she thought if it would be a problem if she and her cooperating teacher had different beliefs about teaching and learning mathematics, Mrs. Windsor answered,

> It can affect you for sure because it could be like one more thing discouraging you, but you can't let it bother you. You've got to…you can convince people it works. You can say, "Just let me try this one day and see what you think." Because in any school, and I'm going back home, which I'm not even sure what kind of stuff that they teach. It's almost 90% sure that they're not going to agree with a lot of these things just because its new and different. So, this would just give me extra practice in trying to convince somebody about it. I really think that everybody has a little bit of compromise in them, so just work with them and try

to…like I said, "Just try this one time and see how it works." I mean I know it will be harder than if she did, but I think it's something that could be worked through unless she was just totally against it. I know for a fact that mine is because she's a presenter for Math Plus, so I know that I don't really have to worry about that. I guess that's why that makes it easier to say.

Fall 2006 Classroom Observations

During the Fall 2006 semester, Mrs. Windsor was observed on three separate occasions. These three observations were spread out over a period of three months. All three observations were of Geometry classes. A typical lesson looked like:

At the beginning of class, the class had to finish discussing some problems from the day before. Previously, they had been talking about triangle similarity. During the previous day's lesson, there was a major discussion about problems involving right triangles. When they worked the triangles using the Pythagorean Theorem, they got one answer, and when they worked the same problem using proportions, they go another answer. In essence, the discussion was about which answer was correct and why. They were actually working on AA, SSS, and SAS, but the students were focused on other things.

The students took a break after this initial discussion. When they came back in, Mrs. Windsor had three problems for them to work on. These problems were asking if two triangles were similar. After the students had time to work on these, some students worked them on the board. Then, they discussed the problems as a class. During the discussion of these problems, the students asked very deep questions. They also didn't hesitate to question each other. They loved

to ask questions such as: “How did you do that?”; “Do you really know enough information to determine similarity?”; and “How did you come to that conclusion?”.

After some discussion on these problems, some of the students still seemed a little foggy about the concepts. Rather than spending a lot more time on this, Mrs. Windsor moved on to the activity. She and Mrs. York assured the students that they would have plenty of time next week to polish up these concepts. She also told them to take this information home and think about it over the weekend.

At this point, the groups began working on the activity “What’s Possible”. They were given packets that had strips of paper for the sides of the triangles and brads to connect the strips into triangles. They were to use these packets to help them with the activity. Also, the groups were given about ten minutes to complete parts one and two on the sheet. As the groups worked, Mrs. Windsor and Mrs. York walked around to see what the groups were doing. They also answered questions and asked questions in return. They generally asked a question to answer a question.

The point of the activity was to come up with the Triangle Inequality Theorem and the Angle Sum Theorem. As the researcher circulated throughout the room, observing the groups, it appeared that all students were on task and questioning each other. Some of the groups only got through parts one and two while others moved on to parts three and four. In the end, all groups had work to present to the class. As with the other discussions, the students didn’t hesitate to

question each other. For example, one group said, “They didn’t write that correctly. Shouldn’t it be…?” This type of discussion went on throughout the lesson. After the presentations, Mrs. Windsor took a few minutes to go over some work she was passing back to the students.

At the conclusion of each of the above mentioned observations, the researcher completed the RTOP for each respective lesson and then determined an average score for each section of the RTOP. Then, the researcher determined the median score of the three observations for each section of the RTOP. When looking at the scores in Table 16, a score of 0 represents “Never Occurred” and 5 represents “Very Descriptive” (AzTEC, 2002). Mrs. Windsor’s scores indicate that she plans and implements lessons that have all of the qualities of reform based mathematics.

Table 16

RTOP Averages and Median for Mrs. Windsor’s Fall 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	3.8	3.4	4	3.4	4
Observation 2	3.4	3.2	3	3.2	4
Observation 3	3.8	3.4	4	3.8	4
Median	3.8	3.4	4	3.4	4

Lesson Design and Implementation

Mrs. Windsor was extremely thorough with her lesson design. The lesson plans she used were very detailed in nature. They included the usual things such as behavioral objectives, assignments, etc. In addition to these things, however, Mrs. Windsor's plans also included higher order questions along with possible student responses. It was obvious to the researcher that she put much time and effort into planning the lessons for her students. Not only did Mrs. Windsor put all of these things on paper, but she also implemented a great majority of what she had planned. To say the least, she had planning down to a science.

The lessons that Mrs. Windsor implemented were definitely student-centered in nature. Most of the instruction was actually done by the students by way of group activities and group presentations. Every once in a while, Mrs. Windsor interjected a comment or two about some of the work that was taking place, but for the most part she was the facilitator. While the students worked, she monitored their progress and helped the groups with any problems they may have had. Like Mrs. York, help from Mrs. Windsor was usually in the form of another question that would get the group thinking about a particular concept they were questioning. Very seldom did Mrs. Windsor come right out and answer a question. This approach appeared to work well with the students. At the end of the activity, the groups generally had some findings to present to the rest of the class. While these presentations took place, Mrs. Windsor stood in the back of the room and just observed. Most of the time, the groups presenting covered all of the pertinent material. If they missed something, the other students in the class generally

asked about it. If this didn't occur, which was very seldom, Mrs. Windsor interjected a comment or two.

The type of teaching style described previously seemed to suite Mrs. Windsor. It was apparent that she was extremely comfortable with the techniques that she implemented in her classroom. It was also obvious that she was comfortable with the material that she was responsible for teaching. It all just seemed like second nature to her.

Communicative Interactions

Student-Led Discussions

A majority of Mrs. Windsor's lessons were designed to facilitate student-led discussions. For this reason, there was always a buzz in the air. In general, the students were always working together in groups or pairs to explore mathematical concepts. Obviously, this can't be done if the students don't talk to one another; hence, the buzz. Additionally, the exploration phase was always followed up by group presentations. The students not only had to complete the assignment, but they also had to be ready to present their findings to the rest of the class. As when Mrs. York was teaching, the climate of the room was one of inquisitiveness. The students were not afraid to question one another. There were many occasions during the group presentations that comments such as "I didn't do it that way" or "How did you come to that conclusion?" could be heard from students in the class. Again, in a similar fashion to Mrs. York, if Mrs. Windsor felt like the students were misguided or she wanted to point out something else about the problem, she interjected a comment every now and then; however, for the most part, Mrs. Windsor did very little talking because the students covered it all for her.

Teacher-Led Discussions

As previously mentioned, because of all the student-led discussions that took place in the classroom, Mrs. Windsor had to say very little during any given class period. It was simple. The students did most of the talking. Mrs. Windsor functioned as a facilitator and not a knowledge giver. According to Mrs. Windsor, her role was to help her students explore the mathematical concepts so that they could figure things out for themselves rather than her telling them everything about the problems. Because of this, much of her time was spent with individual students or with groups. She hardly addressed the class as a whole. She let her students do that by way of their presentations.

Procedural Knowledge

In order to successfully facilitate the types of lessons she had planned, Mrs. Windsor had to have a good grasp of the mathematical concepts the students were exploring. This knowledge was apparent in the lesson plans that she utilized. It was also visible in her questioning technique as well as in the group activities that the students completed. Even though Mrs. Windsor never came right out and said, “First you do…” and “Then, you do…”, the students eventually figured these things out by carrying out the explorative activities that were assigned to them.

Propositional Knowledge

It was apparent from the questions she asked and the activities that she assigned that Mrs. Windsor had a tremendous amount of propositional knowledge. She constantly asked questions such as “Why did it work out that way?”, “How do you know your answer is correct?”, “What would happen if we did this instead of that?”. Her propositional knowledge was also apparent in the activities she chose to assign her

students. Like Mrs. York, rather than using cookie-cutter lessons where all the students had to do was fill in some blanks on a worksheet, the lessons that Mrs. Windsor utilized were designed to allow exploration of various mathematical concepts. In essence, Mrs. Windsor used lessons that were designed so that the students could learn and own the mathematics for themselves, which strengthens their propositional knowledge.

Student/Teacher Relationships

Mrs. Windsor loved her "job" and it was very easy to see this through the reactions of her students. They loved her. It was obvious that Mrs. Windsor had a good relationship with her students. It was perceived that she not only cared about what mathematics they learned but that she also cared about them on a more personal level. Like Mrs. York, Mrs. Windsor took the time to get to know her students. She used this to her benefit, to help her build lessons around topics that were of interest to her students. Without taking the time to get to know their likes and dislikes, this would not have been possible. Additionally, Mrs. Windsor was very sensitive to her students' needs. If she saw a student struggling, she made it a point to get to that student at some point during the class period so that she could provide the encouragement or guidance that was needed.

Similarities and Differences Between Mrs. York and Mrs. Windsor

Upon analyzing all of the information pertaining to Mrs. York and Mrs. Windsor, it appears that they were very similar in many ways. They both cared tremendously for the students. This was apparent in the conversations they had with their students. Both were also more than willing to try new things to get concepts across to the students. Both Mrs. York and Mrs. Windsor exuded qualities of a teacher with a learner-focused or constructivist view as described by Thompson (1992). They both viewed their role as a

facilitator of learning. This was apparent by the activities they utilized: asking intriguing and thought-provoking questions; posing situations for investigation; and challenging students to think. These are all qualities Thompson (1992) used when discussing the constructivist view teacher. The RTOP scores indicate that both Mrs. York and Mrs. Windsor exhibited qualities that classified them as teachers that successfully implemented reform based methods. The main difference between the two is the amount of experience Mrs. York has compared to Mrs. Windsor.

Outcome of the Internship Experience

When asked to look back on her role as cooperating teacher, Mrs. York described her experience as follows:

> My role as a cooperating teacher had many aspects. I served as a sounding board for my intern as she grappled with the responsibilities of teaching. I gave advice about handling the students and the workload. I hope I modeled that I didn't have all of the answers and that some parts of teaching are very difficult and that teachers must adapt to the various situations thrust upon them. I also encouraged my intern to take chances and to try something new, even if it didn't turn out as she had hoped it would. Everything we do as educators is a learning process for us as well as the students. Some lessons will flop, but others will bring about a deeper understanding of mathematics. I hope that she will continue to seek out better methods of teaching. My role as a cooperating teacher was also to foster independence. My intern was trusted with all of my classroom responsibilities because she will be expected to fulfill that role in a teaching position. She learned

about paperwork, health plans, IEP's, appropriate documentation, and parent conferences.

When asked to re-evaluate the role of the university supervisor, Mrs. York replied, "The university supervisor was the liaison between the university and the school. He explained the responsibilities of the intern and the cooperating teacher and made appointments to observe the intern and to visit with both the intern and the cooperating teacher." In discussing the role of the pre-service teacher, Mrs. York made the following comments:

> My intern wrote lesson plans, maintained all classroom records and files (using my passwords), communicated with parents, created evaluations, made copies, graded papers, observed all of the other math teachers at the school, attended faculty meetings, and maintained a neat, orderly classroom. Additionally, she wrote daily reflections, kept an internship notebook, scheduled all observations, and made sure that I completed the necessary paperwork for the university supervisor. She was a master organizer who managed her time well and was always over-prepared for her lessons.

One final comment Mrs. York had to make about the internship experience was

> I was in a win/win situation. I was given an opportunity to mentor a new teacher—one who is talented and capable. With that opportunity, my intern helped me integrate more technology into my own lessons. When I was looking for a new approach to a lesson, she would help me by researching the topic and searching for lessons. I am very thankful that I had this collaborative experience.

When Mrs. Windsor was asked to discussed the role of her cooperating teacher, she described her as a mentor and friend. Additionally, Mrs. Windsor stated that Mrs.

York carried out tasks such as explaining the basic routines of the classroom, assisting in finding activities, and allowing her to take full control of the classroom. Mrs. Windsor also remarked that she had picked up many strategies from Mrs. York that she intended on implementing in her future classroom. When asked to elaborate on the role of her university supervisor, Mrs. Windsor stated that his role was to basically check lesson plans, journals, and other paperwork and to observe her teaching a few times. She further elaborated by stating that her supervisor visited three times and basically got snapshots of her teaching. She stated that after the visits, they discussed both positive and negative things about the lesson. When asked to discuss her role as the pre-service teacher, Mrs. Windsor stated that she had a variety of roles depending on who was asked. She elaborated by saying to her supervisor and cooperating teacher, she was in a student role. To her students, and also at times to her cooperating teacher, she was in a teacher role. In conclusion, when asked to comment on whether or not she and Mrs. York had different beliefs about how to teach and learn mathematics, Mrs. Windsor said, "Definitely Not!". Mrs. Windsor further stated that she and Mrs. Windsor shared the same beliefs and that she had learned several strategies and activities that she planned to implement in her future classroom.

Case 4: Mrs. Brown and Ms. Robinson

Mrs. Brown is the White female cooperating teacher discussed throughout Case Four. She is a veteran teacher that has been teaching mathematics for eighteen years. Ms. Robinson is the White female pre-service teacher discussed throughout Case Four. She is working on her degree in Secondary Mathematics Education.

The internship experience discussed throughout Case Four takes place at Yorkshire High School. Yorkshire High School is a county school that services students in grades seven through twelve. Its total population is 703 students. The student teacher ratio for the school is eighteen to one. Fifty-eight percent of the student body is eligible for the free or reduced-price lunch program. The student body has the following racial components: White, African American, Hispanic, American Indian/Alaskan Native, and Asian/Pacific Islander. Sixty percent of the students are White. Forty percent of the students are African American. Less than one percent of the students are Hispanic. Less than one percent of the students are American Indian/Alaskan Native. Finally, less than one percent of the students are Asian/Pacific Islander.

Table 17

Demographic Summary of Yorkshire High School

System Type	Grades Serviced	Total Population	Student/ Teacher Ratio	Students Eligible for Free or Reduced-Price Lunch	Racial Background
County	7-12	703	18	58%	White – 60% African American – 40% Hispanic – <1% American Indian/ Alaskan Native – <1% Asian/ Pacific Islander – <1%

Mrs. Brown

Mrs. Brown is a White female in her late forties with two children who are in high school. She is very petite, very tan, and very spunky. In addition to her teaching responsibilities, Mrs. Brown is the cheerleading sponsor as well as the senior class sponsor. She is also very involved in the sports program at her school because both of her children play ball. Mrs. Brown has been teaching high school mathematics for eighteen years all of which have been spent teaching at Yorkshire High School. She has a bachelor's degree in mathematics education and a master's degree in mathematics education.

Mrs. Brown is also the Math Plus School Teacher Leader at her school. Refer to pages 37 and 38 for more information pertaining to the role and responsibilities of a school teacher leader. Mrs. Brown reported that over the past year, she has spent approximately 81 to 120 hours involved in some type of professional development. Of those hours, she stated that over twenty of those hours were spent in professional development settings that specifically focused on mathematics. Additionally, she reported that over twenty of her professional development hours were spent in association with Math Plus. It should be noted here that Mrs. Brown really acted as a school teacher leader in name only. As far as the researcher could tell, the most Mrs. Brown did in the way of mathematics reform was attend some of the professional development opportunities that were provided by Math Plus. She also attempted to implement a few activities in her own classroom, but it was apparent that she was not comfortable at all with implementing any of the reform initiatives that she was supposed to be advocating. Ultimately, Mrs. Brown was not observed fulfilling the above listed responsibilities of a school teacher leader.

When asked to describe mathematics, Mrs. Brown answered, "Teaching kids to learn how to solve problems. You know, and just how they can apply that to their daily lives. The problem solving technique is what I feel like is more important rather than them understanding the concept itself. It's the strategies they use to take a larger problem and break it down." According to her responses on the beliefs survey, Mrs. Brown felt that mathematics is an important subject that should be available to all students because it is something that will continue to be used even once the students are out of school. In response to the question concerning the best way for students to learn mathematics, Mrs. Brown stated, "I think a lot of that may depend on what I am teaching, but just in general, for the most part, I do feel like the students learn better by actually actively participating." Furthermore, she said, "I do honestly feel like they retain it for a longer period of time if they are actively involved in the process." Coinciding with the above comments, Mrs. Brown said that the most effective way to teach mathematics "is to let the kids actually experiment and be the discoverers that we know they can be." This was not what she initially indicated on her beliefs survey. At first, Mrs. Brown answered that students should not be allowed to figure things out on their own. Instead, they should rely on teacher demonstrations/explanations. Then, in the second survey, she agreed that students should be allowed to figure things out on their own rather than depending on demonstrations/explanations given by their teacher. She further responded that she agreed that students should not only be able to obtain correct answers, but they should also understand the mathematical concepts involved in getting to that right answer. Additionally, she felt that students should understand important mathematical concepts

before they ever attempt to memorize definitions and facts. Refer to Appendix D (Table 27) to view all of Mrs. Brown's responses to the beliefs survey.

When describing a typical lesson in her classroom, Mrs. Brown said, "There are times that I am going to be demonstrating some things to them, and there are going to be times when they are going to be demonstrating to me." She also replied, "I do allow them to work in groups together in most anything that we do and then we will come back together as a large group." Additionally, she said, "I do allow the students to present."

In discussing the internship experience, Mrs. Brown was asked to define her role as the cooperating teacher. She stated, "I feel like it would be my job to allow the intern to actually have to deal with everything." She also said, "I feel like I should allow her, of course with my supervision, but to allow her to be in whatever situation the class may lend itself to be in because I do not feel like interns have a true experience with what it's all about." In talking about the role of the university supervisor, Mrs. Brown made the comment, "My experience has been, in the past, that person shows up every now and then." She further elaborated by saying, "I see that person coming in for their scheduled visits or whatever they set up."

When asked to discuss the pre-service teacher, Mrs. Brown replied, "I want to see some new things. I'm expecting an intern to be completely Math Plus … I'm kind of expecting big things of my intern." In addition, Mrs. Brown stated that she felt like she would have the most influence on the pre-service teacher because the pre-service teacher would be with her everyday.

When asked about how she would feel if she and her pre-service teacher had different beliefs, Mrs. Brown stated,

No. There would not be a problem, but I'm kind of thinking that an intern now is going to be geared toward what I'm trying to do myself. But, it would not be a problem. I definitely will be open to whatever ideas he or she has because that is the point of all of this. It is to see how an intern can adapt to my students.

Spring 2006 and Fall 2006 Classroom Observations

During the Spring 2006 semester, Mrs. Brown was observed on three separate occasions. These three observations were spread out over a period of one month. The first observation was of an Algebra II class. The second observation was of an Algebra I class. The third observation was also of an Algebra I class. A typical lesson observed by the researcher looked like the following:

> The class began by working on two warm up problems. The students were given two functions and asked to find any asymptotes and/or holes. Then, they were instructed to graph the functions. The class had a substitute yesterday, so while the students worked on these problems, Mrs. Brown passed back tests, quizzes and work from the day before. As Mrs. Brown passed out the tests, she reminded the students that if they brought the test back signed the next day, they would get two bonus points. Simultaneously, Mrs. Brown was walking around explaining what material would be covered on the bench mark test as well as the final exam. Even though she was talking, very few students were paying attention.
>
> The teacher asked for one of the students to work the first problem on the overhead. As the student worked, the teacher asked the rest of the class questions such as: "What do you have when the problem cancels out?"; "What happens when you calculate a value?"; "What is a VA?"; and "Will the graph ever cross

the asymptote?. As this was going on, the presenter continued to work, and several of the students continued to talk. The teacher then explained what the presenter had done instead of letting the student explain. After the explanation, Mrs. Brown had to walk around and "fix" several of the calculators. Many students were having problems getting the calculators to "work the problem correctly". Mrs. Brown explained that one of the goals/reasons for using the graphing calculators was to learn time saving techniques to use during testing such as ACT.

Then, Mrs. Brown had a second student work the second problem. There were a few issues with the work the student had done. Rather than letting the other students figure out what was wrong, the teacher corrected the mistakes. As with the other problem, very few students were paying attention. They were carrying on rather loud conversations, passing out lotion, getting gum, etc. Some of the students even put their heads down on their desks. Again, Mrs. Brown had to walk around and help with the calculators. Many of the students were not putting the parentheses in the problem which ended up giving them the wrong graph.

After working through the two warm up problems, Mrs. Brown began a discussion on solving rational equations. Many times throughout, the teacher asked several questions but didn't give the students long enough to answer. She answered many of her own questions. She fired off question after question. During all of this, the class was actually working through a problem step-by-step.

Due to time constraints, they were unable to finish the problem in class; therefore, Mrs. Brown assigned it to them for homework.

At the conclusion of each of the above mentioned observations, the researcher completed the Reformed Teaching Observation Protocol (RTOP) for each respective lesson. The researcher averaged the scores for the five questions in each section to determine an average score for each section of the RTOP and then determined the median score of the three observations for each section of the RTOP. When looking at the scores in Table 18, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). When asked to discuss the best way for students to learn mathematics, Mrs. Brown stated, "I think a lot of that may depend on what I am teaching, but just in general, for the most part, I do feel like the students learn better by actually actively participating." Furthermore, she said, "I do honestly feel like they retain it for a longer period of time if they are actively involved in the process." Coinciding with the above comments, Mrs. Brown said that the most effective way to teach mathematics "is to let the kids actually experiment and be the discoverers that we know they can be." After reading these comments in conjunction with the above description of her teaching practices, it is clear that even though Mrs. Brown discussed that she felt she believed in and used reform based teaching techniques, her actions did not coincide with her words. In fact, the RTOP scores corroborate that her practices are not reform based hardly at all.

Table 18

RTOP Averages and Median for Mrs. Brown's Spring 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	1.2	1.8	0	0.2	0.8
Observation 2	0.2	1.6	0	0.6	0.8
Observation 3	1	2.4	1.4	1.4	2.2
Median	1	1.8	0	0.6	0.8

At the beginning of the Fall 2006 semester, Mrs. Brown was observed one more time just to see if any major changes in teaching style since Spring 2006 had occurred. The observation was of a remediation mathematics class:

> At the beginning of class, Mrs. Brown had the students work on problems 41-47 out of the Graduation Exam book. She explained to the researcher that she was using these problems as part of her initial diagnostic exam. During the time the class worked, Mrs. Brown had a new student join the class. It was later explained that the student wasn't actually new to the school; she just had a schedule change. While the other students worked, the teacher oriented the student to the class. At this time, Mrs. Brown issued her a Graduation Exam book, calculator, etc.
>
> The teacher had made a poster-size copy of the reference page. So, while the students were working, she referred them back to the reference page. Also, as the students worked, Mrs. Brown walked around the room to monitor the students' progress and to monitor the time. During this time as well, Mrs. Brown

again explained to the researcher that the students were completing the diagnostic test because she didn't have a "prescription" for all of the students. She planned to use this test to figure out the students' strengths and weaknesses. She also planned to take the class to the computer lab the next couple of class days. It was the researcher's understanding that those days would be spent on more diagnostic testing.

After sufficient time, the teacher began discussing the solutions to the assigned problems. She initially asked for a volunteer to go over problem #41, but no one said anything so she called on a student to read the problem. As they discussed problem #41, they discussed key operation words in the problem. They also discussed answers that could be eliminated. They talked about how when you eliminate choices, you increase your chance of getting the right answer.

For problem #42, a problem involving solving a proportion, she called on a student that was in another class she taught. In that class, they had been working on these types of problems. She asked the student the answer and then asked how she got her answer. At this time, Mrs. Brown also talked about the importance of repetition. Additionally, she talked about test-taking skills such as marking questions they are unsure about.

Problem #43 involved finding the distance between two points. They had a small discussion about how to label the ordered pairs, and then Mrs. Brown worked through the entire problem step-by-step. While she was working, she warned the students about being careful using the calculators because the ones they were using, were the ones they were actually going to use on the real test, do

not recognize the order of operations. This turned into a discussion on how to use the calculators. The math teachers at the school had found earlier on that many of the students had problems with the calculators. This in turn made the difference in how the students performed on the test. So, this was a big deal for many of them.

The next problem, problem #44, was on finding the midpoint of a segment if given the two endpoints. As with problem #43, Mrs. Brown discussed how to label the various pieces of information. She also reminded them that the formula was located on their reference page. Then, as with problem #43, she worked the entire problem step-by-step.

Problem #45 involved finding the equation of a given line. The students again had four answers to choose from. Mrs. Brown briefly reminded them about slope-intercept form; however, she was more concerned about showing them how to eliminate some of the four choices. The discussion was not really conceptual at all.

The next problem, problem #46, was on finding a pair of lines whose equations represented parallel lines. The following discussion ensued:

Mrs. Brown: What do you know about parallel lines?

Student 1: They run side by side.

Mrs. Brown: That's good, but we don't have the graphs of these lines.

Student 2: Can we graph them then?

Mrs. Brown: Good, how would you do that?

Again, they discussed the slope intercept form and the different parts of the equation, specifically the *m*. Mrs. Brown reminded them that parallel lines had the

same slope. Then, she took the various pairs and solved each equation for *y*. Luckily, they only had to go through the first pair because it was the answer.

The final problem for the day, problem #47, focused on finding the solution to a system of equations. The students were given the system and four possible points to choose from. The following discussion took place:

Mrs. Brown: What does it mean for the point to be a solution?

(no one said anything)

Mrs. Brown: Won't it check out?

Student 1: Yes

Mrs. Brown: Where do you put the ordered pairs? Just the first equation? No, you have to put it into both.

Mrs. Brown: Remember that it has to satisfy both equations. It's kind of like your teachers. You should want to satisfy them all.

At this point, Mrs. Brown began substituting the ordered pairs into the given equations. Doing this process eliminated choice A. Then they worked with choice C because they didn't want to work with fractions; however, choice C didn't work so they then went back to work with choice B.

After going over these problems one by one, Mrs. Brown asked them to work on page 8 which were problems 48-60. The class literally had about five seconds before the bell rang. Needless to say, they didn't get any more problems done.

At the completion of the observation, the researcher again completed the RTOP for that observation. As with the Spring 2006 observations, the researcher averaged the scores for the five questions in each section to determine an average score for each

section of the RTOP. The scores can be found in Table 19. Again, the lesson was extremely procedural. The whole goal was to get the right answer by using the right steps. Even though Mrs. Brown called on students at various points in the lesson, the lesson itself was still very teacher-centered. Calling on the students didn't really lead to any in-depth discussion of the topics. Like the results from the previous observations, the RTOP scores indicate that Mrs. Brown does not utilize reform based teaching methods.

Table 19

RTOP Averages for Mrs. Brown's Fall 2006 Classroom Observation

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 4	0	1.6	0	0	1

Lesson Design and Implementation

The lessons that Mrs. Brown implemented were very traditional in nature. Even though she stated that she believed the students learned best by getting their hands on the mathematics and discovering things for themselves, these types of activities were never observed. Instead, very teacher-centered lessons were observed.

The classes usually started off with the students working on a warm up problem while Mrs. Brown took care of clerical things such as taking roll. Then, Mrs. Brown quickly went over the assigned problem. Sometimes, she allowed a student to put up his work, but no explanation of the work was ever required from the student. Instead, Mrs. Brown did all of the explaining. From there, Mrs. Brown introduced the new material for

the day. This was generally done by working an example problem and then giving the class a problem to work independently. All throughout, Mrs. Brown was very focused on the steps of working the problem. She was fairly insistent that the problems be worked the way she worked them. This also meant not skipping any steps throughout the process. This pattern continued until Mrs. Brown felt like the students could satisfactorily work through the steps without any intervention from her. At that point, she assigned the homework problems. Most days, this was done right before the dismissal bell rang, so the students rarely had time to work through any of the problems or ask questions in class.

What questions were asked throughout the lesson were very procedural in nature. As stated previously, Mrs. Brown was very focused on the steps involved in solving a problem; therefore, many of her questions were "What comes next?", "What do we do now?", etc. Most of the time when she asked these questions, Mrs. Brown didn't wait for the students to respond even though several of them wanted to answer. Instead, she answered many of her own questions. It was almost like she was teaching herself how to do the problem. There was hardly any higher order thinking questions involved in the lessons whatsoever. It is important to note here that while all of this was taking place, several students were unengaged. Many were carrying on their own conversations, working on things for other classes, getting gum or lotion, etc. Through all of this, Mrs. Brown just kept talking and never paid attention to the fact that hardly no one was listening. Her objective was strictly to cover the material for that day no matter what.

Communicative Interactions

Student-Led Discussions

There were very few times that the students led the discussions in the class. These times generally consisted of a student working through an example problem that had been assigned to the class. Even so, very little discussion took place. The student just usually wrote down his work and then sat down. He never offered any explanation of his work. At the same time, no other students or Mrs. Brown questioned him. The only time anyone would say anything was if the student "presenting" tried to skip a step in his work.

Teacher-Led Discussions

Most of the constructive talking in the class was done by Mrs. Brown. Her lessons could definitely be described as teacher-centered. It was apparent that Mrs. Brown saw herself as the person responsible for relaying knowledge to her students. In no shape form or fashion did the role of facilitator come into play in her lessons. When she wasn't working through a problem for her students, she was asking very procedural type questions which she generally answered herself. As mentioned previously, it was as if she was teaching herself to work the problems. All the while, unengaged students were all around her, and she never noticed.

Procedural Knowledge

It was very obvious that Mrs. Brown knew the mathematics that she was teaching. She demonstrated this knowledge every time she worked a problem which was generally several times a class period. As mentioned previously, she was very focused on the steps that it took to solve a problem. The way she worked through the problems left the students with the impression that the way she demonstrated the problem was the only

way it could be worked; hence, if they followed the prescribed steps, they would eventually arrive at the one and only correct answer. Mrs. Brown never mentioned other possibilities of solving problems.

Propositional Knowledge

It was somewhat apparent to the researcher that Mrs. Brown had the propositional knowledge it took to work through the mathematical concepts she was teaching her students. This knowledge, however, never really came across to the student or through them. As previously mentioned, all of the focus was on the steps to getting the right answer. Very seldom did Mrs. Brown or anyone in the class address the "why" of the work. The students just took it on blind faith that what Mrs. Brown demonstrated for them was the correct way of getting an answer. Even when students were allowed to "present" their work, no explanations of the work were required unless the student presenting the problem tried to skip a step in the process.

Student/Teacher Relationships

Overall, Mrs. Brown had a decent rapport with her students. They didn't seem to mind coming to class, but her spunky attitude definitely did not rub off on them when they entered her classroom. It is believed that the reason for this was because the students always knew that when they came to class they would briefly work through a problem at the beginning of class, watch Mrs. Brown work a few example problems that they didn't really care about, give the class a few problems to work independently, and then assign the homework problems. They just didn't appear to be very motivated, and it didn't come across that Mrs. Brown ever tried anything different to change that. With Mrs. Brown, it appeared that teaching the objectives for the day was what was most important. It was as

if she had a check list that she had to complete by a certain time. If Mrs. Brown was genuinely concerned about her students, it wasn't very obvious to them. One could tell by their body language and the looks on their faces when they entered the room.

Ms. Robinson

As mentioned earlier, Ms. Robinson was the pre-service teacher placed with Mrs. Brown. Ms. Robinson is a White female in her early twenties working on her degree in Secondary Mathematics Education. She is a cute, professional looking young lady with a soft smile and a big heart. Her concern was for her students. She wanted to make sure that all students learn in her classroom. She was also a positive, innovative thinker. For Ms. Robinson, all criticism was perceived as a constructive challenge instead of a reprimand.

When asked to define mathematics, Ms. Robinson responded, "Math is a bunch of things. I think it's about patterns and numbers and symbols. Basically, mathematics is the universal language, so everyone knows something about it, or they should be informed about something about it." When she was asked to talk about what she thought influenced her beliefs and practices about mathematics, Ms. Robinson stated that her many classes in junior high, high school, and college. She stated that the more classes she took, the more interested she became. Additionally, Ms. Robinson commented that she felt like her students would influence her practice the most.

In her response about the best way for students to learn mathematics, Ms. Robinson commented,

> I think that it is very important for students this age to get to work together because they can understand what each other is saying, sometimes more so than

> the students and teachers. So, I like the way that they work together. I like the role of the teacher as being more of a guide instead of just instructing…this is how you do this, this is how you do that. I like for teachers to kind of stand back and just kind of instigate everything.

As indicated by her responses on the beliefs survey, Ms. Robinson agreed that students should be allowed to figure out how to solve mathematics problems for themselves rather than depending on teacher demonstrations/explanations. She agreed this could be done by the students applying their own personal experiences to solving the problem at hand. Additionally, Ms. Robinson agreed that teachers should allow students to communicate their mathematical processes in ways that are relevant to them. While Ms. Robinson disagreed that students learn best by teacher demonstrations and explanations, she agreed that teachers should demonstrate and model mathematical procedures prior to expecting their students to use them.

When asked to discuss how she felt about the best way to teach mathematics, Ms. Robinson replied,

> This is where I think that I in my classroom would combine the Math Plus with almost a traditional but not completely traditional. I enjoy the way students get to work in groups and the way they get to ask questions and answer among themselves without the teacher just telling them the answers. Although, I feel like there will be some subject matters that the teacher will need to be up there and outline it more so and have them work on some problems.

Ms. Robinson indicated on her beliefs survey that she agreed that students should be provided with informal experiences to explore mathematical concepts prior to them being

expected to master that concept. She also agreed that students should have to work with mathematical concepts in several contexts; therefore, the teacher should provide varied and multiple experiences for students to work through problems. Additionally, Ms. Robinson agreed that students must be able to follow directions in order to sharpen their problem-solving skills. Additionally, she agreed that time should be spent practicing mathematical procedures before students spend much time solving mathematics problems. She also disagreed that students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept. Refer to Appendix D (Table 28) to view all of Ms. Robinson's responses to the beliefs survey.

Ms. Robinson made the following comment concerning the role of the cooperating teacher:

> I would like for my cooperating teacher to guide and to listen because I know that I will learn a lot from her. But, I think that she can also learn from me too. So, I want her to be able to have open ears and eyes and me too as well…and just us try to learn from each other. And if she sees me going in the wrong direction, just kind of guide me and not tell me because I like to figure things out.

When discussing the role of the university supervisor, Ms. Robinson stated,

> I would like for them to tell me if they see anything that I need to work on or something. I want them to know that I'm very open to criticism and that's important during internship. I want them to definitely tell me not only when things are bad, but praise when things are good. Keep me on track.

When asked to elaborate on her role as the pre-service teacher, Ms. Robinson responded, "Almost like student but like a teacher. It's very difficult because I want to be learning, but I also want to be there to instruct and to…I don't know."

In response to the question about the cooperating teacher and pre-service teacher having different beliefs about teaching and learning mathematics, Ms. Robinson stated,

> I don't think it will be a problem unless me or my cooperating teacher is not willing to give in and to learn from each other. You know, if we're both just very strict on our beliefs and will not open our world up to other things, then, yes, that could be a problem. But, otherwise, I don't think so.

Fall 2006 Classroom Observations

During the Fall 2006 semester, Ms. Robinson was observed on three separate occasions. These three observations were spread out over a period of three months. The first observation was of an Algebra 1B class. The second and third observations were of Pre-Calculus classes. Typical classes looked like:

> At the beginning of her Pre-Calculus class, Ms. Robinson wrote the following equations on the board: $y = x^2$ and $x = y^2$. She then asked the class to tell her what these equations represented. The class told her that the equations were for parabolas. Ms. Robinson made reference to the fact that they had worked on parabolas in the past. She also told them the activity for today would lead them to discover things about other conic sections.
>
> As the students entered the classroom, a member from each group was responsible for collecting the materials for the group: wax paper for each group member; and a copy of conic sections Activity #2 for each group member. Before

the students started working, Ms. Robinson reminded them that they had to follow the directions exactly in order for their work to turn out accurately. As the students worked, Ms. Robinson walked around and helped the students with questions they had. After the students had worked for about fifteen to twenty minutes, she encouraged them to work on the questions that were on the activity sheet. To do this, Ms. Robinson guided them to a page in their books. Many of the terms that were on this page in their books were: directrix, axis of symmetry, focus, vertex, etc. After some discussion of these terms, Ms. Robinson again referred them to their textbooks. This time, she wanted them to focus on the table that was in their book. Using the table, she wanted them to answer the following questions: "What does this table represent?"; "What does the equation represent?"; "Describe the graphs."; and "What is different about the graphs?". After the students had a couple of minutes to make their observations, she called on particular students to answer/discuss the above questions.

After some discussion relating ellipses, circles, and parabolas, Ms. Robinson asked the class to consider the equation $y^2 + 2x = 0$. She wanted them to re-write it in standard form. After some discussion, they came up with $(y-0)^2 = -2x + 0$ which simplified to $(y-0)^2 = -2(x-0)$. Now, in their groups, they were to work on finding the focus, vertex, equation of directrix, and axis of symmetry. The students were able to answer the questions, but some still seemed a little unsure. So, Ms. Robinson gave them another example.

As they worked in the groups on the second example, Ms. Robinson walked around and asked different students to explain different things to her. She

also suggested that each person in the group write down all of this information in their own notes rather than in just one "group" notebook.

After a few minutes, Ms. Robinson asked a girl in the class to go to the front of the room and explain how she found the various components of the parabola. A couple of the students pointed out that a mistake had been made on finding the focus. The class decided that the girl had used the wrong equation from the table in the book. After deciding this, they fixed what had been done incorrectly.

Following this discussion, Ms. Robinson asked them to graph the parabola using the information they had found. As the students graphed, Ms. Robinson walked around and helped them out mainly by making them answer their own questions. After a few minutes had passed, Ms. Robinson had one of the students graph the parabola. The class ended up guiding him through the graph mainly by telling him what to graph. At this point, the class ended.

At the conclusion of each of the above mentioned observations, the researcher completed the RTOP for each respective lesson. When looking at the scores in Table 20, a score of 0 represents "Never Occurred" and 5 represents "Very Descriptive" (AzTEC, 2002). The RTOP scores indicate that Ms. Robinson is definitely making progress in the area of implementing reform based teaching methods. All throughout the lesson described above, she asked thought provoking questions such as "What does this represent" and "How is what we are doing now the same or different from what we had done previously". Many times, Ms. Robinson answered the students' questions with a question. She made them think for themselves. It was also apparent to the researcher that

Ms. Robinson was facilitating the lesson instead of leading it. Because of this evidence, the scores show that more times than not Ms. Robinson's lessons were designed to implement the techniques she learned in her methods courses.

Table 20

RTOP Averages and Median for Ms. Robinson's Fall 2006 Classroom Observations

	Lesson Design & Implementation	Propositional Knowledge	Procedural Knowledge	Communicative Interactions	Student/Teacher Relationships
Observation 1	2	2.4	0.8	1.8	3.2
Observation 2	2.2	2.4	2.6	2.4	3.6
Observation 3	3	2.8	2.6	2.8	4
Median	2.2	2.4	2.6	2.4	3.6

Lesson Design and Implementation

The lessons that Ms. Robinson designed were very much student-centered. It was apparent that much time and effort went into her lessons. She listed her learning objectives as well as the questions and problems she intended to ask. The questions she had listed were very thought provoking questions; they got at why the problem worked the way it did as well how to solve the problem. Additionally, she listed potential answers that the students might use when responding.

In general, the implementation of the lessons took place in groups. Because of this design, Ms. Robinson's role was that of facilitator instead of lecturer. The students were placed in groups and asked to complete different activities. Sometimes the placement was

random. Other times, it was not. Sometimes the activities were explorations of new topics such as various conic sections. Other times, the purpose of the activities was to act as a review. In these types of activities, the groups were given certain topics and asked to consolidate what they knew so they could "teach" the class. During the times that the groups were working, Ms. Robinson monitored progress and behavior. She also asked prompting questions when the groups got stuck. No matter the activity, the end result was always a group presentation. During the presentations, Ms. Robinson focused on getting the students to explore their work. Just showing the steps involved in solving the problem was not enough. This was very different for the students. Even so, as the semester progressed, they seemed to get more comfortable with Ms. Robinson's method of teaching.

Communicative Interactions

Student-Led Discussions

The design of Ms. Robinson's lessons naturally reinforced student-led discussions. Most of her lessons involved some type of group work where the students had to work collectively to either explore a new topic or review old ones. During these times, Ms. Robinson simply monitored the groups and prompted them when necessary. All of the work, however, was on the students. At the end of the activities, the groups always had some type of work to present to the rest of the class. This was when most of the student-led discussions took place. At first, the students were very shy and uncomfortable with this method. They were not used to being responsible for their work and for presenting their work to the class. Also, simply showing the steps to solving the problem was no longer acceptable. The students had to justify their work. At first, Ms.

Robinson asked them questions such as "How do you know your process worked?" or "Could that have been done a different way?", etc. Eventually, the students learned to incorporate these types of explanations in their discussion of the work. If they didn't, the rest of the class usually asked before Ms. Robinson ever had a chance. It is safe to say that by the end of the semester, they were much more comfortable and vocal.

Teacher-Led Discussions

Ms. Robinson tried to keep teacher-led discussions to a minimum. When she first started teaching the classes, there were times when she had to interject more explanation than she wanted, but as the semester went on, she was able to get away from that. There were two reasons for this. First, Ms. Robinson had to work on making her directions clearer and more concise. Second, the students had to get used to the idea of the teacher being a facilitator instead of a lecturer. This took a little bit of time, but the students eventually came around. As a result, the discussions in the room turned from being teacher-led to being student-led which was what Ms. Robinson wanted.

Procedural Knowledge

It appeared that Ms. Robinson had a good grasp on the procedural knowledge that it took to present the material she was responsible for teaching. This was conveyed in the activities that she designed for her students. Instead of lecturing and giving her students all of the information she thought they should know Ms. Robinson designed things in a manner that forced the students to figure things out for themselves. This was very different from Mrs. Brown's method of teaching which focused solely on the steps for solving problems.

Propositional Knowledge

Much of the focus of Ms. Robinson's lessons was on building her students' level of propositional knowledge. Yes, she wanted her students to be able to work through a problem; however, it was more important to her that they understand why the problem worked the way it did. This was challenging for the students initially because they were not used to this method of teaching. They were used to being told how to work the problem and that was it. The fact that Ms. Robinson wanted them to understand what they had done to arrive at the answer was totally foreign to them. The bottom line was that they were not used to thinking problems through for themselves and to begin with, they were not very confident with what they came up with when using this approach. With the thought-provoking questions that Ms. Robinson asked along with her encouraging words, the students eventually got to a point where they began to feel more comfortable with this process.

Student/Teacher Relationships

It was obvious that Ms. Robinson genuinely cared for all of her students. She always had a smile and an encouraging word for each of them. The students seemed to respond positively to this. The class that seemed to have a special place in Ms. Robinson's heart was her inclusion class. She made a special effort to build a relationship with each student in the class. The difference in their attitudes by the end of the semester was amazing. At first, they all hated coming to class because they didn't enjoy math and had believed for years that they could not be successful in mathematics; therefore, Ms. Robinson made it a point to design activities for them that were mathematically challenging but were not intimidating. These activities proved to them that they could do

the work when they put their minds to it so their confidence levels were definitely boosted. By the end of the semester, some students still didn't enjoy math class that much, but they all enjoyed working with Ms. Robinson.

Similarities and Differences Between Mrs. Brown and Ms. Robinson

Upon analyzing all of the information pertaining to Mrs. Brown and Ms. Robinson, it appears that they were similar in some ways but different in others. The most obvious difference was the amount of experience Mrs. Brown had compared to Ms. Robinson. Another obvious difference was in the difference in their words and actions. Mrs. Brown stated that she was very excited about having and learning new techniques to use in her classrooms; however, when it actually came time to use them, she hardly ever did. She maintained the status quo. Mrs. Brown could be described as a teacher with an instrumentalist view (Thompson, 1992). Her focus was definitely on students gaining a mastery of rules and procedures. She also demonstrated to the researcher that she felt her role in the classroom was to demonstrate, explain, and define mathematics in an expository style (Thompson, 1992). On the other hand, Ms. Robinson stated she really wanted to implement several of the techniques she had learned in her methods courses. When it came time to design her lessons, she actually implemented many of the techniques she had learned. Ms. Robinson could be described as having a Platonist view of teaching (Thompson, 1992). She made valiant attempts to emphasize students' understanding of the logical relations among various mathematical topics and the logic underlying the mathematical procedures (Thompson, 1992). This difference is evident in the RTOP scores. A similarity that they had was that they both cared tremendously for the students. This was apparent in the conversations they had with their students.

Outcome of the Internship Experience

In a discussion about her internship experience, Ms. Robinson commented on the role of the cooperating teacher by stating, "My cooperating teacher was very helpful. She was a great listener, helper, and was able to offer me advice." When mentioning the university supervisor, she said, "My university supervisor was also very helpful. She always gave me some suggestions and encouraged me in many ways." Ms. Robinson also commented on her role by describing herself as a "teacher in training". She also said, "I was able to live in the shoes of a real teacher for weeks before my actual teaching career began. As the intern I was learning from others but I also feel that I was able to teach others too." When the researcher asked who influenced her most throughout her experience, Ms. Robinson responded, "My university supervisor; she had a way of placing a challenge for me after every confrontation. I strived to achieve whatever suggestion that she gave me during the debriefing sessions. She has and will continue to influence my teaching." Finally, when asked to discuss whether or not she and her cooperating teacher had different beliefs about teaching and learning mathematics, Ms. Robinson responded, "No; my cooperating teacher and I have the belief that every student should be given a variety of assessment and learning methods." One final comment she made was that she felt the internship experience as a whole was very beneficial, and she wouldn't change anything about it.

Comparison of the Cases

Previously, the participants of each case were compared to one another. In the following sections, the cases will be compared. The same categories that were used to

analyze differences or similarities between the individual participants will now be used to do the same for the cases. The categories are: lesson design and implementation; student-led discussions; teacher-led discussions; procedural knowledge; propositional knowledge; and student/teacher relationships.

Lesson Design and Implementation

All pairs focused on lesson design and implementation; however, the focus was not always the same. Each pair indicated that this process was determined by which class was being taught. In general, the more conceptual lessons were reserved for the higher level math classes while the more procedural lessons were carried out in the lower level mathematics classes. This was very apparent with Mrs. Smith and Mrs. Franklin, both content-focused teachers (Thompson, 1992). When teaching the Pre-Calculus classes, they were more inclined to delve into topics more deeply than they did with the remediation class. In the remediation class, it was strictly procedural. According to the pair, there was no time or patience for exploration and group work. The same was true for Mrs. Brown and Ms. Robinson, especially when Mrs. Brown, a teacher with an instrumentalist view (Thompson, 1992) was teaching. In their higher level classes, the students were allowed to explore concepts and work together to figure things out for themselves. In the remediation classes, however, the focus of instruction was more on learning the steps. As stated previously, this was definitely the case when Mrs. Brown was teaching. On the other hand, Ms. Robinson, a teacher who exhibited characteristics of the Platonist view (Thompson, 1992), really tried to incorporate more thought provoking activities in the remediation classes. This approach seemed to be well accepted by her students. Mrs. Johnson and Ms. Walters taught the same class all day, so there was

not much distinction to be made between the levels. It was clear to the researcher, however, that even though they tried to implement things that looked conceptual in nature, they were really procedurally oriented. Everything was geared around what step came next in the process of trying to solve a particular problem; hence, qualities of teachers displaying characteristics of a Platonist view (Thompson, 1992). The same could not be said for Mrs. York and Mrs. Windsor, teachers who exuded constructivist view qualities (Thompson, 1992). All lessons taught in their room, no matter the level of the class, were geared toward conceptual understanding. The students were constantly working in groups when exploring concepts. Additionally, they were normally working on problems that had more than one right answer or more than one way to get to the answer.

Based on this information, it is the researcher's opinion that Mrs. Franklin and Ms. Walters will end up teaching the way their cooperating teachers taught, which is generally procedural in nature. Their focus will likely continue to be on getting the students to implement the correct steps instead of concentrating on the conceptual knowledge. On the other hand, Ms. Robinson will likely continue to make progress in implementing the methods she learned in her methods courses. Even though she did not have the full support of her cooperating teacher, she persevered and recognized issues that need improvement in her teaching as challenges instead of roadblocks. Finally, it is the researcher's opinion that Mrs. Windsor will continue implementing techniques that are geared toward conceptual understanding. This just seemed to be second nature for her. Also, she had a tremendous amount of support and encouragement from her

cooperating teacher, so even when things did not go according to plan, she had a supportive mentor who was willing and able to help her out.

Student-Led Discussions

As indicated by the Communication Standard in NCTM's *Principles and Standards of School Mathematics* (2000), student-led discussions are indicative of classrooms that are implementing reform mathematics techniques. It was observed that all pairs allowed for varying degrees of student-led discussions. It was also apparent that the amount of student-led discussions was directly related to the type of lesson that had been developed. Because of this, there were very few student-led discussions in Mrs. Smith's and Mrs. Franklin's classes. Many of the conversations that were intended to be student-led eventually ended up being teacher-led because the teachers always felt that further explanations were needed. This same thing happened with Mrs. Brown and Ms. Robinson, although Ms. Robinson allowed more time for student-led discussions than did Mrs. Brown. Mrs. Johnson and Ms. Walters made an attempt to facilitate student-led discussions; however, these conversations always ended up being "what step comes next" type of conversations. By far, Mrs. York and Mrs. Windsor facilitated the best student-led discussions. For the most part, the class consisted of student-led discussion from the minute the students entered the door. The teachers simply prodded the students as needed.

Teacher-Led Discussions

For all of the pairs except one, it was apparent that teacher-led discussion was the preferred method of delivery. The teaching styles of the participants contributed to this. As indicated previously, with the exception of one pair, the participants were functioning

as instrumentalists or content-focused teachers (Thompson, 1992). Even the pairs that attempted to facilitate student-led discussions ended up "butting in". It just always seemed that whatever the students had to say was never enough. The teachers always had to add more to it rather than probe the class for further explanations. The one pair that was the exception to this was Mrs. York and Mrs. Windsor, the constructivist teachers (Thompson, 1992). They had very few teacher-led discussions. The ones they had were more to clear up confusion about directions on an activity or something similar to that.

Procedural Knowledge

Procedural knowledge was the primary focus for all of the pairs except Mrs. York and Mrs. Windsor. This came as no surprise due to the instructional tendencies of each pair as defined by Thompson (1992). Mrs. Smith and Mrs. Franklin generally structured their lessons around how to solve a particular type of problem. This was particularly the case with the remediation class. They were both very meticulous about going through things step-by-step with these students; however, it was not structured so that the students would understand why they were working each step. The emphasis was on memorizing the steps, which is indicative of content-focused teachers (Thompson, 1992). The primary focus for the remediation class was on getting through the problems. This wasn't so much the case with the Pre-Calculus classes; however, the lessons were still very procedural in nature. The students did not respond in a manner that was desired by either Mrs. Smith or Mrs. Franklin the few times Mrs. Franklin attempted to "go deeper" with the students, so Mrs. Franklin ended up with lessons that looked very similar to Mrs. Smith's. Mrs. Johnson and Ms. Walters had lessons that appeared to be conceptual in nature; however, these lessons were really clever disguises for very procedurally oriented lessons. All of

them ultimately had the feel of "First we do… Then we do…" The same was true for Mrs. Brown, but not so much for Ms. Robinson. When Mrs. Brown taught, the lessons were very methodical and procedural in nature; however, when Ms. Robinson taught, she tried to get at the deeper meaning behind the objectives by allowing the students to explore the various topics. Because of time constraints, however, this wasn't always possible. Mrs. York and Mrs. Windsor were not so much concerned about how the students got their answers, but about how well they understood the problem which is indicative of the constructivist view of teaching (Thompson, 1992). As mentioned earlier, most lessons in their classes were designed to be student-oriented. This meant that there was very little time to discuss the step-by-step processes that the other pairs spent time going over. In Mrs. York's and Mrs. Windsor's classes, the students had to develop the steps for themselves; therefore, not all students had the same steps.

Propositional Knowledge

Of the pairs, the one that focused mainly on propositional knowledge was Mrs. York and Mrs. Windsor. All activities that were designed and implemented focused on the students understanding the concepts. The focus was not on how the students got the answer. This, however, is not intended to imply that the process of getting the answer was not important. The process was simply a part of the bigger problem because when giving his/her answer, the student had to also explain the process that was taken to get to that point. In order to do this, however, he/she had to understand the concepts behind what he/she had done in order to satisfactorily explain things to the class. This type of focus was not the case with the other pairs. As described above, most of the pairs focused on the step-by-step process. As mentioned previously, Ms. Robinson did attempt to focus

more on the propositional knowledge instead of always looking at the procedural knowledge. The level to which she did this, however, cannot compare to the level that this was carried out by Mrs. York and Mrs. Windsor. With more practice and more collegial support, Ms. Robinson will continue to modify her lessons so that they are more in line with the process Mrs. York and Mrs. Windsor implemented.

Student/Teacher Relationships

The pairs had a variety of relationships with their students. Mrs. Smith and Mrs. Franklin had more of a stand off approach than any of the other pairs. It was strictly business in their classroom. The class was supposed to be all about the objectives for that day and not necessarily about what was going on in the lives of the students. There appeared to be a high level of respect for authority. There was no question as to who was in charge in the room. When "personal" affairs were brought up, it was generally at the end of class and was not directed toward either teacher. The same could almost be said for Mrs. Brown and Ms. Robinson; however, they were more personable with the higher level math classes than they were with the remediation classes. Ms. Robinson made a valiant attempt to change this when she was teaching; however, time was not on her side. She did, however, make strides in the right direction. Also, the level of respect that was seen in Mrs. Smith's classrooms was not always seen in Mrs. Brown's classrooms. Many times, the students carried on their own conversations while she was trying to explain something to them. Instead of demanding their attention, Mrs. Brown just continued her lecture as if no one was talking. This was not the case with Ms. Robinson. The students appeared to show more respect to Ms. Robinson than they did to Mrs. Brown. On the surface, Mrs. Johnson and Ms. Walters appeared to be concerned about their students'

personal lives, but at times it almost came across as being artificial. The atmosphere in the room was very laid back, but sometimes because of this, the students had to be reminded to work when it was time to work. Mrs. York and Mrs. Windsor appeared to genuinely care about their students. They always seemed to know what was going on in their students' lives. The students really seemed to appreciate this concern. Also, there was an air of respect in the room, both for student and teacher. The feeling was very comforting. The room was not a threatening place to be.

V. SUMMARY AND RECOMMENDATIONS

This chapter begins with the limitations of the study. Next, the overall outcomes of the internship experiences are reviewed. Then, implications for teacher education programs are posited. Subsequently, implications for selecting school teacher leaders and mentor teachers are discussed. Finally, ideas for future research are proposed.

Limitations

Before discussing the conclusions of the study, it is necessary to point out some limitations of the study. The study actually started with six pre-service teachers, but due to "natural attrition", only four followed the study all the way to the end. Next, the placements of some of the pre-service teachers were not based on the request of the coordinator of the secondary mathematics education program. Another limitation was the amount of time the researcher had to complete the Spring 2006 teacher observations. By the time things were approved for the study, there were only about three weeks left in the school year to squeeze in three observations per teacher. A disadvantage of this was that all of the teachers were trying to wrap up the school year; therefore, they may or may not have been doing a "normal" lesson at the time the researcher completed the observations. One final limitation was the overall amount of time the researcher had to complete all of the classroom observations for both cooperating teachers and pre-service teachers. Due to

the location of the schools, the researcher may or may not have been able to observe each type of class the teachers had. For example, one pair had two planning periods. The planning periods were scheduled for first block and fourth block. This meant that the pair could only teach during second and third block. Since the researcher lived more than an hour away, the schedule was problematic. Due to the combination of these reasons, the researcher was only able to observe second block whereas, this wasn't necessarily the case with all of the other pairs. Despite the limitations, however, the researcher was able to collect the data that was needed to carry out the study.

Conclusion

This study incorporated the input from cooperating teacher/pre-service teacher pairs. The purpose of the study was to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approach to teaching based on their preparation. The specific questions of research that were investigated using qualitative methods were:

1. What beliefs and practices do cooperating teachers have that support or hinder the growth of a pre-service teacher immersed in reform based teaching?

2. What happens when there is a misalignment of the beliefs and practices held by the cooperating teacher and the educational background of the pre-service teacher?

Table 21 shows the overall outcomes of the internship experience. In the table below, weak is intended to indicate traditional-minded thinking about teaching and learning mathematics, strong is intended to indicate reform-minded thinking about

teaching and learning mathematics, and ambivalent is intended to indicate no strong preferences for either traditional teaching or reform teaching. When looking at the results posted below, there is a strong correlation between the teaching practices of the cooperating teachers and the pre-service teachers' degree of reform at the conclusion of the internship experience. As displayed in the table, Mrs. Franklin and her cooperating teacher had weak and ambivalent tendencies, and Mrs. Franklin ended up being more traditional-minded than reform-minded. Likewise, Ms. Walters and her cooperating teacher had mainly ambivalent tendencies, and Ms. Walters concluded her experience remaining ambivalent. Mrs. Windsor and her cooperating teacher had strong tendencies throughout, and Mrs. Windsor ended up being reform-minded. According to Curcio and Artzt (2005), this type of outcome is to be expected. What was not expected, however, was that the beliefs of the pre-service teachers also had an influence on the outcome of the internship experiences. This can be seen particularly in the case of Ms. Robinson. As shown in the table, she had strong beliefs about reform teaching and strong scores on her RTOP observations. Ms. Robinson's cooperating teacher, however, had weak beliefs about reform teaching as well as weak scores on her RTOP observations. Even so, Ms. Robinson indicated a strong degree of reform-mindedness at the conclusion of her experience. As previously indicated, this was due in large part to the support provided by her university supervisor.

Table 21

Overall Outcomes of the Internship Experience

Pre-service Teacher	Pre-service Teacher Beliefs Survey	Pre-service Teacher RTOP Observations	Cooperating Teacher Beliefs Survey	Cooperating Teacher RTOP Observations	Pre-service Teacher Degree of Reform at Conclusion of Internship
Mrs. Franklin	Ambivalent	Weak	Weak	Weak	Weak
Ms. Walters	Ambivalent	Weak	Ambivalent	Ambivalent	Ambivalent
Mrs. Windsor	Strong	Strong	Strong	Strong	Strong
Ms. Robinson	Strong	Strong	Weak	Weak	Strong

Implications for Teacher Education Programs

As stated by Pourdavood, 1999), existing classroom norms and the cooperating teachers' methods of instructions have a profound impact on pre-service teachers' beliefs and practices. According to the research, it seems that if pre-service teachers are to internalize coherent applications to teaching and learning mathematics, the environment in which they complete their internship and the support they receive need to be consistent with the principles being advocated in their professional preparation program (Vacc & Bright, 1999). As quoted by Vacc and Bright:

> Although we believe that providing pre-service teachers with a robust research-based model of children's thinking during a mathematics methods course changes their beliefs about teaching and learning mathematics, their abilities to incorporate these beliefs during student teaching may depend on the support pre-service teachers receive from the classroom teacher who supervises their student-teaching experiences. (1999, p. 109)

The findings of this study indicate that in order for cooperating teachers to be supportive, common beliefs about teaching and learning mathematics as well as common teaching practices must be shared by the cooperating teacher and pre-service teacher.

The overall outcomes of the internship experiences observed for this study appear to corroborate what the research has indicated. One pre-service teacher was very much reform-minded as was her cooperating teacher. The alignment between the practices of the pre-service teacher and her cooperating teacher, as well as the support the pre-service teacher received from her cooperating teacher, enabled the pre-service teacher to flourish in her internship. Another pre-service teacher was reform-minded and her cooperating teacher was not. Even so, the pre-service teacher was able to successfully implement the techniques she had learned in her methods courses. The other two pre-service teachers involved in this study ended up imitating the more traditional practices that were carried out by their cooperating teachers instead of implementing the newer techniques they had been taught in their methods courses. It is believed that that the cooperating teachers' degree of belief in reform mathematics approaches impacted the actions of the pre-service teachers. All cooperating teachers were comfortable allowing the pre-service teachers to try the reform approaches; however, the more traditional cooperating teachers

were not able to mentor the pre-service teachers in ways that would help the pre-service teachers implement reform practices well. As a result, the traditional cooperating teachers' respective pre-service teachers succumbed to the teaching methods used by them.

It seems that extensive field experiences and linkages between theory and practice are essential elements for changing pre-service teachers' beliefs (Vacc & Bright, 1999). The problem is finding field placements that support the philosophy of reform-based teacher preparation programs. According to the research, recent evidence suggests that incongruent field placements may be counterproductive and damaging in developing open-minded attitudes toward reform among pre-service teachers (Curcio & Artzt, 2005). Curcio and Artzt (2005) further stated that in order for fieldwork to be most effective, it needs to take place in an environment in which the philosophy is aligned with that of the teacher preparation program. The framework underlying the content presented in mathematics methods courses needs to be consistent with the framework of the mathematics education program that pre-service teachers observe and implement during field experiences. If the two frameworks are not in sync, the theories and concepts presented during the mathematics methods course may not seem plausible and may be rejected by the pre-service teacher (Vacc & Bright, 1999).

Coordinators of teacher education programs should take heed of this implication. As indicated above, mismatching the pre-service teacher and cooperating teacher could prove to be detrimental to the overall outcome of any given internship experience. Likewise, an alignment in the pairings could conclude in a win-win situation for all parties involved.

Implications for Selecting School Teacher Leaders and Mentor Teachers

The outcomes listed in the above table indicate selecting school teacher leaders or mentor teachers is not a decision that should be taken lightly. As a matter of fact, serious consideration should be given to the matter. As demonstrated by Mrs. Smith and Mrs. Brown, years of experience do not necessarily guarantee that a teacher will make a successful teacher leader or mentor. Other factors, such as willingness to grow should be taken into consideration as well. Both Mrs. Smith and Mrs. Brown had several years of teaching experience; however, neither demonstrated strong qualities of reform mathematics teaching. Accordingly, neither could provide the support their pre-service teachers needed to successfully implement the reform approaches they had learned in their methods courses; therefore, one pre-service teacher reverted to the traditional-style methods used by her cooperating teacher. The other pre-service teacher turned to her university supervisor for support. Conversely, Mrs. York had many years of teaching experience accompanied by constant growth in her teaching practices; hence, she was an effective mentor for her pre-service teacher. Consequently, her pre-service teacher, Mrs. Windsor, flourished throughout the internship experience.

Possibilities for Future Research

This study focused on four specific cases composed of cooperating teacher/pre-service teacher pairs. These cases were used to answer two questions: what beliefs and practices do cooperating teachers have that support or hinder the growth of a pre-service teacher immersed in reform based teaching; and what happens when there is a misalignment of the beliefs and practices held by the cooperating teacher and the

educational background of the pre-service teacher. As with any research study, in the process of answering the questions for the study, more questions arise. This study was no different. At the conclusion of the study, the researcher uncovered some new questions that could be used for future research. This study showed that sometimes the cooperating teacher has the most impact on the pre-service teacher, and sometimes he/she does not. Questions for future research are as follows: What would have occurred if one of the pairs had been a pre-service teacher with weak reform beliefs about the teaching and learning of mathematics and a cooperating teacher with strong reform beliefs about the teaching and learning mathematics? What factors determine or impact who is more influential to the pre-service teacher: the university supervisor or the cooperating teacher? Will pre-service teachers who were successfully supported in their reform teaching practices throughout their internship experience continue to use those techniques once they are teaching in their own classrooms?

REFERENCES

AzTEC. (2002). *About RTOP*. Retrieved January 20, 2006, from http://physicsed.buffalostate.edu/AZTEC/rtop/RTOP_full/about_RTOP.html

Beck, C., & Kosnick, C. (2000). Associate teachers in pre-service education: Clarifying and enhancing their role. *Journal of Education for Teaching, 26*(3), 207-225.

Borko, H., & Mayfield, V. (1995). The roles of the cooperating teacher and university supervisor in learning to teach. *Teaching & Teacher Education, 11*(5), 501-518.

Bristor, V. J., Kinzer, S., Lapp, S., & Ridener, B. (2002). The Teacher Education Alliance (TEA): A model teacher preparation program for the twenty-first century. *Education, 122*(4), 688-700.

Charambous, C. Y., Philippou, G., & Kyriakides, L. (2004). Towards a unified model on teachers' concerns and efficacy beliefs related to a mathematics reform. *International Group for the Psychology of Mathematics Education, 2(3), 199-206.*

Committee on Science, Engineering, and Public Policy (CSEPP). (2006). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: National Academies Press.

Cooney, T. J., Shealy, B. E., & Arvold, B. (1998). Conceptualizing belief structures of pre-service secondary mathematics teachers. *Journal of Research in Mathematics Education, 29*(3), 306-333.

Curcio, F. R., & Artzt, A. F. (2005). Providing meaningful fieldwork for pre-service mathematics teachers: A college-school collaboration. *Mathematics Teacher, 98*(9), 604-609.

Drafall, L. E., & Grant, J. W. (1994). Improving communication with student teachers. *Music Educators Journal, 81*(1), 35-39.

Fine, M., Weis, L., Weseen, S., & Wong, L. (2003). For whom? Qualitative research, representations, and social responsibilities. In N. K. Denzin & Y. S. Lincoln (Eds.), *The landscape of qualitative research: Theories and issues* (2nd ed., pp. 167-207). Thousand Oaks, CA: Sage Publications.

Frykholm, J. A. (1998). Beyond supervision: Learning to teach mathematics in community. *Teaching & Teacher Education, 14*(3), 305-322.

Fueyo, V. (1991). Implementing a field-based elementary teacher training program. *Education & Treatment of Children, 14*(4), 280-299.

Graham, K. J., & Fennell, F. (2001). Principles and standards for school mathematics and teacher education: Preparing and empowering teachers. *School Science and Mathematics, 101*(6), 319-327.

Greenes, C. (1995). Mathematics learning and knowing: A cognitive process. *Journal of Education, 177*(1), 85-106.

Gubrium, J. F., & Holstein, J. A. (2003). Analyzing interpretive practice. In N. Denzin & Y. S. Lincoln (Ed.), *Strategies of qualitative inquiry* (2nd ed., pp. 214-248). Thousand Oaks, CA: Sage Publications, Inc.

Hart, E. W., & Keller, B. (2001). *The NCTM Illuminations website project: Changing the vision of school mathematics.* Paper presented at the ED-MEDIA 2001 World

Conference on Educational Multimedia, Hypermedia, and Telecommunications, Tampere, Finland.

Herrera, T. A., & Ownes, D. T. (2001). The new new math: Two reform movements in mathematics education. *Theory Into Practice, 40*(2), 84-93.

Holm, L., & Horn C. (2003). Priming schools of education for today's teachers. *Education Digest, 68*(7), 25-32.

Ishii, D. K. (2003). *Constructivist views of learning in science and mathematics*. (No. ED482722). Columbus, OH: ERIC Clearinghouse for Science Mathematics and Environmental Education.

Klein, D. (2003). A brief history of American K-12 mathematics education in the 20th century. In J. Royer (Ed.), *Mathematical cognition: A volume in current perspectives on cognition, learning, and instruction* (pp. 175-225). Charlotte, NC: Information Age Publishing.

McIntyre, D. J., Byrd, D. M., & Foxx, S. M. (1996). Field and laboratory experiences. In J. Sikula (Ed.), *Handbook of research on teacher education* (2nd ed., pp. 171-193). New York: Macmillan.

Mtetwa, D. K. J., & Thompson, J. J. (2000). The dilemma of mentoring in mathematics teaching: Implications for teacher preparation in Zimbabwe. *Journal of In-Service Education, 26*(1), 139-152.

Manouchehri, A., & Goodman, T. (2000). Implementing mathematics reform; The challenge within. *Educational Studies in Mathematics, 42*(1), 1-34.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Nolder, R., Smith, S., & Melrose, J. (1994). Working together: Roles and relationships in the mentoring process. In B. Jaworski & A. Watson (Eds.), *Mentoring in mathematics teaching* (pp. 41-51). Washington, DC: The Falmer Press.

Peterson, B. E., & Williams, S. R. (1998). Mentoring beginning teachers. *The Mathematics Teacher, 91*(8), 730-734.

Philippou, G. & Charambous, C.Y. (2005). Disentangling mentors' role in the development of prospective teachers' efficacy beliefs in teaching mathematics. *International Group for the Psychology of Mathematics Education, 4(2), 73-80.*

Pourdavood, R. G. (1999). Toward a better understanding of mathematics teacher change: A case study of four pre-service secondary mathematics teachers. *Ohio Journal of School Mathematics, Spring,* 11-24.

Reyes, R. (2002). *Reform math education*. Retrieved October 7, 2005 from http://mathematicallysane.com/analysis/mathedreform.asp

Scientific Software Development GmbH. (2003). Retrieved April 21, 2006 from http://dl.element5.com/d/ba6d8275b3f25943/445A865E/50815/A5Setup.exe

Schoen, H. L., Fey, J. T., Hirsch, C. R., & Coxford, A. F. (1999). Issues and options in the math wars. *Phi Delta Kappan, 80*(6), 444-454.

Schoenfeld, A. H. (2004). The math wars. *Educational Policy, 18*(1), 253-286.

Schwandt, T. A. (2001). *Dictionary of qualitative inquiry* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Smith, J.P. (1996). Efficacy and teaching mathematics by telling: A challenge for reform. *Journal for Research in Mathematics Education, 27(4), 387-402.*

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. London: Sage.

Taylor, P. M. (2002). Implementing the standards: Keys to establishing positive professionalism inertia in pre-service mathematics teachers. *School Science & Mathematics, 102*(3), 137-143.

Telese, J. (1999). *Social constructivism: Its role in algebra classrooms*. Paper presented at the Annual Meeting of the Association of Mathematics Teacher Educators, Chicago, IL.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). New York, NY: Simon & Schuster and Prentice Hall International.

Tsui, A. B., Lopez-Real, F., Law, Y. K., Tang, R., & Shum, M. S. (2001) Roles and relationships in tripartite supervisory conferencing processes. *Journal of Curriculum and Supervision, 16*(4), 322-344.

Vacc, N. N., & Bright, G. W. (1999). Elementary pre-service teachers' changing beliefs and instructional use of children's mathematical thinking. *Journal for Research in Mathematics Education, 30*(1), 89-110.

Van de Walle, J. A. (2005). *Reform mathematics vs. the basics: Understanding the conflict and dealing with it.* Retrieved October 7, 2005, from http://mathematicallysane.com/analysis/reformvsbasics.asp

Van de Walle, J.A. (2006). *Elementary and middle school mathematics: Teaching developmentally* (6th ed.). New York, NY: Allyn & Bacon.

Wheatley, G. H., Blumsack, S., & Jakubowski, E. (1995). *Radical constructivism as a basis for mathematics reform*. Paper presented at the Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Columbus, OH.

APPENDICES

APPENDIX A

INTERVIEW QUESTIONS

Spring 2006 Cooperating Teacher Interview Questions

1.) How many years of teaching experience do you have?
2.) Is your certification level 7-12?
3.) What do you think mathematics is all about?
4.) What do you think is the best way for students to learn math?
5.) In what ways do you have an impact on students' learning of mathematics?
6.) What are the three most important characteristics of good mathematics teaching?
7.) How do you know when you've had a successful mathematics lesson?
8.) What do you think is the most effective way to teach mathematics?
9.) Is this different or the same for teaching other content areas?
10.) What is a typical mathematics lesson like in your class?
11.) What kinds of tasks are your students engaged in during mathematics class?
12.) How would you describe the mathematical learning environment in your room?
13.) What most influences your mathematics beliefs?
14.) What most influences your practice?
15.) To what extent do you believe your mathematics beliefs are reflected in your practice?
16.) What keeps your mathematics beliefs and practices from being consistent all the time?
17.) Throughout the internship experience, how do you see your role as the cooperating teacher?
18.) How do you see the role of the university supervisor?
19.) Who do you think has the most influence on the intern? Why?
20.) What kinds of things do you expect out of your intern?
21.) Do you think it will be a problem if you and your intern have different beliefs about teaching and learning mathematics?

Spring 2006 Pre-Service Teacher Interview Questions

1.) What do you think mathematics is all about?
2.) What do you think is the best way for students to learn math?
3.) In what ways to do you think you will have an impact on students' learning of mathematics?
4.) What are the three most important characteristics of good mathematics teaching?
5.) How do you know when you've had a successful mathematics lesson?
6.) What do you think is the most effective way to teach mathematics?
7.) Is this different or the same for teaching other content areas?
8.) What will a typical mathematics lesson in your class look like?
9.) What kinds of tasks will your students be engaged in during your mathematics class?
10.) How do you envision the mathematical learning environment of your classroom?
11.) What most influences your mathematics beliefs?
12.) What do you think will most influence your practice?
13.) To what extent do you think your mathematics beliefs will be reflected in your practice?
14.) Throughout the internship experience, how do you see the role of the cooperating teacher?
15.) How do you see the role of the university supervisor?
16.) Who do you think will influence you the most? Why?
17.) How do you see your role as the intern?
18.) Do you think it will be a problem if you and your cooperating teacher have different beliefs about teaching and learning mathematics?

Fall 2006 Cooperating Teacher Interview Questions

1.) Do you feel that your beliefs about teaching and learning mathematics changed since Spring 2006? If so, please elaborate.
2.) Describe your role as the cooperating teacher throughout this internship experience.
3.) Describe the role the university supervisor had throughout the internship experience.
4.) Who do you think had the most influence on the intern throughout the internship experience? Why/How?
5.) Describe the intern's role throughout the internship experience.
6.) Was the internship experience what you thought it would be? Why or why not?
7.) In your opinion, did you and your intern have different beliefs about teaching and learning mathematics? If so, please explain.
8.) If you and your intern had differing beliefs about teaching and learning mathematics, did it cause any problems? If so, please explain.
9.) What was the most beneficial part of the internship experience?
10.) If you could change one thing about the internship experience, what would it be? Why?
11.) Is there anything else you think I should know?

Fall 2006 Pre-Service Teacher Interview Questions

1.) What do you think mathematics is all about?
2.) What do you think is the best way for students to learn math?
3.) In what ways do you think you had an impact on your students' learning of mathematics?
4.) How did you know when you had a successful mathematics lesson?
5.) How did you know when you had an unsuccessful lesson?
6.) What did you find to be your most effective way to teach mathematics? Why?
7.) What did your typical mathematics lesson look like?
8.) What kinds of tasks were your students engaged in?
9.) Describe the mathematical learning environment of your math class.
10.) What most influenced your practice throughout your internship? Why?
11.) To what extent do you think your mathematics beliefs were reflected in your practice? Please explain in detail.
12.) Describe the role your cooperating teacher had throughout your internship.
13.) Describe the role your university supervisor had throughout your internship.
14.) Who influenced you the most throughout your internship? Why/How?
15.) Describe your role throughout your internship.
16.) Was your internship experience what you thought it would be? Why or why not?
17.) In your opinion, did you and your cooperating teacher have different beliefs about teaching and learning mathematics? If so, please explain.
18.) If you and your cooperating teacher had differing beliefs about teaching and learning mathematics, did it cause any problems? If so, please explain.
19.) What was the most beneficial part of your internship experience?
20.) If you could change one thing about your internship experience, what would it be? Why?
21.) Is there anything else you think I should know?

APPENDIX B

INFORMATION LETTERS AND CONSENT FORMS

Note:

In order to maintain the confidentiality of the university reform initiative program along with its participants, identifying information has been intentionally deleted from the following letters and forms.

March 21, 2006

Dear Cooperating Teacher:

My name is April Parker. I am a doctoral student. I would like to ask you to participate in the data collection process for my dissertation. My study will incorporate the input from participants which will consist of cooperating teacher/intern pairs and the university supervisor. The purpose of the study is to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approaches to teaching based on their preparation. The specific research questions that will be investigated are:

- What beliefs and practices do cooperating teachers have that support or hinder the growth of pre-service teachers indoctrinated in reform based mathematics teaching?
- What happens when there is a misalignment of the beliefs and practices related to the teaching and learning of mathematics held by the cooperating teacher and the educational background of the pre-service teacher?

Each cooperating teacher that chooses to participate will be asked to complete a questionnaire about his/her beliefs, knowledge, and attitudes related to the teaching and learning of mathematics. Completion of the questionnaire should take approximately 45 minutes. In addition to the questionnaire, each participant will be asked to participate in an interview that will provide additional information about his/her beliefs pertaining to the teaching and learning of mathematics. This interview should take no longer than 30 minutes to complete. Also, each participant will be observed teaching mathematics lessons. These observations will take place on at least three separate occasions. The purpose of these observations is to assess the pedagogical methods that are being used by the participants. These observations should take no additional time from the cooperating teacher. It is my desire that each participant will become more aware of his/her beliefs about teaching and learning mathematics. This new awareness will hopefully result in increased mathematics achievement and learning by the students.

Thank you in advance for your cooperation in this endeavor. If you should have any questions or concerns, please feel free to contact me

Sincerely,

April C. Parker
Graduate Student

March 21, 2006

Dear Pre-Service Teacher:

My name is April Parker. I am a doctoral student. I would like to ask you to participate in the data collection process for my dissertation. My study will incorporate the input from participants which will consist of cooperating teacher/intern pairs and the university supervisor. The purpose of the study is to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approaches to teaching based on their preparation. The specific research questions that will be investigated are:

- What beliefs and practices do cooperating teachers have that support or hinder the growth of pre-service teachers indoctrinated in reform based mathematics teaching?
- What happens when there is a misalignment of the beliefs and practices related to the teaching and learning of mathematics held by the cooperating teacher and the educational background of the pre-service teacher?

Each pre-service teacher that chooses to participate will be asked to complete a questionnaire about his/her beliefs, knowledge, and attitudes related to the teaching and learning of mathematics. Completion of the questionnaire should take approximately 45 minutes. In addition to the questionnaire, each participant will be asked to participate in an interview that will provide additional information about his/her beliefs pertaining to the teaching and learning of mathematics. This interview should take no longer than 30 minutes to complete. Also, each participant will be observed teaching mathematics lessons. These observations will take place on at least three separate occasions. The purpose of these observations is to assess the pedagogical methods that are being used by the participants. These observations should take no additional time from the pre-service teacher. It is my desire that each participant will become more aware of his/her beliefs about teaching and learning mathematics. This new awareness will hopefully result in increased mathematics achievement and learning by the students.

Thank you in advance for your cooperation in this endeavor. If you should have any questions or concerns, please feel free to contact me.

Sincerely,

April C. Parker
Graduate Student

March 21, 2006

Dear Principal:

My name is April Parker. I am a doctoral student. As part of the data collection process for my dissertation, I would like to ask a few of the teachers at your school to participate in my study. This study will incorporate the input from participants which will consist of cooperating teacher/intern pairs and the university supervisor. The purpose of the study is to explore the impact of the alignment or misalignment of the cooperating teachers' practices and the pre-service teachers' approaches to teaching based on their preparation. The research questions that will be investigated are:

- What beliefs and practices do cooperating teachers have that support or hinder the growth of pre-service teachers indoctrinated in reform based mathematics teaching?
- What happens when there is a misalignment of the beliefs and practices related to the teaching and learning of mathematics held by the cooperating teacher and the educational background of the pre-service teacher?

Each teacher that chooses to participate will be asked to complete a questionnaire about his/her beliefs, knowledge, and attitudes related to the teaching and learning of mathematics. Completion of the questionnaire should take approximately 45 minutes. In addition to the questionnaire, each participant will be asked to participate in an interview that will provide additional information about his/her beliefs pertaining to the teaching and learning of mathematics. This interview should take no longer than 30 minutes to complete. Also, each participant will be observed teaching mathematics lessons. These observations will take place on at least three separate occasions. The purpose of these observations is to assess the pedagogical methods that are being used by the participants. These observations should take no additional time from the teacher. It is my desire that each participant will become more aware of his/her beliefs about teaching and learning mathematics. This new awareness will hopefully result in increased mathematics achievement and learning by the students.

Thank you in advance for your cooperation in this endeavor. If you should have any questions or concerns, please feel free to contact me.

Sincerely,

April C. Parker
Graduate Student

INFORMED CONSENT BY TEACHERS
Partnership for the Improvement of Mathematics Education

You are being invited to participate in a research study related to a project whose goal is to improve mathematics education in . The study is being conducted by , associate professor in the at and director of the project, along with faculty members at and . The project is being conducted by a partnership of , and twelve school districts in the area, including the district in which you are currently teaching. The project's goal is to improve students' mathematics achievement and learning through changes in educational policies and practices over a five-year period. You were selected as a possible participant because you are a teacher in a school which has agreed to participate in initial data collection.

If you decide to participate, we will ask you to complete a questionnaire about your beliefs, knowledge, and attitudes related to the teaching and learning of mathematics. Completion of the questionnaire should take approximately 45 minutes. You may also be chosen to participate in an interview providing additional information about your knowledge of mathematics. Participation in the interview will take approximately 30 minutes. A trained investigator may also observe you teaching a mathematics classroom in order to assess the pedagogical methods used. This, however, should not require that you take any additional time. This data collection will be repeated on an annual basis for the next five years. As such, if you agree to participate we will be recontacting you each of the following years.

Any information obtained in connection with this study that can be identified with you will remain confidential. No information will be shared with anyone who has supervisory responsibilities over your nor will it be shared with any of your colleagues. To minimize the potential risk that any information gathered will be inadvertently divulged, we will use a unique code to identify you, and any identifying information will be removed as the information is transcribed. The original documents containing identifying information will be stored in a secure location, and the key linking codes with identifying information will be stored in a separate, secure location. Information collected through your participation may be used to meet dissertation requirements of graduate students associated with the project, published in a professional journal, and/or presented at a professional meeting. If so, none of your identifiable information will be included. All data that might identify you, including the list of codes, will be destroyed one year after the conclusion of the study.

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #
APPROVED TO

Participant's Initials

Your decision whether or not to participate will not jeopardize your future relations with or its , or with . Note that you may withdraw from participation at any time, without penalty, and that any data which has been collected may be withdrawn, as long as that data is identifiable.

As a result of your participation in this project, you may experience increased effectiveness in carrying out your duties related to mathematics teaching and learning, resulting in increased mathematics achievement and learning by your students. Moreover, if the model developed in this project is successful, it may also benefit teachers and students in other parts of the state. I cannot, however, promise that you will receive any or all of the benefits described. No additional compensation will be offered for participating in the research study, although stipends may be offered for participation in other selected activities of the project.

By agreeing to participate in this study, you will be provided professional development designed to improve your effectiveness as a teacher. However, this professional development may occur at different times, depending on your school's assignment to one of four cohorts that will begin participation in the project in the following four years. All teachers who agree to participate in the study will have an opportunity to participate in the project's activities at some time in the following four years.

For more information regarding your rights as a research participant you may contact the Office of Human Subjects Research or the Institutional Review Board by phone or e-mail at or

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

Participant's signature Date	Principal Investigator's signature Date
Print Name	Print Name

Interviews and classroom observations may be audio or videotaped. The tapes will only be used for research purposes, allowing qualified researchers to review the event after the fact, or for educational purposes, such as professional development. In no case will a tape be used for any commercial enterprise, disseminated beyond the project, or used in anyway designed to cause a negative perception. Please sign below if you agree to allow audio and videotaping.

Participant's signature

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #
APPROVED TO

APPENDIX C

REFORMED TEACHING OBSERVATION PROTOCOL (RTOP)

Reformed Teaching Observation Protocol (RTOP)

Daiyo Sawada
External Evaluator

Michael Piburn
Internal Evaluator

and

Kathleen Falconer, Jeff Turley, Russell Benford and Irene Bloom
Evaluation Facilitation Group (EFG)

Technical Report No. IN00-1
Arizona Collaborative for Excellence in the Preparation of Teachers
Arizona State University

I. BACKGROUND INFORMATION

Name of teacher _____ Announced Observation? _____ (yes, no, or explain)

Location of class _____ (district, school, room)

Years of Teaching _____ Teaching Certification _____ (K-8 or 7-12)

Subject observed _____ Grade level _____

Observer _____ Date of observation _____

Start time _____ End time _____

II. CONTEXTUAL BACKGROUND AND ACTIVITIES

In the space provided below please give a brief description of the lesson observed, the classroom setting in which the lesson took place (space, seating arrangements, etc.), and any relevant details about the students (number, gender, ethnicity) and teacher that you think are important. Use diagrams if they seem appropriate.

Record here events which may help in documenting the ratings.

Time	Description of Events

III. LESSON DESIGN AND IMPLEMENTATION

		Never Occurred				Very Descriptive
1)	The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	0	1	2	3	4
2)	The lesson was designed to engage students as members of a learning community.	0	1	2	3	4
3)	In this lesson, student exploration preceded formal presentation.	0	1	2	3	4
4)	This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	0	1	2	3	4
5)	The focus and direction of the lesson was often determined by ideas originating with students.	0	1	2	3	4

IV. CONTENT

Propositional knowledge

6)	The lesson involved fundamental concepts of the subject.	0	1	2	3	4
7)	The lesson promoted strongly coherent conceptual understanding.	0	1	2	3	4
8)	The teacher had a solid grasp of the subject matter content inherent in the lesson.	0	1	2	3	4
9)	Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	0	1	2	3	4
10)	Connections with other content disciplines and/or real world phenomena were explored and valued.	0	1	2	3	4

Procedural Knowledge

11)	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	0	1	2	3	4
12)	Students made predictions, estimations and/or hypotheses and devised means for testing them.	0	1	2	3	4
13)	Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	0	1	2	3	4
14)	Students were reflective about their learning.	0	1	2	3	4
15)	Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	0	1	2	3	4

Continue recording salient events here.

Time	Description of Events

V. CLASSROOM CULTURE

	Communicative Interactions	Never Occurred				Very Descriptive
16)	Students were involved in the communication of their ideas to others using a variety of means and media.	0	1	2	3	4
17)	The teacher's questions triggered divergent modes of thinking.	0	1	2	3	4
18)	There was a high proportion of student talk and a significant amount of it occurred between and among students.	0	1	2	3	4
19)	Student questions and comments often determined the focus and direction of classroom discourse.	0	1	2	3	4
20)	There was a climate of respect for what others had to say.	0	1	2	3	4
	Student/Teacher Relationships					
21)	Active participation of students was encouraged and valued.	0	1	2	3	4
22)	Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	0	1	2	3	4
23)	In general the teacher was patient with students.	0	1	2	3	4
24)	The teacher acted as a resource person, working to support and enhance student investigations.	0	1	2	3	4
25)	The metaphor "teacher as listener" was very characteristic of this classroom.	0	1	2	3	4

Additional comments you may wish to make about this lesson.

APPENDIX D

MATHEMATICS BELIEFS SURVEY

Teacher Survey

Note:
In order to maintain the confidentiality of the university reform initiative program along with its participants, identifying information has been intentionally deleted from the following survey.

This page will be separated from your completed survey to make sure that your name can NOT be linked directly to your responses. We will assign a code number so that your information from this survey can be linked to other information from future surveys. All information will remain confidential.

(Please print neatly)

Date _____ **School** _____

Name _____
Last Name First Name

Thank you for taking your time to complete this survey.

(Office use only below this line)

	System #	School #	Survey #	2006
	_____	_____	_____	
0	O O O	O O O	O O O O	O O
1	O O O	O O O	O O O O	O O
2	O O O	O O O	O O O O	O O
3	O O O	O O O	O O O O	O O
4	O O O	O O O	O O O O	O O
5	O O O	O O O	O O O O	O O
6	O O O	O O O	O O O O	O O
7	O O O	O O O	O O O O	O O
8	O O O	O O O	O O O O	O O
9	O O O	O O O	O O O O	O O

O O O

Please turn the page and begin.

SECTION A – Please indicate how much you agree or disagree with the following statements about teaching and learning mathematics.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Students need to have good mathematics problem-solving skills to be successful in the future.	O	O	O	O	O
b. My students aren't really going to use much of what they are learning in mathematics when they get out of school.	O	O	O	O	O
c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	O	O	O	O	O
d. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	O	O	O	O	O
e. If the class is going to use manipulatives or a physical model to model of a mathematical situation, I usually prefer first to show my students how to use the manipulatives or model.	O	O	O	O	O
f. In a mathematics class, each student's solution process should be accepted and valued.	O	O	O	O	O
g. Students learn mathematics best from their teacher's demonstrations and explanations.	O	O	O	O	O
h. Mathematics is a worthwhile, necessary subject for all students regardless of what their career goals may be.	O	O	O	O	O
i. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	O	O	O	O	O
j. It is important for all students to be able to do basic mathematical computations.	O	O	O	O	O
k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	O	O	O	O	O
l. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	O	O	O	O	O
m. It is important for students to figure out how to solve mathematics problems for themselves.	O	O	O	O	O
n. Taking time to investigate why a solution to a math problem works is time well spent.	O	O	O	O	O
o. It doesn't really matter if a student understands a math problem as long as he or she can get the right answer.	O	O	O	O	O

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
p. Teachers should demonstrate mathematical procedures and then have students practice those procedures.	O	O	O	O	O
q. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	O	O	O	O	O
r. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	O	O	O	O	O
s. Getting a right answer in math is more important than understanding why the answer works.	O	O	O	O	O
t. Teachers should allow students to figure out their own ways of solving mathematics problems.	O	O	O	O	O
u. Taking advanced mathematics is a waste of time for many students.	O	O	O	O	O
v. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction.	O	O	O	O	O

SECTION B – The next statements reflect different tasks that teachers are called upon to do during the school day or throughout the school year. How <u>confident</u> are you that you can:

	Not at all Confident		Somewhat Confident		Very Confident
a. Revise curriculum and instruction so that it is more sensitive to your students' prior understanding of mathematical concepts.	O	O	O	O	O
b. Lead a class of students using investigative strategies to "discover" concepts or solve problems.	O	O	O	O	O
c. Make connections between mathematics and other disciplines.	O	O	O	O	O
d. Develop students' conceptual understanding of mathematics.	O	O	O	O	O
e. Actively monitor students as they do mathematics in order to gauge their progress in understanding key concepts.	O	O	O	O	O
f. Design exercises that would help students identify and repair misconceptions about key mathematical concepts.	O	O	O	O	O
g. Help students deduce mathematics concepts or support them as they solve problems without giving them the answer.	O	O	O	O	O

	Not at all Confident		Somewhat Confident		Very Confident
h. Manage a class of students engaged in hands-on or project-based mathematics work.	○	○	○	○	○
i. Provide deep or extensive coverage of a specific concept taught in mathematics.	○	○	○	○	○
j. Use resources other than a textbook as the primary instruction tool.	○	○	○	○	○
k. Craft good questions for your students.	○	○	○	○	○
l. Implement alternative instructional strategies in your classroom.	○	○	○	○	○
m. Provide an alternative explanation or example when students are confused.	○	○	○	○	○

SECTION C - Information About The Mathematics Classes You Teach

For this section of the survey, we would like you to report on a specific MATHEMATICS class that you teach. We will call this class your **TARGET CLASS**. To identify your TARGET CLASS, please read the following instructions carefully. If you teach more than one math class, **your FIRST CLASS OF THE WEEK in which MATHEMATICS is taught is your TARGET CLASS** (e.g., 1st period Monday, 3rd period Monday, etc.).

Class Information

1. How many different subject or course preparations are you responsible for?

1	2	3	4	5 or more
○	○	○	○	○

Please answer the following questions regarding your TARGET MATH CLASS.

2. What is the grade level(s) of the students in your TARGET MATH CLASS?

Pre-K	1	2	3	4	5	6	7	8	9	10	11	12	Non-graded
○	○	○	○	○	○	○	○	○	○	○	○	○	○

3. On a typical day, how long is your TARGET MATH CLASS?

< 40 minutes	41-50 minutes	51-60 minutes	61-70 minutes	71-80 minutes	81-90 minutes	Over 90 minutes
○	○	○	○	○	○	○

4. On a typical day, what time does your TARGET MATH CLASS begin (rounded to nearest hour)?

7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm
○	○	○	○	○	○	○	○	○

5. How many students are in your TARGET MATH CLASS?
For example, if you had 18 students: Number of students in your class:

1	8
0○	0○
1●	1○
2○	2○
3○	3○
4○	4○
	5○
	6○
	7○
	8●
	9○

0○	0○
1○	1○
2○	2○
3○	3○
4○	4○
	5○
	6○
	7○
	8○
	9○

6. Please describe the range of student ability in your TARGET MATH CLASS. (mark only one)

- ○ Mostly below grade level
- ○ Mostly below or at grade level
- ○ A balance of students at, below, and above grade level
- ○ Mostly at or above grade level
- ○ Mostly above grade level

7. Approximately what proportion of students in your TARGET MATH CLASS are:

	None	1-25%	26-50%	51-75%	76-100%	Not sure
Title 1 Math	○	○	○	○	○	○
Students with disabilities	○	○	○	○	○	○
ESL students	○	○	○	○	○	○
Gifted and talented	○	○	○	○	○	○
African Americans	○	○	○	○	○	○
Asian American	○	○	○	○	○	○
Biracial/Multiethnic	○	○	○	○	○	○
Hispanic	○	○	○	○	○	○
White, non-Hispanic	○	○	○	○	○	○

8. Approximately what proportion of students in your TARGET MATH CLASS do you expect to:

	None	1-25%	26-50%	51-75%	76-100%
Graduate from high school	○	○	○	○	○
Attend a trade school or technical school	○	○	○	○	○
Attend a junior college	○	○	○	○	○
Attend a four-year college/university	○	○	○	○	○

9. **Please indicate how much you agree or disagree with the following statements about how you teach the students in your TARGET MATH CLASS.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I make a special effort to recognize students' individual progress	○	○	○	○	○
b. I give special privileges to students who do the best work.	○	○	○	○	○
c. I call attention to students' work that is incorrect or poorly written as an example of what not to do.	○	○	○	○	○
d. I consider how much students have improved when I give them report card grades.	○	○	○	○	○
e. I make an example of students who are not prepared to answer questions in class.	○	○	○	○	○
f. I display the work of the highest achieving students as an example.	○	○	○	○	○
g. I emphasize the importance of learning from mistakes.	○	○	○	○	○
h. I help students understand how their performance compares to others.	○	○	○	○	○
i. I stress to students that it's important to understand each concept, not just get the right answer.	○	○	○	○	○
j. I tell my students it is important <u>not</u> to be the worst at doing math.	○	○	○	○	○
k. I encourage students to compete with each other.	○	○	○	○	○
l. I encourage students to find several ways to solve each problem.	○	○	○	○	○
m. I stress to students how important it is to avoid making mistakes on their work.	○	○	○	○	○
n. I point out students who do well as a model for the other students.	○	○	○	○	○
o. I tell my students that learning should be fun.	○	○	○	○	○
p. I give students opportunities to think about how they have improved their skills or understanding.	○	○	○	○	○
q. I tell students it is important to show others they can do the work in math.	○	○	○	○	○
r. I take away privileges from students who do poorly on their assignments.	○	○	○	○	○

9. **Please indicate how much you agree or disagree with the following statements about how you teach the students in your TARGET MATH CLASS.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I make a special effort to recognize students' individual progress	○	○	○	○	○
b. I give special privileges to students who do the best work.	○	○	○	○	○
c. I call attention to students' work that is incorrect or poorly written as an example of what not to do.	○	○	○	○	○
d. I consider how much students have improved when I give them report card grades.	○	○	○	○	○
e. I make an example of students who are not prepared to answer questions in class.	○	○	○	○	○
f. I display the work of the highest achieving students as an example.	○	○	○	○	○
g. I emphasize the importance of learning from mistakes.	○	○	○	○	○
h. I help students understand how their performance compares to others.	○	○	○	○	○
i. I stress to students that it's important to understand each concept, not just get the right answer.	○	○	○	○	○
j. I tell my students it is important not to be the worst at doing math.	○	○	○	○	○
k. I encourage students to compete with each other.	○	○	○	○	○
l. I encourage students to find several ways to solve each problem.	○	○	○	○	○
m. I stress to students how important it is to avoid making mistakes on their work.	○	○	○	○	○
n. I point out students who do well as a model for the other students.	○	○	○	○	○
o. I tell my students that learning should be fun.	○	○	○	○	○
p. I give students opportunities to think about how they have improved their skills or understanding.	○	○	○	○	○
q. I tell students it is important to show others they can do the work in math.	○	○	○	○	○
r. I take away privileges from students who do poorly on their assignments.	○	○	○	○	○

11. **How often do the students in your TARGET MATH CLASS do the following instructional activities?**

Never
Rarely (a few times a year)
Sometimes (once or twice a month)
Often (once of twice a week)
All or almost all math lessons

	Never	Rarely	Some-times	Often	All or Almost All
a. Use a calculator or computer to explore a concept or extend the understanding of a concept or skill	O	O	O	O	O
b. Participate in small group discussions to make sense of math	O	O	O	O	O
c. Listen to me lecture about math	O	O	O	O	O
d. Copy notes or problems off the board	O	O	O	O	O
e. Give a written explanation about how they solved a math problem	O	O	O	O	O
f. Present how they solved a problem to the class	O	O	O	O	O
g. Use wooden or plastic blocks, rods, shapes or other objects to solve a math problem	O	O	O	O	O
h. Work on one math problem or question for more than 10 minutes	O	O	O	O	O
i. Do 10 or more practice problems by themselves	O	O	O	O	O
j. Memorize formulas and rules for a test or quiz	O	O	O	O	O
k. Think about why something in math class is true	O	O	O	O	O
l. Do math projects or investigations that take several days to complete	O	O	O	O	O
m. Apply math situations to life outside of school	O	O	O	O	O
n. Take tests where they have to explain their answers	O	O	O	O	O
o. Take multiple-choice tests	O	O	O	O	O
p. Complete many math problems quickly	O	O	O	O	O
q. Practice to take a standardized-test, like the SAT-10 or AHSGE	O	O	O	O	O

12. How much time do you spend preparing students in your TARGET MATH CLASS for standardized tests, such as the SAT-10? (mark only one)

O1 day or less
O2 days
O3 days
O4 days
O1 week
O2-3 weeks
O1 month or more

SECTION D - Background Information

1. How many years have you: (round up to the nearest year)

Example:

2	5
0 O	0 O
1 O	1 O
2 ◉	2 O
3 O	3 O
4 O	4 O
	5 ◉
	6 O
	7 O
	8 O
	9 O

Years taught at this school?

0 O	0 O
1 O	1 O
2 O	2 O
3 O	3 O
4 O	4 O
	5 O
	6 O
	7 O
	8 O
	9 O

Total years as a teacher?

0 O	0 O
1 O	1 O
2 O	2 O
3 O	3 O
4 O	4 O
	5 O
	6 O
	7 O
	8 O
	9 O

2. Have you ever taught outside this school system?

OYes ONo

3. Are you a graduate of this school system?

OYes ONo

4. What is the highest level of education you have completed?

O Bachelors degree
O Bachelors with additional graduate credits
O Masters degree
O Masters + 15 credits
O Masters + 30 credits
O Masters + 45 credits
O Specialist
O Doctorate

5. Please indicate whether your degree(s) were in Mathematics Education, Mathematics, or another discipline:

Bachelors	Masters	Specialists	Doctorate
O Elementary Ed	O Elementary Ed	O Elementary Ed	O Elementary Ed
O Math Ed	O Math Ed	O Math Ed	O Math Ed
O Math	O Math	O Math	O Math
O Other, please specify	O Other, please specify	O Other, please specify	O Other, please specify
_____	_____	_____	_____

6. Approximately how much time overall have you spent in professional development during the past year?

Less than 20 hours	20-40 hours	41-80 hours	81-120 hours	121-160 hours	Over 160 hours
O	O	O	O	O	O

7. Approximately how much time have you spent in professional development associated with during the past year?

None	Less than 5 hours	6-10 hours	11-15 hours	16-20 hours	Over 20 hours
O	O	O	O	O	O

8. Approximately much time have you spent in mathematics-specific professional development (other than that offered by) during the past year?

None	Less than 5 hours	6-10 hours	11-15 hours	16-20 hours	Over 20 hours
O	O	O	O	O	O

9. Are you:

O Female O Male

10. Are you:

O African-American (Black)
O Asian-American
O Biracial/Multiethnic
O Hispanic
O Native American
O White, Non-Hispanic
O Other (please specify): _____

SECTION E – For the next set of questions, we ask you about teachers at your school. First, please consider how true each statement is at the school and in your math department where you currently teach.

1. In this *school*…	Not at all True		Somewhat True		Very True
a. Teachers care about students as people..	○	○	○	○	○
b. Students do schoolwork that really makes them think.	○	○	○	○	○
c. Teachers do not have the skills to deal with student disciplinary problems.	○	○	○	○	○
d. Teachers really believe every child can learn.	○	○	○	○	○
e. Teachers have the necessary skills to effectively enact the current curriculum.	○	○	○	○	○
f. Students ask questions when they do not understand.	○	○	○	○	○
g. Teachers fail to reach some students because of poor teaching methods.	○	○	○	○	○
h. Teachers are confident they will be able to support student motivation.	○	○	○	○	○
i. Teachers don't have the skills needed to produce meaningful student learning.	○	○	○	○	○
j. If a child doesn't want to learn teachers give up.	○	○	○	○	○
k. Teachers are able to get through to difficult students.	○	○	○	○	○
l. Teachers treat all students fairly.	○	○	○	○	○

2. In this *math department*…. **If you are not in a math department, please skip to Section F.**	Not at all True		Somewhat True		Very True
a. Teachers care about students as people..	○	○	○	○	○
b. Students do math work that really makes them think.	○	○	○	○	○
c. Teachers do not have the skills to deal with student disciplinary problems.	○	○	○	○	○
d. Teachers really believe every child can learn.	○	○	○	○	○
e. Teachers have the necessary skills to effectively enact the current curriculum.	○	○	○	○	○
f. Students ask questions when they do not understand.	○	○	○	○	○
g. Teachers fail to reach some students because of poor teaching methods.	○	○	○	○	○
h. Teachers are confident they will be able to support student motivation.	○	○	○	○	○
i. Teachers don't have the skills needed to produce meaningful student learning.	○	○	○	○	○
j. If a child doesn't want to learn teachers give up.	○	○	○	○	○
k. Teachers are able to get through to difficult students.	○	○	○	○	○
l. Teachers treat all students fairly.	○	○	○	○	○

SECTION F – Involvement in

1. Please indicate how much you agree or disagree with the following statements about

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Members of our school meet regularly to discuss the progress of our efforts.	O	O	O	O	O
b. I am more enthusiastic about our school now that I am involved in this project.	O	O	O	O	O
c. I personally support the mission and vision.	O	O	O	O	O
d. Our school has enough staff, time, and other resources to really make this project pay off for the school.	O	O	O	O	O
e. The mission and vision are understood by members of our school.	O	O	O	O	O
f. I am satisfied with our relationship with members of the project team.	O	O	O	O	O

2. To what extent have you personally been involved in this project? (Mark all that apply.)

- O I am not involved at all
- O I am not directly involved, but I have heard about from colleagues who are involved
- O I have been involved in extensive discussions about with colleagues
- O I have been involved in implementing aspects of in my school
- O I serve as a School Teacher Leader
- O I serve as a District Teacher Leader

3. To what extent have you implemented various aspects of ?

	Not at All	Monthly	Weekly	Daily
a. Curriculum Guide	O	O	O	O
b. Recommended text series (Scott Foresman, Prentice Hall, Glencoe)	O	O	O	O
c. Recommended investigation series (Investigations, CMP, IMP)	O	O	O	O
d. Activities that promote problem-solving and critical thinking	O	O	O	O
e. Instructional techniques suggested by	O	O	O	O
f. Assessment techniques suggested by	O	O	O	O

Pre-Service Teacher Survey

Note:

In order to maintain the confidentiality of the university reform initiative program along with its participants, identifying information has been intentionally deleted from the following survey.

This page will be separated from your completed survey to make sure that your global ID can NOT be linked directly to your responses. We will use your ID to link information from this survey to other information from future surveys. All information will remain confidential.

(Please print neatly)

Name _____ **Course** _____
Last Name **First Name**

Global ID (e,g, shanndm)

A	○	○	○	○	○	○	○
B	○	○	○	○	○	○	○
C	○	○	○	○	○	○	○
D	○	○	○	○	○	○	○
E	○	○	○	○	○	○	○
F	○	○	○	○	○	○	○
G	○	○	○	○	○	○	○
H	○	○	○	○	○	○	○
I	○	○	○	○	○	○	○
J	○	○	○	○	○	○	○
K	○	○	○	○	○	○	○
L	○	○	○	○	○	○	○
M	○	○	○	○	○	○	○
N	○	○	○	○	○	○	○
O	○	○	○	○	○	○	○
P	○	○	○	○	○	○	○
Q	○	○	○	○	○	○	○
R	○	○	○	○	○	○	○
S	○	○	○	○	○	○	○
T	○	○	○	○	○	○	○
U	○	○	○	○	○	○	○
V	○	○	○	○	○	○	○
W	○	○	○	○	○	○	○
X	○	○	○	○	○	○	○
Y	○	○	○	○	○	○	○
Z	○	○	○	○	○	○	○

SECTION A – Learning Mathematics

1. These questions pertain to the ways you learn math. Think about how you study for and learn math. For each sentence, please darken the circle that indicates how true each statement is for you

	Never True		Sometimes True		Always True
a. I'm sure I can learn everything taught in math.	O	O	O	O	O
b. It's important to me to learn a lot of new things in math.	O	O	O	O	O
c. I can do even the hardest work in my math class.	O	O	O	O	O
d. Improving my math skills is one of my goals.	O	O	O	O	O
e. I can do all the work in math class if I don't give up.	O	O	O	O	O
f. My goal in math is to learn as much as I can.	O	O	O	O	O
g. Even if the work in math is hard, I can learn it.	O	O	O	O	O
h. It's important to me that I really understand my math work.	O	O	O	O	O
i. I'm sure I can do even the most difficult math work.	O	O	O	O	O
j. Learning new skills in math is one of my goals.	O	O	O	O	O
k. In math, doing better than other students is important to me.	O	O	O	O	O
l. My goal is to keep others from thinking I'm not smart in math.	O	O	O	O	O
m. My goal in math is to look smarter than other students.	O	O	O	O	O
n. It's very important to me that I don't look stupid in math class.	O	O	O	O	O
o. One of my goals is to show others that math is easy for me.	O	O	O	O	O

p. I do my math work so that I don't embarrass myself.	O	O	O	O	O
q. It's important to me that others think I am good at doing math.	O	O	O	O	O
r. I do my math work so that my teacher doesn't think I know less than others.	O	O	O	O	O
s. My goal in math is to do better than other students.	O	O	O	O	O
t. My goal in math is to avoid looking like I can't do my work.	O	O	O	O	O

2. The following items pertain to how math is taught in the current class. For each sentence, please darken the circle that represents how math is taught in this class.

Course: _____

	Never True		Sometimes True		Always True
a. My math instructor connects my current math understanding to the math concepts he/she is teaching	O	O	O	O	O
b. My math instructor provides opportunities for me to make conjectures, invent problem-solving strategies, and solve problems.	O	O	O	O	O
c. My math instructor helps me connect math to real-life situations and to other topics in math that I have studied before.	O	O	O	O	O
d. My math instructor questions me to probe my math knowledge and my ability to reason.	O	O	O	O	O
e. My math instructor facilitates whole class and small group discussions that help me make sense of math.	O	O	O	O	O

f. My math instructor communicates with me about my performance in a continuous, comprehensive manner.	O	O	O	O	O
g. My math instructor asks questions that foster math understandings and challenge misconceptions when revealed by student responses.	O	O	O	O	O
h. My math instructor encourages me to rely on my own math knowledge to determine if something is mathematically correct.	O	O	O	O	O
i. My math instructor uses a variety of assessment tools (such as performance tasks, projects, writing assignments, demonstrations and portfolios) to determine what I know and can do.	O	O	O	O	O
j. During math class, I work individually or in small groups to figure out how to solve a problem.	O	O	O	O	O
k. During math class, I am required to explain why my solution strategy works and I am required to justify my results.	O	O	O	O	O
l. During math class, I solve problems that require me to think, as well as reinforce computational procedures.	O	O	O	O	O
m. During math class, I communicate about mathematics both orally and in writing.	O	O	O	O	O
n. During math class, I make connections between the math I am learning and the real world.	O	O	O	O	O
o. During math class, I explore math using physical objects (e.g. blocks) and technology.	O	O	O	O	O
p. During math class, I learn to assess my own progress.	O	O	O	O	O
q. During math class, I experience more than just math computations.	O	O	O	O	O

3. About how much time **each week** do you spend outside of class doing course-related work?

1 hour or less	2-3 hours	4-6 hours	7-9 hours	10 or more hours
O	O	O	O	O

4. What is your current level of performance in this class?

O Worse than most other students
O About the same as other students
O Better than other students
O Don't know

5. What grade do you expect to earn in this math class?

A	B	C	D	F
O	O	O	O	O

SECTION B – Teaching Mathematics

1. Think about how you will teach the students in your math class. For each sentence, please darken the circle that says how true the sentence is for you.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I will make a special effort to recognize students' individual progress	O	O	O	O	O
b. I will give special privileges to students who do the best work.	O	O	O	O	O
c. I will call attention to students' work that is incorrect or poorly written as an example of what not to do.	O	O	O	O	O
d. I will consider how much students have improved when I give them report card grades.	O	O	O	O	O
e. I will display the work of the highest achieving students as an example.	O	O	O	O	O
f. I will make an example of students who are not prepared to answer questions in class.	O	O	O	O	O
g. I will emphasize the importance of learning from mistakes.	O	O	O	O	O
h. I will help students understand how their performance compares to others.	O	O	O	O	O
i. I will tell my students it is important not to be the worst at doing math.	O	O	O	O	O
j. I will stress to students that it's important to understand each concept, not just get the right answer.	O	O	O	O	O
k. I will encourage students to compete with each other.	O	O	O	O	O
l. I will stress to students how important it is to avoid making mistakes on their work.	O	O	O	O	O

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
m. I will encourage students to find several ways to solve each problem.	O	O	O	O	O
n. I will point out students who do well as a model for the other students.	O	O	O	O	O
o. I will take away privileges from students who do poorly on their assignments.	O	O	O	O	O
p. I will give students opportunities to think about how they have improved their skills or understanding.	O	O	O	O	O
q. I will tell students it is important to show others they can do the work in math.	O	O	O	O	O
r. I will tell my students that learning should be fun.	O	O	O	O	O

2. Please read each of the following items pertaining to how teachers teach and how students learn math. Indicate the degree to which you agree or disagree with each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. Teachers should ensure as much as possible that students experience success in mathematics by clearly explaining and modeling how to complete each day's assignment, by closely monitoring students' work, and by continually providing feedback including, if necessary, supplementary detailed explanation of how to solve a problem.	O	O	O	O	O
b. It is important for students to figure out how to solve mathematics problems for themselves.	O	O	O	O	O
c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	O	O	O	O	O
d. In a mathematics class, each student's solution process should be accepted and valued.	O	O	O	O	O
e. Students learn mathematics best from their teacher's demonstrations and explanations.	O	O	O	O	O
f. Students should have many informal experiences (such as solving word problems) with a mathematical concept before they are expected to master that concept.	O	O	O	O	O
g. Students must confront a mathematical idea many times before they will understand it, so teachers must provide a variety of mathematics problems addressing that idea and challenge the students to figure out how to solve those problems.	O	O	O	O	O

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
h. No student should associate mathematics with frustration, so a teacher should limit the questions he or she asks of the student to those that the teacher is reasonably confident that the student can answer correctly.	○	○	○	○	○
i. When planning a mathematics lesson, I know that I will be able to provide mathematics activities that are relevant to students' lives.	○	○	○	○	○
j. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	○	○	○	○	○
k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	○	○	○	○	○
l. Teachers should model and demonstrate mathematical procedures and then, ideally, time should be allowed for the students to have the opportunity to practice those procedures.	○	○	○	○	○
m. I don't feel that I need to recall all of the answers to all of the questions that my students may have about mathematics because I know that I will be able to figure out a solution as my students and I work on a question.	○	○	○	○	○
n. Students achieve mathematical understanding through the direct personal experience of figuring out their own solutions to problems and then verifying their thinking for themselves.	○	○	○	○	○
o. When students are grouped for instruction on the basis of their past mathematical performance, each student may then receive the level of mathematics instruction that is most appropriate for that student.	○	○	○	○	○
p. Rather than demonstrating how to solve a problem, a teacher should allow students to figure out their own ways of solving mathematics problems and to explain their own ways of solving mathematics problems, including word problems.	○	○	○	○	○
q. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	○	○	○	○	○
r. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction that encourages greater student-student and student-teacher interaction.	○	○	○	○	○

SECTION C - BACKGROUND INFORMATION

1. Are you a: O Male O Female

2. Are you:
O African-American (Black)
O Asian-American
O Hispanic
O White, non-Hispanic
O Native American
O Biracial/Multiethnic
O Other (please specify): _____

3. Academic Major:

O Elementary Education O Early Childhood Education
O Secondary Math Education O Math
O Other, please specify: _____

4. Coursework Completed

Early Childhood Majors. Please indicate which of the following courses you have completed:
NT = Not Taken, E = Enrolled, C = Completed

	Not Taken	Enrolled	Completed
MATH 1130 Precalculus Trigonometry	O	O	O
MATH 1610 Calculus I	O	O	O
MATH 2850 Math for Elementary Teachers I	O	O	O
MATH 4970 Special Problems	O	O	O
Other MATH elective, please specify _____	O	O	O
CTEC 3020 Primary Math and Science	O	O	O
CTEC 3030 Intuitive Thought and Symbolic Function	O	O	O

Elementary Education Majors. Please indicate which of the following courses you have completed:
NT = Not Taken, E = Enrolled, C = Completed

	Not Taken	Enrolled	Completed
MATH 1100 Finite Mathematics	O	O	O
MATH 1120 Precalculus Algebra	O	O	O
MATH 1130 Precalculus Trigonometry	O	O	O
MATH 1150 Precalculus Algebra and Trigonometry	O	O	O
MATH 2850 Math for Elementary Teachers I	O	O	O
MATH 2860 Math for Elementary Teachers II	O	O	O
MATH 4970 Special Problems	O	O	O
Other MATH elective, please specify _____	O	O	O
CTEC 3020 Primary Math and Science	O	O	O
CTEE 4040 Curriculum of Mathematics	O	O	O

Secondary Mathematics Majors. Please indicate which of the following courses you have completed:
NT = Not Taken, E = Enrolled, C = Completed

	Not Taken	Enrolled	Completed
MATH 1610 Calculus I	○	○	○
MATH 1620 Calculus II	○	○	○
MATH 2630 Calculus III	○	○	○
MATH 2650 Differential Equations	○	○	○
MATH 2660 Linear Algebra	○	○	○
ADMH 3710 Discrete Math	○	○	○
STAT 3600 Applied Prob & Stat I	○	○	○
MATH 3100 Foundations Of Math	○	○	○
MATH 3010 History Of Math	○	○	○
MATH 6000 Analysis I	○	○	○
MATH 6310 Abstract Algebra	○	○	○
MATH 6380 Geometry I	○	○	○
MATH 6390 Geometry II	○	○	○
ADMH Elective, please specify _____	○	○	○
CTMD 4010 Teaching Mathematics in the Middle School	○	○	○
CTSE 4030 Mathematics Curriculum and Teaching	○	○	○
CTSE 4040 Technology in Teaching Secondary Mathematics	○	○	○

Teachers Responses to Beliefs Survey

Table 21

Mrs. Smith's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
Aa. Students need to have good mathematics problem-solving skills to be successful in the future.	Agree	Agree
Ab. My students aren't really going to use much of what they are learning in mathematics when they get out of school.	Strongly Disagree	Disagree
Ac. Time should be spent practicing mathematical procedures before students spend much time solving mathematical problems.	Neutral	Neutral
Ad. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	Neutral	Neutral
Ae. If the class is going to use manipulatives or a physical model to model a mathematical situation, I usually prefer first to show my students how to use the manipulatives or model.	Disagree	Agree
Af. In a mathematics class, each student's solution process should be accepted and valued.	Agree	Agree
Ag. Students learn mathematics best from their teacher's demonstrations and explanations.	Disagree	Neutral
Ah. Mathematics is a worthwhile, necessary subject for all students regardless of what their career goals may be.	Strongly Agree	Agree

	Spring 2006	Fall 2006
Ai. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Neutral	Agree
Aj. It is important for all students to be able to do basic mathematical computations.	Agree	Strongly Agree
Ak. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Agree	Agree
Al. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	Disagree	Disagree
Am. It is important for students to figure out how to solve mathematics problems for themselves.	Agree	Agree
An. Taking time to investigate why a solution to a math problem works is time well spent.	Agree	Agree
Ao. It doesn't really matter if a student understands a math problem as long as he or she can get the right answer.	Disagree	Disagree
Ap. Teachers should demonstrate mathematical procedures and then have students practice those procedures.	Neutral	Neutral
Aq. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	Agree	Agree

	Spring 2006	Fall 2006
Ar. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Disagree	Disagree
As. Getting a right answer in math is more important than understanding why the answer works.	Disagree	Disagree
At. Teachers should allow students to figure out their own ways of solving mathematics problems.	Agree	Agree
Au. Taking advanced mathematics is a waste of time for many students.	Disagree	Disagree
Av. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction.	Neutral	Agree

Table 22

Mrs. Franklin's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
B2a. Teachers should ensure as much as possible that students experience success in mathematics by clearly explaining and modeling how to complete each day's assignment, by closely monitoring students' work, and by continually providing feedback including, if necessary, supplementary detailed explanation of how to solve a problem.	Strongly Agree	Strongly Agree
B2b. It is important for students to figure out how to solve mathematics problems for themselves.	Strongly Agree	Strongly Agree
B2c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	Strongly Disagree	Disagree
B2d. In a mathematics class, each student's solution process should be accepted and valued.	Strongly Agree	Strongly Agree
B2e. Students learn mathematics best from their teacher's demonstrations and explanations.	Strongly Agree	Strongly Agree
B2f. Students should have many informal experiences (such as solving word problems) with a mathematical concept before they are expected to master that concept.	Strongly Agree	Strongly Agree
B2g. Students should confront a mathematical idea many times before they will understand it, so teachers must provide a variety of mathematics problems addressing that idea and challenge the students to figure out how to solve those problems.	Strongly Agree	Strongly Agree

	Spring 2006	Fall 2006
B2h. No student should associate mathematics with frustration, so a teacher should limit the questions he or she asks of the student to those that the teacher is reasonably confident that the student can answer correctly.	Strongly Disagree	Strongly Agree
B2i. When planning a mathematics lesson, I know that I will be able to provide mathematics activities that are relevant to students' lives.	Strongly Agree	Strongly Agree
B2j. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Strongly Agree	Strongly Agree
B2k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Strongly Agree	Strongly Agree
B2l. Teachers should model and demonstrate mathematical procedures and then, ideally, time should be allowed for the students to have the opportunity to practice those procedures.	Strongly Agree	Neutral
B2m. I don't feel that I need to recall all of the answers to all of the questions that my students have about mathematics because I know that I will be able to figure out a solution as my students and I work on a question.	Neutral	Neutral
B2n. Students achieve mathematical understanding through the direct personal experience of figuring out their own solutions to problems and then verifying their thinking for themselves.	Strongly Agree	Strongly Agree

	Spring 2006	Fall 2006
B2o. When students are grouped for instruction on the basis of their past mathematical performance, each student may then receive the level of mathematics instruction that is most appropriate for that student.	Strongly Disagree	Strongly Disagree
B2p. Rather than demonstrating how to solve a problem, a teacher should allow students to figure out their own ways of solving mathematics problems and to explain their own ways of solving mathematics problems, including word problems.	Strongly Agree	Strongly Agree
B2q. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Strongly Disagree	Strongly Disagree
B2r. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction that encourages greater student-student and student-teacher interaction.	Strongly Agree	Strongly Agree

Table 23

Mrs. Johnson's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
Aa. Students need to have good mathematics problem-solving skills to be successful in the future.	Strongly Agree	Strongly Agree
Ab. My students aren't really going to use much of what they are learning in mathematics when they get out of school.	Strongly Disagree	Strongly Disagree
Ac. Time should be spent practicing mathematical procedures before students spend much time solving mathematical problems.	Strongly Agree	Neutral
Ad. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	Strongly Agree	Disagree
Ae. If the class is going to use manipulatives or a physical model to model a mathematical situation, I usually prefer first to show my students how to use the manipulatives or model.	Strongly Agree	Strongly Agree
Af. In a mathematics class, each student's solution process should be accepted and valued.	Neutral	Neutral
Ag. Students learn mathematics best from their teacher's demonstrations and explanations.	Neutral	Disagree

	Spring 2006	Fall 2006
Ah. Mathematics is a worthwhile, necessary subject for all students regardless of what their career goals may be.	Strongly Agree	Strongly Agree
Ai. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Strongly Agree	Strongly Agree
Aj. It is important for all students to be able to do basic mathematical computations.	Strongly Agree	Strongly Agree
Ak. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Neutral	Strongly Agree
Al. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	Disagree	Disagree
Am. It is important for students to figure out how to solve mathematics problems for themselves.	Neutral	Agree
An. Taking time to investigate why a solution to a math problem works is time well spent.	Strongly Agree	Agree
Ao. It doesn't really matter if a student understands a math problem as long as he or she can get the right answer.	Strongly Disagree	Disagree

	Spring 2006	Fall 2006
Ap. Teachers should demonstrate mathematical procedures and then have students practice those procedures.	Strongly Agree	Agree
Aq. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	Strongly Agree	Agree
Ar. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Neutral	Disagree
As. Getting a right answer in math is more important than understanding why the answer works.	Disagree	Disagree
At. Teachers should allow students to figure out their own ways of solving mathematics problems.	Agree	Agree
Au. Taking advanced mathematics is a waste of time for many students.	Strongly Disagree	Strongly Disagree
Av. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction.	Strongly Agree	Agree

Table 24

Ms. Walters' Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
B2a. Teachers should ensure as much as possible that students experience success in mathematics by clearly explaining and modeling how to complete each day's assignment, by closely monitoring students' work, and by continually providing feedback including, if necessary, supplementary detailed explanation of how to solve a problem.	Strongly Agree	Neutral
B2b. It is important for students to figure out how to solve mathematics problems for themselves.	Agree	Strongly Agree
B2c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	Disagree	Strongly Disagree
B2d. In a mathematics class, each student's solution process should be accepted and valued.	Agree	Strongly Agree
B2e. Students learn mathematics best from their teacher's demonstrations and explanations.	Disagree	Strongly Disagree
B2f. Students should have many informal experiences (such as solving word problems) with a mathematical concept before they are expected to master that concept.	Neutral	Disagree

	Spring 2006	Fall 2006
B2g. Students should confront a mathematical idea many times before they will understand it, so teachers must provide a variety of mathematics problems addressing that idea and challenge the students to figure out how to solve those problems.	Agree	Agree
B2h. No student should associate mathematics with frustration, so a teacher should limit the questions he or she asks of the student to those that the teacher is reasonably confident that the student can answer correctly.	Disagree	Disagree
B2i. When planning a mathematics lesson, I know that I will be able to provide mathematics activities that are relevant to students' lives.	Agree	Strongly Agree
B2j. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Neutral	Strongly Disagree
B2k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Agree	Strongly Agree
B2l. Teachers should model and demonstrate mathematical procedures and then, ideally, time should be allowed for the students to have the opportunity to practice those procedures.	Disagree	Strongly Disagree

	Spring 2006	Fall 2006
B2m. I don't feel that I need to recall all of the answers to all of the questions that my students have about mathematics because I know that I will be able to figure out a solution as my students and I work on a question.	Disagree	Neutral
B2n. Students achieve mathematical understanding through the direct personal experience of figuring out their own solutions to problems and then verifying their thinking for themselves.	Agree	Strongly Agree
B2o. When students are grouped for instruction on the basis of their past mathematical performance, each student may then receive the level of mathematics instruction that is most appropriate for that student.	Disagree	Disagree
B2p. Rather than demonstrating how to solve a problem, a teacher should allow students to figure out their own ways of solving mathematics problems and to explain their own ways of solving mathematics problems, including word problems.	Strongly Agree	Strongly Agree
B2q. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Disagree	Strongly Disagree
B2r. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction that encourages greater student-student and student-teacher interaction.	Agree	Strongly Agree

Table 25

Mrs. York's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
Aa. Students need to have good mathematics problem-solving skills to be successful in the future.	Strongly Agree	Strongly Agree
Ab. My students aren't really going to use much of what they are learning in mathematics when they get out of school.	Strongly Disagree	Strongly Disagree
Ac. Time should be spent practicing mathematical procedures before students spend much time solving mathematical problems.	Disagree	Disagree
Ad. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	Strongly Agree	Agree
Ae. If the class is going to use manipulatives or a physical model to model a mathematical situation, I usually prefer first to show my students how to use the manipulatives or model.	Neutral	Disagree
Af. In a mathematics class, each student's solution process should be accepted and valued.	Strongly Agree	Strongly Agree
Ag. Students learn mathematics best from their teacher's demonstrations and explanations.	Strongly Disagree	Neutral
Ah. Mathematics is a worthwhile, necessary subject for all students regardless of what their career goals may be.	Strongly Agree	Strongly Agree

	Spring 2006	Fall 2006
Ai. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Strongly Agree	Agree
Aj. It is important for all students to be able to do basic mathematical computations.	Strongly Agree	Strongly Agree
Ak. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Strongly Agree	Agree
Al. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	Disagree	Strongly Disagree
Am. It is important for students to figure out how to solve mathematics problems for themselves.	Agree	Strongly Agree
An. Taking time to investigate why a solution to a math problem works is time well spent.	Agree	Strongly Agree
Ao. It doesn't really matter if a student understands a math problem as long as he or she can get the right answer.	Strongly Disagree	Strongly Disagree
Ap. Teachers should demonstrate mathematical procedures and then have students practice those procedures.	Strongly Disagree	Neutral
Aq. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	Strongly Agree	Strongly Agree

	Spring 2006	Fall 2006
Ar. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Disagree	Strongly Disagree
As. Getting a right answer in math is more important than understanding why the answer works.	Strongly Disagree	Disagree
At. Teachers should allow students to figure out their own ways of solving mathematics problems.	Strongly Agree	Strongly Agree
Au. Taking advanced mathematics is a waste of time for many students.	Disagree	Strongly Disagree
Av. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction.	Strongly Agree	Strongly Agree

Table 26

Mrs. Windsor's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
B2a. Teachers should ensure as much as possible that students experience success in mathematics by clearly explaining and modeling how to complete each day's assignment, by closely monitoring students' work, and by continually providing feedback including, if necessary, supplementary detailed explanation of how to solve a problem.	Strongly Agree	Strongly Agree
B2b. It is important for students to figure out how to solve mathematics problems for themselves.	Strongly Agree	Strongly Agree
B2c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	Disagree	Strongly Disagree
B2d. In a mathematics class, each student's solution process should be accepted and valued.	Agree	Strongly Agree
B2e. Students learn mathematics best from their teacher's demonstrations and explanations.	Disagree	Disagree
B2f. Students should have many informal experiences (such as solving word problems) with a mathematical concept before they are expected to master that concept.	Agree	Strongly Agree

	Spring 2006	Fall 2006
B2g. Students should confront a mathematical idea many times before they will understand it, so teachers must provide a variety of mathematics problems addressing that idea and challenge the students to figure out how to solve those problems.	Agree	Agree
B2h. No student should associate mathematics with frustration, so a teacher should limit the questions he or she asks of the student to those that the teacher is reasonably confident that the student can answer correctly.	Agree	Disagree
B2i. When planning a mathematics lesson, I know that I will be able to provide mathematics activities that are relevant to students' lives.	Agree	Agree
B2j. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Strongly Agree	Strongly Agree
B2k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Strongly Agree	Agree
B2l. Teachers should model and demonstrate mathematical procedures and then, ideally, time should be allowed for the students to have the opportunity to practice those procedures.	Neutral	Disagree
B2m. I don't feel that I need to recall all of the answers to all of the questions that my students have about mathematics because I know that I will be able to figure out a solution as my students and I work on a question.	Disagree	Agree

	Spring 2006	Fall 2006
B2n. Students achieve mathematical understanding through the direct personal experience of figuring out their own solutions to problems and then verifying their thinking for themselves.	Strongly Agree	Strongly Agree
B2o. When students are grouped for instruction on the basis of their past mathematical performance, each student may then receive the level of mathematics instruction that is most appropriate for that student.	Agree	Agree
B2p. Rather than demonstrating how to solve a problem, a teacher should allow students to figure out their own ways of solving mathematics problems and to explain their own ways of solving mathematics problems, including word problems.	Strongly Agree	Strongly Agree
B2q. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Strongly Disagree	Strongly Disagree
B2r. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction that encourages greater student-student and student-teacher interaction.	Strongly Agree	Strongly Agree

Table 27

Mrs. Brown's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
Aa. Students need to have good mathematics problem-solving skills to be successful in the future.	Agree	Strongly Agree
Ab. My students aren't really going to use much of what they are learning in mathematics when they get out of school.	Strongly Disagree	Strongly Disagree
Ac. Time should be spent practicing mathematical procedures before students spend much time solving mathematical problems.	Disagree	Strongly Agree
Ad. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem.	Disagree	Disagree
Ae. If the class is going to use manipulatives or a physical model to model a mathematical situation, I usually prefer first to show my students how to use the manipulatives or model.	Agree	Neutral
Af. In a mathematics class, each student's solution process should be accepted and valued.	Agree	Agree
Ag. Students learn mathematics best from their teacher's demonstrations and explanations.	Disagree	Disagree
Ah. Mathematics is a worthwhile, necessary subject for all students regardless of what their career goals may be.	Agree	Strongly Agree

	Spring 2006	Fall 2006
Ai. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Agree	Strongly Agree
Aj. It is important for all students to be able to do basic mathematical computations.	Strongly Agree	Strongly Agree
Ak. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Strongly Agree	Agree
Al. It's not important to understand why a mathematical procedure works as long as it gives a correct answer.	Strongly Disagree	Strongly Disagree
Am. It is important for students to figure out how to solve mathematics problems for themselves.	Agree	Agree
An. Taking time to investigate why a solution to a math problem works is time well spent.	Strongly Agree	Strongly Agree
Ao. It doesn't really matter if a student understands a math problem as long as he or she can get the right answer.	Disagree	Strongly Disagree
Ap. Teachers should demonstrate mathematical procedures and then have students practice those procedures.	Agree	Disagree
Aq. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct.	Agree	Strongly Agree
Ar. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Disagree	Strongly Disagree

	Spring 2006	Fall 2006
As. Getting a right answer in math is more important than understanding why the answer works.	Disagree	Strongly Disagree
At. Teachers should allow students to figure out their own ways of solving mathematics problems.	Disagree	Agree
Au. Taking advanced mathematics is a waste of time for many students.	Agree	Neutral
Av. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction.	Agree	Strongly Agree

Table 28

Ms. Robinson's Spring 2006 and Fall 2006 Responses to Beliefs Survey

	Spring 2006	Fall 2006
B2a. Teachers should ensure as much as possible that students experience success in mathematics by clearly explaining and modeling how to complete each day's assignment, by closely monitoring students' work, and by continually providing feedback including, if necessary, supplementary detailed explanation of how to solve a problem.	Agree	Neutral
B2b. It is important for students to figure out how to solve mathematics problems for themselves.	Agree	Agree
B2c. Time should be spent practicing mathematical procedures before students spend much time solving mathematics problems.	Neutral	Agree
B2d. In a mathematics class, each student's solution process should be accepted and valued.	Strongly Agree	Agree
B2e. Students learn mathematics best from their teacher's demonstrations and explanations.	Disagree	Neutral
B2f. Students should have many informal experiences (such as solving word problems) with a mathematical concept before they are expected to master that concept.	Neutral	Agree
B2g. Students should confront a mathematical idea many times before they will understand it, so teachers must provide a variety of mathematics problems addressing that idea and challenge the students to figure out how to solve those problems.	Agree	Agree

	Spring 2006	Fall 2006
B2h. No student should associate mathematics with frustration, so a teacher should limit the questions he or she asks of the student to those that the teacher is reasonably confident that the student can answer correctly.	Disagree	Neutral
B2i. When planning a mathematics lesson, I know that I will be able to provide mathematics activities that are relevant to students' lives.	Agree	Agree
B2j. If a student is going to be a good problem solver, then it is important for that student to know how to follow directions.	Agree	Agree
B2k. Students should understand the meaning of a mathematical concept before they memorize the definitions and procedures associated with that concept.	Disagree	Agree
B2l. Teachers should model and demonstrate mathematical procedures and then, ideally, time should be allowed for the students to have the opportunity to practice those procedures.	Neutral	Agree
B2m. I don't feel that I need to recall all of the answers to all of the questions that my students have about mathematics because I know that I will be able to figure out a solution as my students and I work on a question.	Agree	Disagree
B2n. Students achieve mathematical understanding through the direct personal experience of figuring out their own solutions to problems and then verifying their thinking for themselves.	Agree	Neutral

	Spring 2006	Fall 2006
B2o. When students are grouped for instruction on the basis of their past mathematical performance, each student may then receive the level of mathematics instruction that is most appropriate for that student.	Disagree	Neutral
B2p. Rather than demonstrating how to solve a problem, a teacher should allow students to figure out their own ways of solving mathematics problems and to explain their own ways of solving mathematics problems, including word problems.	Neutral	Agree
B2q. Students will not understand a mathematical concept until they have memorized the definitions and procedures associated with that concept.	Neutral	Disagree
B2r. Teachers should incorporate students' diverse ideas and personal experiences into mathematics instruction that encourages greater student-student and student-teacher interaction.	Agree	Agree