

PRIMARY GRADES TEACHERS' TEACHER IDENTITIES
AND TEACHING PRACTICES IN UNITED STATES AND
JAPANESE MATHEMATICS CLASSROOMS

by

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A DISSERTATION

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ABSTRACT

The research supports the contentions that teachers' beliefs influence classroom practice and student achievement. Although research has been done to examine teachers' beliefs and classroom practice, limited research has investigated how one's culture and community affect teacher identity and mathematics classroom practice. The development over time of teachers' perceptions about mathematics and teacher identities has been overlooked in research that compares education in the United States and Japan. This study investigates how teachers' views on what effective teaching looks like and how their views, beliefs, and preferences (dispositions) influence the ways in which they teach mathematics, as well as their pedagogical content knowledge in the four primary classrooms in United States and Japan.

Because the process of understanding an individual's identity is complex, the language and actions the participants use within a certain context are examined to explore the socioculturally-situated identity being expressed in each case. The findings of this study may contribute to efforts that seek to understand how mathematics identity relates to how mathematics is taught.

DEDICATION

This dissertation is dedicated to everyone who helped me and guided me through the trials and tribulations of creating this manuscript. In particular, thanks to my family and friends who stood by me throughout the time taken to complete this masterpiece.

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CONTENTS

ABSTRACT	ii
DEDICATION	iii
ACKNOWLEDGMENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
1. INTRODUCTION	1
2. LITERATURE REVIEW	14
3. METHODOLOGY	47
4. THE RESEARCHER AS THE INSTRUMENT	58
5. REPRESENTATIONS OF THE STUDY	71
6. DISCUSSION	111
REFERENCES	124
APPENDIX A	130
APPENDIX B	132
APPENDIX C	138

LIST OF TABLES

1. Descriptions of Participants	51
2. Sequence of Data Collection.....	52

LIST OF FIGURES

1. Teacher Identity	43
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CHAPTER 1

Introduction

“Teachers must be at the heart of the solution. Not only are they the gatekeepers for all improvement efforts, they are also in the best position to acquire the knowledge that is needed. They are, after all, the only ones who can improve teaching” (Stigler & Hiebert, 1999, p. 174).

Increasing numbers of comparison studies on student academic performance in mathematics among different countries and the publication of such results have created an intense focus on the United States education system in the past two decades. The Third International Mathematics and Science (TIMSS) study revealed the poor achievement of U.S. students compared with that of other nations (Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). Criticism and concern from policymakers and the general public pressed for reform and the establishment of national standards and accountability from educators (Cuban, 1993; Schmidt, Houang & Cogan, 2002).

Partly as a response to the need for reform, the National Council of Teachers of Mathematics (NCTM) developed standards based on an extensive body of research on effective teaching and student learning in order to improve mathematics education in the United States (2000). Since their development, the NCTM standards have been used to develop curriculum. Standards-based classroom practice has been the focus of the reform movement and is reflected in curriculum development efforts. According to reform documents produced by NCTM (2000), problem solving, reasoning and proof, communication, connection, and representation are regarded as important mathematical skills students should understand in order to become

mathematically literate. These skills are considered as parts of everyday routines as one navigates through today's demanding world. Even though classroom teachers realize the importance of mathematics reform documents, there seems to be a gap between current mathematics teaching practice in the U.S. classrooms and mathematics knowledge and a vision of teaching in a reform based manner (Cuban, 1993; Good & Brophy, 2000; Nieto, 1999; Payne, 1996, Wright, Horn & Sanders, 1997; Stigler & Hiebert, 1999).

The development of the standards has greatly influenced the ways in which mathematics is taught in U.S. classrooms (Ma, 1999; NCTM, 2000; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). Studies indicate that the organization of mathematics lessons, classroom norms, and instructional practices have a great impact on students' mathematics achievement as well as on their attitude and orientation toward mathematics (Boaler, 2002; Cuban, 1993; Gutstein, 2003; Lubienski, 2000; Ma, 1999; Nathan & Knuth, 2003; Stigler & Hiebert, 1999).

Mathematics lessons and instructional practices are part of a broader issue that encompasses the learning environment that is created within the classroom by teachers and students. This classroom environment is considered to be one of the most important factors when building an effective learning community that supports students' learning (Gay, 2000; Good & Brophy, 2000; Gutstein, 2003; Lubienski, 2000; Stigler & Hiebert, 1999) and developing mathematics identity (Boaler, 1998; Lave & Wenger, 1991; Martin, 2003). Learning communities and teaching practices are profoundly influenced by teachers' professional identities as mathematics educators. In order to create an effective learning environment that promotes student mathematics learning, there is a need to identify teacher identities, specific teaching practices, and classroom environment that support student learning with regard to a specific culture. It is

important to understand how teachers come to choose the way in which they teach mathematics in relation to their educational and cultural backgrounds.

From the sociocultural perspective, mathematics identity refers to “the beliefs that individuals and groups develop about their mathematical abilities, their perceived self-efficacy in mathematical contexts (that is, their beliefs about their ability to perform effectively in mathematical contexts and to use mathematics to solve problems in the contexts that impact their lives), and their motivation to pursue mathematics knowledge” (Martin, 2003, p.16) and is situated within a group or community (Gee, 1999; Lave & Wenger, 1991). In a learning community, participants communicate and interact with each other and develop their own goals, objectives, and understanding of what they are learning about and how they are going to learn. Mathematics identities are culturally and socially situated. Boaler (2002) emphasizes that different classroom communities provide different learning environments, that have an effect on the ways in which students build their relationships with mathematics and form mathematics identities.

Another factor that this study does not cover is that cultural and social activities that are uniquely different in each community and society create the context for learning and contribute to the ways in which people perceive their reasons and purposes for learning (Boaler, 2002; Gee, 1999; Gutstein, 2003; Heath, 1983; Lave & Wenger, 1991; Lubienski, 2000; Nieto, 1999; Payne, 1996; Rogoff, 2003). In recent years, some researchers have come to recognize teachers’ beliefs and identities in mathematics classrooms as one of the important variables (Nathan & Knuth, 2003; Thompson, 1984) when creating an effective learning environment that supports the vision promoted by the standards. Rogoff (2003) asserts that one’s identity is associated with one’s participation and involvement in a particular community rather than with the traditional fixed

categories that consist of race, socioeconomic status, and ethnicity. Each community's distinctive identity contributes to shaping its community members' individual identities (Gee, 1999; Heath, 1983; Lave & Wenger, 1991; Nieto, 1999; Payne, 1996; Rogoff, 2003). Classrooms and schools are considered as a unit of the learning community (Sergiovanni, 2005). Students develop their mathematics identities through classroom participation in a learning community where they discuss, debate, confirm, and clarify their knowledge and understanding about mathematics with their peers and teachers. Teachers develop their professional identities as mathematics educators in the same manner. Teachers' professional identities as mathematics educators are shaped by their experiences as teachers and learners in a specific culture and society. Teachers' identities consist of their beliefs and dispositions toward mathematics and teaching. Previous research has investigated the impact of different teaching styles, learning styles, and student motivation along with other variables upon student learning and achievement. Little is known, however, about the relationship between primary grade teachers' professional identities as mathematics educators and their classroom practices.

Background to the Study

Mathematics achievement of primary grades students in the United States and Japan has been examined many times in recent years (Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). Teaching approaches, strategies, and curriculum were among the topics that researchers focused on during those studies in order to understand the possible reasons for achievement differences between these two countries. As a student who attended Japanese schools for 12 years from kindergarten to high school and US higher education afterward and later became a U.S. elementary school teacher, I started to wonder why there was a big mathematics achievement gap when comparing the U.S.A. and Japan. It is well documented that different teaching

strategies and methods produce different student achievement (Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). I could not think of any noticeable difference in how I learned mathematics in Japanese classrooms long ago and how I was teaching mathematics now in the U.S.A.

Previous studies have found that students gain deeper understanding of mathematics concepts when provided with learning opportunities in which they can explore, question, investigate, discuss, and articulate their understanding and knowledge (Good & Brophy, 2000; Gutstein, 2003; Lubienski, 2000; McClain & Cobb, 2001; Stigler & Hiebert, 1999; Yackel & Cobb, 1996). Meaningful learning takes place in a classroom where students are part of a learning community. Each learning community provides different learning opportunities and objectives for children, which enable them to develop their unique identity (Boaler, 2002; Gutstein, 2003; Heath, 1983; Lubienski, 2000; Nieto, 1999; Payne, 1996; Rogoff, 2003). Every classroom is different whether it is in the United States or Japan. Previous research has given more attention to students' achievement when comparing mathematics classrooms although a few investigations have evaluated the relationship between teachers' identities and classroom practices (Boaler, 2002; Thompson, 1984). Considering that teachers have a tremendous influence on how the learning community is built and operated, the relationship between teachers' views, beliefs, and preferences about mathematics and teaching becomes the focus of the current study.

As a teacher, I hear my third graders make comments such as "I'm not good at math," "I don't want to do this (mathematics problem) because I know I won't do it right," and "This is too hard for me (to solve)!" Even students who have good grades in mathematics make similar comments when I challenge them to go beyond the basic mathematics computational skills that

have been taught during mathematics lessons. My students seem to wait for instructions or hints on how to proceed or on what procedure to use when presented with a problem during mathematics lessons. Only a few students attempt to solve challenging problems with which they are not familiar with on their own. They repeatedly shrug their shoulders and mumble, “I don’t know,” when I ask them to explain their thoughts and logic during our whole group discussions. Students also say “I just knew it,” or “I guessed it,” or even “I think I made a mistake,” and look embarrassed when I ask them to explain their thought process. As I continue to encounter similar situations in my classroom year after year, I have begun to wonder if my teaching style is different from that of other teachers whom my students have had in the past. Those students truly look lost and confused when they are asked to explain and communicate their mathematics understanding and thinking as if I’m speaking to them in a foreign language. If I were teaching mathematics differently from their previous teachers, was it because of the way I was taught mathematics in Japan? Or did I learn to teach this way through my days in college? How does one learn to teach mathematics in a particular way anyway? Does a teacher’s identity have anything to do with how one teaches mathematics?

Even though many school districts mandate that teachers use a specific mathematics textbook or program for instruction, a competent teacher does not have to rely on them to drive classroom instruction (Cuban, 1993). When using a mathematics textbook, it is imperative for teachers to add and modify what to teach and how to teach skills and concepts based on students’ needs and abilities in a particular classroom. This knowing what teaching approaches to implement and how to represent the content so students learn best is what Shulman (1986) called pedagogical content knowledge (PCK). Planning and preparing mathematics lessons that include small groups and whole group discussions in order to encourage students to communicate,

collaborate, and problem solve on a daily basis ensures that students are exposed to the variety of learning opportunities suggested by the NCTM standards. So, why do some teachers teach this way and not others? A hypothesis can be constructed based on previous research (Boaler, 2002; Thompson, 1984) that classroom practice is based on the belief system of a particular teacher. Some teachers believe that students need to interact with others in order to clarify, modify, and confirm their understanding about mathematics whereas others do not (Ball, 1991; Boaler, 2002; Thompson, 1984). These findings suggest that the different educational, social, and cultural backgrounds of teachers are likely to yield different teacher identities. The term, teacher identity, differs from one's beliefs and beliefs about teaching in that it is culturally shaped over time and that it includes one's dispositions toward mathematics and teaching. Rogoff (2003) differentiates identity from "social address" which is based on race, ethnicity, and socioeconomic status and refers to it as one's cultural practice. When one takes a certain perspective on a specific issue or problem and such a perspective is developed through participating in particular cultural and social categories, one's identity is being created (Lave & Wenger, 1991). A study by Thompson (1984) advances the notion that teachers' beliefs, and preferences about mathematics and teaching are related to their classroom practices, but the study gives little attention to teachers' identities in relation to their educational and cultural backgrounds and their effect on classroom practices. The current study was developed to focus on mathematics teacher identity and its' effects on classroom practices. Figure 1 summarizes the ideas discussed in this section.

Statement of the Problem

Previous studies have focused on teacher behavior and classroom practice, but there is very limited information on teacher identities and classroom practice and the relationship between those two aspects. Hence, the problem of this study is to examine primary grade

teachers' identities, dispositions toward mathematics and teaching, and their effects on classroom teaching practices.

Purpose of the Study

Teachers' dispositions toward mathematics and teaching have been investigated as one variable for different learning environments (Ball, 1991; Boaler, 2002; Thompson, 1984). It is clear from the brief review of literature described above that the educational and cultural differences between Western and Asian societies are likely to result in differences in the teaching practices of classroom teachers and in teacher identities in these societies. The purpose of this study is to investigate whether some of those differences can be identified by comparing the teaching practices of four primary grade teachers whose educational experiences are culturally diverse. In this study I wish to explore teacher identities and teaching practices in United States and Japan.

Significance of the Problem

In order to become mathematically literate and to be able to function in today's society, students must be able to represent and interpret mathematical ideas and concepts. In this changing world, students will be challenged to keep current with new technologies, to think mathematically, and to problem solve on a daily basis. Much research has been conducted about the teaching strategies and teacher characteristics that promote student learning to prepare students for their future, but very few studies have focused on teacher identity and its effect on classroom practices in the primary grades. The need to investigate the teacher identities and classroom practices in the United States and Japan is important because (1) mathematics achievement of U.S. students continues to be a concern for educators and the general public; (2) the relationship between the classroom practices suggested by the standards and teacher

identities in primary grade classrooms has not been examined in those two countries; and (3) information on effective mathematics teaching practices continues to emerge at a rapid rate, creating the need for ongoing training of classroom teachers to support their development of mathematics pedagogical content knowledge.

The current study follows upon the research conducted by Thompson (1984) that established the relationship between middle school teachers' beliefs about mathematics and teaching and teaching practices, but it focuses on a closer inspection of teachers' educational, social, and cultural backgrounds in terms of mathematics and teaching. The case studies are embedded in Vygotsky's sociocultural perspective and Lave and Wenger's situated learning theory. Vygotsky's sociocultural perspective and Lave and Wenger's situated learning theory help to explain how social and cultural aspects interact with individuals' identities in a community. Lave and Wenger (1991) define learning as "increasing participation in communities of practice concerns the whole person acting in the world (p. 49)." There is a great need to investigate how teachers' views on what effective teaching look like and how their views, beliefs, and preferences (dispositions) influence the ways in which they teach mathematics, their pedagogical content knowledge. Moreover, the development over time of teachers' beliefs about mathematics and teacher identities has been overlooked in research that compares education in the United States and Japan. The findings of this study may contribute to efforts that seek to understand how mathematics identity relates to how mathematics is taught.

Research Questions

The following research questions guided this inquiry:

1. What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
2. What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
3. How can the relationships between the identities and mathematics teaching practices of four second grade teachers, two in the United States and two in Japan, be explained locally and globally?
 - a) What is the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community?
 - b) How can the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community be explained in terms of its relationship to the broader culture in which the mathematics classroom is situated?

Limitations of the Study

This research study has limitations. It was conducted with four primary grade teachers in two public elementary schools, one in the United States and one in Japan. The case studies of four primary grade teachers' classroom practices served as a hypothesis-generating study for future study. Given the nature of the study, participants might have offered to discuss only what they considered socially acceptable responses to oral and written interviews regarding their beliefs, views, and preferences regarding mathematics and teaching.

Two primary limitations occurred with the data collection in Japan. The first limitation was gaining access to the mathematics classrooms in Japan. Because Japanese teachers were

normally not familiar with having this type of research study conducted in their classrooms by an outsider, the researcher had to first access a “gatekeeper” who had an insider status within a cultural group and led the researcher to other insiders (Hammersley & Atkinson, 1995). In this study, the gatekeeper was a member of the school board who was willing to contact elementary schools in the school district in an effort to find a school for the research site in Japan.

The second limitation was the inability to audio-tape or video-tape mathematics lessons for accuracy and as an aid for stimulations to recall specific events and conversations during later interviews. Such recording was not used in the data collection process, because Japanese teachers did not want to be audio- or video-taped. For them, this was a process with which they were not familiar and so they were unwilling and uncomfortable with taping. For this reason, quotations in chapters four and five are partially paraphrased. Short quotations were written down and no paraphrasing was needed. For longer quotations, the teachers were asked to verify the notes used, and relatively few words were noted as missing from the statements, so they were partially paraphrased and shown as quotations.

Definition of Terms

The following definitions of terms apply in this study:

Community

Community is defined as a group of people “who have some common and continuing organization, values, understanding, history, and practices” (Rogoff, 2003, p.80).

Disposition

An inclination or tendency to act in a particular manner based on one’s belief system.

Identity

Identity is a set of characteristics that one recognizes as belonging uniquely to him/herself and constituting one's individual personality.

Elementary school

The United States elementary school in this study serves students in kindergarten through 4th grades. The Japanese elementary school in this study serves students in 1st through 6th grades.

Learning community

Learning community refers to a group of people held together by a common frame and goal (Sergiovanni, 2005).

Mathematical disposition

Mathematical disposition refers to the mathematical beliefs and values that individuals construct as they participate in the “renegotiation of sociomathematical norms (Yackel & Cobb, 1993)” in a classroom and become autonomous members of that community.

Mathematics identity

Mathematics identity refers to “the beliefs that individuals and groups develop about their mathematical abilities, their perceived self-efficacy in mathematical contexts (that is, their beliefs about their ability to perform effectively in mathematical contexts and to use mathematics to solve problems in the contexts that impact their lives), and their motivation to pursue mathematics knowledge” (Martin, 2003, p.16).

Mathematically literate

Mathematically literate refers to being able to understand and to use mathematics in everyday life and in the workplace (NCTM, 2000).

Mathematics achievement

Mathematics achievement is measured using a set of math problems created for this study.

Mathematics conceptual development

Mathematics conceptual development refers to students' ideas about math and how they place value on it and their math experiences.

Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) is the knowledge of what teaching approaches to implement and how to represent the content so students learn best.

Sociocultural perspective

An educational view that all human actions are situated in cultural, historical, and institutional settings (Wertsch, 1991).

Sociomathematical norms

Sociomathematical norms refers to the normative aspects of classroom practices and interactions that are accepted within a mathematics classroom (Yackel & Cobb, 1996).

Teacher identity

Teachers' beliefs, views, preferences, dispositions toward mathematics and teaching that are developed over time by participating in a particular social and cultural practices.

Teaching practices

Classroom procedures used to teach students, which include instructional objectives, pedagogical practices, conversations among students and teachers, teaching materials, and assessment to evaluate student learning. These practices are negotiated within the context of the classroom.

CHAPTER 2

Literature Review

Introduction

The purpose of this study was to advance understanding of teacher identity and mathematics teaching practices in the United States and Japan with specific consideration of with the relationship of both to the sociocultural backgrounds of the four teachers studied. This chapter describes literature relevant to the research purposes of this study. The following questions guided the research study:

1. What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
2. What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
3. How can the relationships between the identities and mathematics teaching practices of four second grade teachers, two in the United States and two in Japan, be explained locally and globally?
 - a) What is the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community?

- b) How can the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community be explained in terms of its relationship to the broader culture in which the mathematics classroom is situated?

The chapter is organized into four sections: (1) community and identity, (2) pedagogical contents related to mathematics and identity, (3) mathematics teaching practices in the United States and Japan, and (4) teacher identity in the mathematics classroom. At the end of each section, the relevance of the literature to the research questions in this study is discussed.

Review of the Literature

Community and Identity

Situated learning theory (Lave & Wenger, 1991) provided a theoretical framework for the study. From a sociocultural perspective, one's identity was considered to have a particular relevance to one's participation in, and relationship with, a society or a community to which an individual belonged (Lave & Wenger, 1991; Rogoff, 2003; Wertsch, 1991). An individual was thought to learn to communicate with other members of the community by using cultural tools such as signs and language. Community was defined, here, as a group of people "who had some common and continuing organization, values, understanding, history, and practices" (Rogoff, 2003, p.80). The idea that an individual formed his or her identity by participating in multiple communities has gained significant ground in a field of educational research in recent years. Following John Dewey's notion of community as the essence of learning, a classroom with students and at least one teacher was seen as a unit of a learning community (Nieto, 1999). There was a culture within each community that supported cognitive learning in a various ways.

Vygotsky (1986) emphasized the impact of the social environment on the individual's thought and concept formation. Concept was defined by Vygotsky as "an active part of the

intellectual process, constantly engaged in serving communication, understanding, and problem solving” (p. 98). He contended that this complex process involves all aspects of human functions. Studies have identified social and cultural activities that were uniquely different in each community, so researchers have concluded that society created the context for learning and contributed to the ways in which individuals perceived their reasons and purposes for learning (Boaler, 2002; Gutstein, 2003; Heath, 1983; Lave & Wenger, 1991; Lubienski, 2000; Nieto, 1999; Payne, 1996; Rogoff, 2003).

Heath (1983) investigated how children from different communities learned to use language. She found children were taught language, numeric systems, and speech patterns differently by adult members in their communities based on their traditional views of what children should know and how they should learn those skills. Children in different communities, for example, were found to have learned to behave accordingly by appropriating their actions and speech to suit their community’s expectations. The study revealed that working-class African American children in a community learned the acceptable speech pattern of their community by listening to adult members of their community, but not by interacting with them. In this community, children were expected to be the observers of their surroundings and they role-played what they had learned among community members. Whereas, children from a Caucasian community on the other side of town learned to speak and act much differently by observing behaviors that were similar to what happened in typical school settings such as reading, writing, and questioning in a particular manner in those surroundings. Children learned to speak and react to situations by being around adults and watching what was happening in their community. Each community’s distinctive identity contributed to shaping its community members’ individual identities (Heath, 1983; Lave & Wenger, 1991; Nieto, 1999; Payne, 1996;

Rogoff, 2003). Rogoff (2003) asserted that one's identity was associated with one's participation in, and involvement with, a particular community rather than with the traditional fixed categories that consist of race, socioeconomic status, and ethnicity. She stated,

Sociocultural theories have built on the realization that thinking is closely tied to particular situations...the connection between thinking and situations is not mechanical. Rather, individuals determine their approaches to particular situations with reference to cultural practices in which they have previously participated. The creative role of individuals in relating one situation to another is supported by social interaction in which social partners suggest connections. In addition, individuals and social groups build on connections made for them by previous generations, often mediated by cultural tools that they inherit. As people use cultural tools such as literacy and number systems to handle cognitive problems, in the process they often extend or modify the use of such tools for themselves and future generations. (p. 258)

An individual in a particular community at a particular time developed his or her identity through interacting with others in that community. Identities were not static but were generated when individuals learned to communicate a personal understanding of what it meant to be a member of a particular community (Lave & Wenger, 1991; Nasir, 2002; Rogoff, 2003; Wenger, 1998). Individual identities, thus, were situated within a cultural community as one participated in communities of practice and contributed to shaping and reshaping the practices of those communities (Lave & Wenger, 1991). Mathematics identities were developed in the same manner within a classroom community as students and teachers interacted with each other (Martin, 2003).

Lave and Wenger (1991) furthered the notion of situated learning through illustrations of various apprenticeships such as those experienced by Yucatec midwives, meat-cutters, and U.S. Navy quartermasters. They explained:

Learners inevitably participate in communities of practitioners and... the mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community. "Legitimate peripheral participation" provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artifacts, and communities of knowledge and practice. A person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice. This social process, indeed it subsumes, the learning of knowledgeable skills (1991, p.29).

One's identity was constructed through various experiences in a certain community and culture as an individual participated in learning, and negotiated, particular rules that were specific to each community and culture according to Gee (1999). Wenger (1998, p.163) characterized identity as follows:

Lived. Identity is not merely a category, a personality trait, a role, or a label; it is more fundamentally an experience that involves both participation and reification.

Negotiated. Identity is a becoming; the work of identity is ongoing and pervasive.

Social. Community membership gives the formation of identity a fundamentally social character.

A learning process. An identity is a trajectory in time that incorporates both past and future into the meaning of the present.

A nexus. An identity combines multiple forms of membership through a process of reconciliation across boundaries of practice.

A local-global interplay. An identity is neither narrowly local to activities nor abstractly global. Like practice, it is an interplay of both.

How students develop mathematics beliefs and values in second and third grade classrooms was examined by Yackel and Cobb (1996) who found that sociomathematical norms were not predetermined criteria introduced into a classroom from the outside. They were continually regenerated and modified by students and teachers through their ongoing interactions.

McClain and Cobb (2001) investigated the development of sociomathematical norms in a first grade classroom over four months and analyzed a teacher's proactive role in the development of the classroom culture. The study found that a teacher was simultaneously

supporting students' development both of what might be termed a mathematical disposition and of intellectual autonomy.

The effects that classroom environment and teacher characteristics had on students' perception on mathematics were explored by Frank and Carey (1997). They conducted interviews with 36 first graders in two elementary schools to investigate what it meant to engage in mathematics. Students in an inquiry based classroom where problem solving was valued as recommended by the national mathematics standards and where teachers were knowledgeable in students' mathematical knowledge and thinking processes, students' beliefs of what it meant to do mathematics were different from that of students in traditional classrooms.

Studies indicated that the culture of a classroom community created by students and teachers affected the ways in which students responded to mathematical tasks and their beliefs about what mathematics was all about (Ball, 1991; Boaler, 2002; Frank & Carey, 1997; Lampert, 1990; McClain & Cobb, 2001; Yackel & Cobb, 1996). The teachers' role in such classrooms was deemed critical as teachers must provide opportunities for their students to communicate respectfully and responsibly with others in their environment.

In a mathematical social setting, individuals had opportunities to observe others perform problem solving, analyze texts, and construct meaning through discussions and arguments. Going through this process developed the mathematical identity of students and of teachers (Martin, 2003). A study found that modeling alone was not sufficient in building such mathematics skills; students needed opportunities to discuss and debate with others to develop these skills (Resnick, 1988). This kind of social norm was created within a classroom by students and teachers as they interacted. Whereas social norms described classroom norms in any content area, norms for learning opportunities and experiences specific to mathematics constructed a

sociomathematical norm (McClain & Cobb, 2001; Yackel & Cobb, 1996). This kind of social setting provided scaffolding (Mason, 2000; Nathan & Knuth, 2003; Resnick, 1988) and created specific rules and routines that reflected acceptable behaviors for the classroom.

Vygotsky (1986) described learning as a process in which a child gradually took on characteristics of adult thought as a result of carrying out activities in many situations in which an adult constrained meaning and action possibilities. This developmental stage was what Vygotsky called the zone of proximal development (ZPD). The ZPD was described as a developmental stage in which children participated in activities that they were not able to complete on their own. With the assistance of capable others, children became increasingly capable of completing tasks independently. This learning process was what Wood, Bruner, and Ross (1976) called scaffolding. Scaffolding was described as a “process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts” (p. 90) and viewed as an important instructional strategy. Mason (2000) defined the framework of scaffolding as directed, prompted, and spontaneous. While teachers often planned scaffolding, others saw it as spontaneous. The scaffolding process was completed when the child took over what the capable other did in the ZPD. Individual students’ ZPD must be considered when teachers plan scaffolding (Rodgers & Rodgers, 2004). Through engaging with others in a classroom, students became able to construct their own understanding of what it meant to do mathematics. They learned how to use cultural tools available for them within a classroom community. The beliefs, views, and values those students developed toward mathematics while participating in a classroom community constituted a foundation for their mathematics identity (Martin, 2003).

The interactions and conversations within a classroom community as students and teachers engaged in mathematics lessons became a unit of analysis for researchers in their quest to examine the dynamic interplay among mathematics identity and context (Ball, 1991; Boaler, 2002). A study of questioning styles used by teachers indicated that varying the types of questions used in the classroom could provoke students to make sense of mathematics and construct meanings that facilitated scaffolding (Mason, 2000). Resnick (1988) defined socialization as “the long-term process by which personal habits and traits were shaped through participation in social interactions with particular demand and reward characteristics” (p. 14) and Martin (2003) defined mathematics socialization as “the experiences that individuals and groups had within a variety of mathematical contexts, including school and the workplace, and that legitimized or inhibited meaningful participation in mathematics,” and mathematics identity as “the beliefs that individuals and groups developed about their mathematical abilities, their perceived self-efficacy in mathematical contexts (that was, their beliefs about their ability to perform effectively in mathematical contexts and to use mathematics to solve problems in the contexts that impacted their lives), and their motivation to pursue mathematics knowledge” (p. 16). Martin recognized that mathematics socialization and the development of mathematics identity were embedded within the contexts in which individuals and groups were members and closely correlated to interactions with others and environment. The adult’s role in reciprocal teaching sessions was to facilitate the general process, model problem-solving processes, and provide careful reinforcement in order to support children’s learning. Engaging in such learning experiences, students found that they were capable of solving problems and constructing own meanings about mathematics. When a teacher used well thought out questions to elicit students’ mathematical thought and ideas, students were likely to participate in discussions and debate

with their peers and develop their own mathematical concepts (Ball, 1991; Boaler, 2002; Lampert, 1990; Mason, 2000; McClain & Cobb, 2001; Yackel & Cobb, 1996).

Studies found that positive interactions and relationships within the school culture were one of the most important factors related to student learning (Nieto, 1999; Payne, 1996). Hiebert et al. (1997) emphasized the importance of creating a community where “assumptions about what things mean must be agreed on, assertions or conjectures are made, methods of solutions are proposed and defended, challenges are usually offered, and discussions are held about the soundness and accuracy of solutions” (p. 44). This kind of experience provided students with opportunities to learn what mathematics was all about (Ball, 1990; Boaler 2002; Gutstein, 2003; Lampert, 1990; Martin, 2003; Stigler & Hiebert, 1999). Because one’s identity was shaped and reshaped by participating in a community, students and teachers’ identities as learners and teachers were closely related to how they learned mathematics. Through interactions and engagements in a mathematics classroom, students and teachers developed their mathematics identity. If the mathematical identity that each individual developed differed because of the community to which the person belonged, the contents of classroom communities and the teaching practices that might contribute to such differences warranted a closer investigation.

Students experienced different mathematics instructions depending on the classroom in which they participated, and they formed different beliefs, values, and views toward mathematics (Ball, 1991; Boaler, 2002). These beliefs, values, and views toward mathematics became the foundation for one’s mathematics identity (Martin, 2003). Thus, it was reasonable to assume that teachers with different educational backgrounds in different communities held different beliefs, values, and views toward mathematics based on their own experiences as a student and as a teacher because they participated in mathematics classroom communities that were situated in a

particular society and culture. Pedagogical contents that related to mathematics influenced how mathematics was taught within a classroom and ultimately influenced community members' identities as they perceived who they were and how they viewed themselves as mathematics doers (Ball, 1991; Boaler 2002; Gutestein, 2003; Lampert, 1990; Martin, 2003; Stigler & Hiebert, 1999). The issues regarding pedagogical contents related to mathematics are discussed in the next section.

Pedagogical Contents Related to Mathematics

The issues regarding what should be taught in school mathematics, how it should be taught, and to whom it should be taught became a major national concern in the United States during the 1950s. With the launching of Sputnik in 1957, policymakers and the general public demanded a more rigorous mathematics curriculum to educate U.S. children (Cuban, 1993; National Research Council, 2001). Enormous pressure was placed on educators and policy makers resulting in a variety of reform movements such as the “new” math of 1960s and the “back-to-basics” mathematics of the 1970s. The needs of a changing society and the improvement of technology pressed for a development of frameworks and guidelines for school mathematics to help all U.S. students become successful in school and in life. A national effort to increase mathematics achievement resulted in rethinking the way in which mathematics had been taught in U.S. classrooms. Historically, an opportunity to acquire mathematics knowledge had been reserved for those who had power to make important decisions in one's society (Stinson, 2004). This practice kept the class structure in a society for a long time by excluding particular classes of people from participating in decision-making processes. With the advancement of technology, scholars started to recognize the need for educating all students to become mathematically literate.

The National Council Teachers of Mathematics (NCTM) published *An Agenda for Action* (1980), in which a 10-year reform process for school mathematics was introduced. Followed by the *Curriculum and Evaluation Standards for School Mathematics* (1989), the *Professional Standards for Teaching Mathematics* (1991), the *Assessment Standards for School Mathematics* (1995), and *Principles and Standards for School Mathematics* (2000), the NCTM continued to address issues regarding mathematics education and help educators in this capacity. The NCTM developed the conceptual framework for standards identifying what students need to learn and how to teach students those standards. The goals of school mathematics identified in the standards included the following: (a) mathematically literate citizens, (b) life long learning, and (c) mathematics for all. In order to address equity, the *Curriculum and Evaluation Standards for School Mathematics* (1989) made the following statement:

The social injustices of past schooling practices can no longer be tolerated. Current statistics indicate that those who study advanced mathematics are most often white males. Women and most minorities study less mathematics and are seriously underrepresented in careers using science and technology. Creating a just society in which women and various ethnic groups enjoy equal opportunities and equitable treatment is no longer an issue. Mathematics has become a critical filter for employment and full participation in our society. We cannot afford to have the majority of our population mathematically illiterate: Equity has become an economic necessity. (p. 4)

Even though equity remained an issue when school mathematics and changing classroom practice were mentioned, the establishment of the standards influenced the way in which mathematics is taught in the United States. It was important to note the space the NCTM standards created for a conversation among stakeholders.

One argument critics often raised against the NCTM standards was that marginalized students were disadvantaged because of their social and cultural backgrounds that kept them from fully appreciating and benefiting from standards based instructions (Lubienski, 2000; Martin, 2003; Stinson, 2004). Martin (2003) called attention to events that had a significant

impact on the mathematics reform movement in the past two decades and addressed issues regarding equity in school mathematics education. He described the publication of *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) and the international comparison study by the Third International Mathematics and Science Studies (TIMSS) along with other literature as the beginning of a new era that placed a significant emphasis on educating all students. Critics raised questions regarding the intentions of the standards and the effects of standards-based curriculum on marginalized students (Lubienski, 2000; Martin, 2003; Secada, 1996; Stinson, 2004). Even though the *Curriculum and Evaluation Standards* (NCTM, 1989) addressed the need to educate all students and made an explicit statement regarding the importance of creating a just society where equal learning opportunities were provided for women and different ethnic groups, the updated *Principles and Standards for School Mathematics* (NCTM, 2000) did not elaborate on this issue. A misalignment between the teaching approaches used by mathematics educators and the real life experiences marginalized students brought to the classrooms seemed to create a gap between research and practice. By incorporating social justice issues into mathematics lessons, teachers could empower students and change their orientation toward mathematics. Several researchers took the position that mathematics was a gatekeeper to academic and life opportunities for students (Lubienski, 2000; Martin, 2003; Secada, 1996; Stinson, 2004).

The NCTM standards, on the other hand, articulated a vision for a direction that mathematics education in the U.S.A. needed to take, and provided much needed support for educators. The standards set guidelines to unify school mathematics by describing what needed to be taught, when, and why (Martin, 2003; NRC, 2001; Stinson, 2004). A vision for ideal classroom practice illustrated in the standards included the use of communication. A number of

studies showed that communication between students and teacher in mathematics classrooms lead to a deeper understanding of concepts (Boaler, 2002; Davis & Krajcik, 2005; Gutstein, 2003; Lampert, 1990; Mason, 2000; McClain & Cobb, 2001; Nathan & Knuth, 2003; Resnick, 1988; Stigler & Hiebert, 1999; Yackel & Cobb, 1996; Yang & Cobb, 1995).

Davis and Krajcik (2005) videotaped mathematics lessons from two Japanese fifth-grade and two U.S. fifth grade classrooms and analyzed them in order to characterize classroom discourse, which was the talk among teachers and students in a classroom. The mathematics lessons videotaped covered the area of triangles. The study examined the data from a qualitative viewpoint by listening to videotaped lessons and from a quantitative viewpoint by analyzing the content and the context of the talk that happened in the classrooms and by comparing the data between the two cultures. The results of the study confirmed the authors' assumption that Japanese teachers valued students thinking and problem solving process in planning and implementing mathematics lessons. For example, a typical Japanese mathematics lesson in the study consisted of a teacher posing a problem, students attempting to solve the problem on their own for an extended period of time, students discussing and debating their solutions to a problem as a whole, and students coming to an agreed answer for a specific problem. In U.S. classrooms, teachers acted as authorities who provided needed mathematical information. Students in the U.S. A. did not have opportunities to express their thoughts and understandings and to construct their knowledge as did Japanese students. On one occasion, a U.S. teacher dismissed students' comments when they were trying to find out the area of a triangle by placing smaller squares inside of it even though students were coming up with their own solutions. Instead of building onto students' mathematical thought and knowledge, the teacher demonstrated the "right way" to solve the problem. Japanese students were challenged to construct their own understanding of

mathematics whereas U.S. teachers tended to supply the formula for students to use in order to solve problems. Mathematics lessons in Japanese classrooms used two-way communication, but the U.S. classrooms had only one-way communication. The researchers asserted that Japanese teachers were better prepared to teach mathematics and Japanese students were well prepared with knowledge in order to function in such open-ended lessons. Japanese teachers also had resources that helped them understand student thinking in mathematical topics thus equipping them with knowledge to help all students. By approaching mathematics teaching differently, teachers created their own classroom discourse.

Resnick (1988) examined 12 pairs of children, three pairs each from grades 4, 5, 6, and 7. Each pair of children spent 40 minutes in solving two to six problems in the course of three meetings to explore how “specific aspects of scaffolding problem-solving practice, together with discussion and argument, may shape the dispositions and skills of problem solving” (p. 24). In this study, some children used a “Planning Board” to record what was known and what knowledge was needed in order to solve the problem while others didn’t. The board was used not just as a recording device but as a prompt to support children in identifying goals and subgoals during their problem solving process. The study found that children were not good at generating goals in general, but the use of the Planning Board helped children to generate goals. The study concluded that the use of record keeping tools such as the Planning Board and other similar tools supported the scaffolding process. An interesting finding of the study was that the use of debates and elaborations during the problem solving process seemed to facilitate peer scaffolding, but children rarely used these modes while working on the problems. The study contended that encouraging and facilitating the use of mathematical talk and providing opportunities to develop vocabularies to express children’s mathematical knowledge and ideas within the classroom was

imperative in supporting scaffolding. Given the appropriate support and tools, children could often perform beyond their capacity. Resnick (1988) presented a strong argument that teachers needed to encourage socialization within their classrooms in order to facilitate problem-solving skills.

The students who learned mathematics in a traditional way by practicing skills repeatedly and memorizing rules and procedures had difficulty articulating and explaining their knowledge and understanding about what it meant to do mathematics (Boaler, 2002; Gutstein, 2003; Lampert, 1990; Mason, 2000; McClain & Cobb, 2001; Nathan & Knuth, 2003; Resnick, 1988; Stigler & Hiebert, 1999; Yackel & Cobb, 1996; Yang & Cobb, 1995). But, the students who experienced mathematics in an environment where communication was encouraged developed a positive orientation toward mathematics (Boaler, 2002; Gutstein, 2003; Lampert, 1990).

In light of the reform movement, there was a growing body of evidence that showed teachers were the agents for improving teaching and learning. Lampert (1990) reflected this view when she attempted to change the way in which students learn mathematics by creating a classroom in which students were expected to share their mathematics understanding and question their thoughts along with others in order to develop their own meaning about what it meant to do mathematics. Students, for example, were asked to write their solutions for a problem on the board, articulate their reasoning, and discuss and question their thinking and the thinking of others in a constructive way. This kind of learning allowed students to know and learn to use mathematics in an authentic way. The following described Lampert's view:

...changing students' ideas about what it means to know and do mathematics was in part a matter of creating a social situation that worked according to rules different from those that ordinarily pertain in classrooms, and in part respectfully challenging their assumptions about what knowing mathematics entails. Like teaching someone to dance, it required some telling, some showing, and some doing it with them along with regular rehearsals. (p. 58)

Ball (1991) described a mathematics discussion in her third grade classroom and her mental discourse as a teacher to illustrate how she conducted productive exchanges between students and a teacher to promote student learning. She emphasized the importance of creating a safe learning environment where students could exchange their thoughts and ideas with their peers and teachers. The NCTM standards were used as a tool to create such conversations among individuals in this classroom.

In his study of seventh and eighth grade classrooms, Gutstein (2003) described how a middle school mathematics teacher utilized an NCTM standards-based curriculum and real-life projects to promote critical thinking skills and sociopolitical consciousness. He investigated student change in orientation toward mathematics along with the development of sociopolitical consciousness, awareness of social justice, and the development of a social and cultural identity. The study found that the use of mathematics projects that students could relate to, and a program called *Mathematics in Context* (MiC) which had a similar philosophy to that of the NCTM standards, encouraged students to develop as mathematics learners who were able to find multiple solutions and articulate their understanding of mathematics and other real-life problems related to social justice. Students, for example, were asked to investigate housing prices in their community and to justify their reasoning for the different prices found in the area. This project led middle school students to question why some parts of their community only housed certain groups of people. Another project had students simulate “the distribution of world wealth by continents” (p. 49). The projects used in this classroom allowed students to “read the world” and led them to understand inequality in their urban Latino community. The students who participated in this mathematics classroom for two years demonstrated that they gained power to use mathematics as tools with which to question and solve problems that affect them. They also

created a learning community in which everyone shared their thoughts and understanding. Gutstein (2003) asserted that the development of such communities promoted successful student learning. The discussions among students and teacher in the classroom contributed to deeper understanding and meaningful learning (Boaler, 2002; Fernandez & Cannon, 2005; Gutstein, 2003).

Boaler (2002) examined how different teaching approaches affected the way in which students understood and applied the mathematics taught in school in different situations. The researcher spent three years in two schools in England using a grounded theory approach for the study. Observation, interviews, and questionnaires were used to collect data from Year 8, 9, and 10 students. The study found that students who were taught mathematics in standards-based classrooms performed better on examinations than those who learned to do mathematics in traditional classrooms. According to Boaler, students in standards-based classrooms were able to apply their mathematics knowledge in order to solve problems in new and different situations by using different strategies, whereas students in traditional classrooms demonstrated difficulty in making those adjustments if the situations looked different from what they had seen in their classroom lessons. The students in the traditional classroom used textbooks and followed mathematical procedures demonstrated by their teachers to solve problems. Their view of mathematics lessons was that school mathematics did not apply to real life situations. They regarded school mathematics only as a set of rules and procedures that they needed to memorize in order to solve problems. Without explicit instruction, these students were at a loss. A standards-based classroom in the study utilized an open-ended project approach to teaching. Students worked on different projects that allowed each student to decide what and how he or she was going to learn. One of the projects, for example, asked students to come up with

different shapes that could be created by 36 pieces of fencing. This kind of open project provided multiple learning opportunities for all students at different levels. Some students might start the project by learning names and definitions of different shapes while others worked on finding areas. The results of the study indicated that open-ended projects offer many teaching opportunities to address important mathematics concepts from the Standards during the process of problem solving. The study suggested students learned and enjoyed mathematics more when they were taught in real-life situations and were guided to make connections between different mathematics concepts. These students found school mathematics was a way of thinking. For them, mathematics was a tool that they could use to solve problems (Boaler, 2002; Gutstein, 2003). Sociomathematical norms in the sample classroom provided support for students as they developed a positive disposition toward mathematics. Such a disposition included one's views, values, and beliefs. It had a great influence on one's identity as a mathematician. The implication was that identity was influenced by one's social and cultural participation.

The sociocultural aspects of mathematics in Taiwan and in the United States of America were investigated by Yang and Cobb (1995). Their study found that Chinese students were better at articulating their mathematics understanding than were U.S. students. The difference in student performance between these two countries suggested the relationship between the social and cultural contexts in which those children learned to use mathematics. Chinese mothers and teachers engaged children in a number activities in which they taught them to think of a number in terms of groups of tens and ones from early on. Mothers and teachers in the U.S.A. tended to delay in teaching children such concepts until later because of their belief that children were not ready to learn them. The mathematics activities those children engaged in differed greatly because of the social and cultural contexts in which they lived according to the findings of Yang

and Cobb. The study indicated that the amount of mathematical discussions Chinese children experienced in their classroom encouraged them to think mathematically and become confident mathematics learners. Comparison studies in recent years generated an intense interest in the ways in which mathematics is taught in the U.S.A. and in Asian countries. Evidence provided by research studies has supported the importance of social and cultural aspects to mathematics teaching and learning.

The recurrent theme in the literature was that teachers needed to understand mathematics content deeply and flexibly in order to help students develop meaningful cognitive maps that supported their learning. Teachers also needed to understand and know how to present ideas and information to students so that they could see the connections between different ideas across the subjects. Shulman (1987) introduced the term pedagogical content knowledge (PCK) to describe this particular knowledge that effective teachers must possess. He (1987) defined PCK as “that special amalgam of content and pedagogy that was uniquely the province of teachers, their own special form of professional understanding (p. 8).” Teachers developed PCK through their experiences by learning to balance the issues of pedagogical content and general teaching pedagogy. By participating in communities of practice through learning experiences, teachers developed mathematics identity as teachers and learners (Lave & Wenger, 1991; Wenger, 1998).

Mathematics Teaching Practices in the U.S.A. and in Japan and Mathematics Identity

The Third International Mathematics and Science Study (TIMSS) conducted an extensive comparison study of mathematics achievement of students in forty-one nations. The study revealed that U.S. students’ mathematics scores did not fare well against those of other nations (Stigler & Hiebert, 1999). The study suggested that teaching practice in U.S. mathematics classrooms contributed to the poor achievement of U.S. students. Previous studies (Ma, 1999;

Stevenson & Stigler, 1992; Stigler & Hiebert, 1999) strongly suggested the need to reexamine teaching practice in U.S. mathematics classrooms. In an effort to improve mathematics education in the United States, the National Council Teachers of Mathematics (NCTM) developed standards based on extensive research on effective teaching and student learning, which greatly influenced the way mathematics was taught (NCTM, 2000; Stigler & Hiebert, 1999).

Stigler and Hiebert (1999) examined videotapes collected for the TIMSS Study and discovered that the cultural differences found on those tapes provided different perspectives on how mathematics was taught in the United States, Japan, and Germany and how these differences contributed in the level of student achievement in each country. Their study described how U.S. teachers taught mathematics and how their teaching differed from that of other countries by observing videotaped lessons and studying questionnaire responses from 231 teachers. The results suggested that typical U.S. mathematics lessons provided more practice on skills already taught and fewer challenges than Japanese and Germany lessons. Stigler and Hiebert (1999) used the following descriptions for each country's mathematics teaching styles: "developing advanced procedures" for Germany, "structured problem solving" for Japan and "learning terms and practicing procedures" for the United States. While Japanese and German mathematics lessons' content was at the high eighth- and beginning ninth-grade level, U.S. mathematics lessons were at a mid-seventh-grade level. The study indicated that Japanese mathematics lessons often placed more responsibility on students to come up with different solutions and develop their own understanding about how mathematics works. The researchers revealed that more than half of U.S. teachers in the study emphasized the importance of teaching skills for their students, whereas most Japanese teachers stressed the importance of developing new ways to solve problems and making connections between mathematical ideas. These

differences in teachers' beliefs were apparent in their teaching practice. Teachers in the U.S.A. always started the lesson by demonstrating how to solve a problem whereas Japanese teachers challenged students to solve a problem and share their ideas with the class. Japanese teachers recognized a range of ideas shared during the class as "a resource for both students and teachers (p.94)" thus providing opportunities for all students to learn some things from the same instructional material.

The use of the NCTM standards to develop curriculum and standards-based classroom practice has been the focus of the reform movement in mathematics education. Studies indicated that classroom practice had a great impact on students' mathematics achievement and their orientation toward mathematics (Cuban, 1993; Gutstein, 2003; Lubienski, 2000; Nathan & Knuth, 2003; Stigler & Hiebert, 1999). But, there seemed to be a gap between the research findings and teaching practice in real classrooms. If changes were to be made in mathematics classrooms to improve student learning, it was necessary to include teachers in this process. Classroom teachers often were not included in the educational decision making process that might greatly impact the way in which they taught. They were pressured by policy makers, administrators, and the general public to raise student achievement, but they usually received minimal support from those who placed this tremendous responsibility on them (Cuban, 1993; Nieto, 1999; Stigler & Hiebert, 1999). International comparison studies (Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999) revealed aspects of concern in regard to U.S. mathematics education.

The mathematics curriculum in Japan, for example, was based on the national curriculum developed by Monbusho, the Japanese Ministry of Education (United States Office of Educational Research and Improvement, 1998). The guidelines set by Monbusho specified the

content along with the number of hours that had to be devoted to teach each subject. Monbusho not only provided frameworks for all schools to follow, it also oversaw the training of teachers and certified all the textbooks used in schools to ensure the quality of teaching materials and resources. Many elementary schools created their own standards that correlated with the national curriculum to suit their needs. Unlike the Japanese government, the U.S. government did not develop national standards to unify what was taught in schools across the country (United States Office of Educational Research and Improvement, 2002). The professional societies such as the National Council Teachers of Mathematics (NCTM) and groups such as the National Research Council published standards to serve as guidelines to improve education practices and many states developed various standards to help schools to improve student achievement.

The outline of mathematics curricula taught in Japanese primary grades was very similar to that of the U.S. primary grades, consisting of basic concepts, such as number and operation, measurement, geometry, and data analysis and probability. In second grade, both Japanese and some U.S. mathematics curricula focused on developing number sense to 1000, the use of graphing, analyzing data from information collected in their environment, the use of addition and subtraction, interpreting multiplication as a different representation of addition and division, and the use of mathematics vocabulary (Alabama Course of Study, 1997; California Content Standards, 1997; Ministry of Education, Culture, Sports, Science and Technology, 1998; Texas Essential Knowledge and Skills, 1998). Curricula in both nations emphasized the importance of developing mathematics interest and understanding by connecting mathematics concepts and skills with objects and events familiar to students. Students were more likely to master mathematical concepts and skills when they made personal connections between what was being taught and their prior knowledge (Ball, 1991; Boaler, 2002; Lampert, 1990; NCTM, 2000).

Student learning was maximized when students were engaged in a meaningful mathematics learning context that related to their real needs and concerns and this helped them become independent and confident learners (Ball, 1991; Boaler, 2002; Lampert, 1990; McClain & Cobb, 2001; Yackel & Cobb, 1996). Both curricula recognized the connection between school mathematics and real-life situations as the main component of a developmentally appropriate mathematics program.

Even though the NCTM Standards attempted to establish unified standards across the nation, a lack of national standards created a competitive market for textbook publishing companies in the United States and turned into a political agenda in many states (NRC, 2001). Because each state had the authority to develop its' own mathematics standards and decide what students needed to know and when, there was a discrepancy among states' standards. In order to make textbooks marketable across the nation, textbook companies included a significant amount of topics to cover all the concepts and skills taught in different states. These textbooks were often viewed as the "official curriculum" in many schools and teachers tended to cover all content in a textbook (Schmidt, 1996). The massive amount of mathematics topics covered in U.S. classrooms was considered to be one of the factors responsible for American students' poor achievement (Stigler & Hiebert, 1999; Yoshida, Fernandez, & Stigler, 1993). Studies indicated the use of well-coordinated curriculum with selected mathematics concepts and skills resulted in higher student achievement (Stigler & Hiebert, 1999; Yoshida, Fernandez & Stigler, 1993). The unified standards proposed by NCTM could help this situation by limiting the number of mathematics concepts and skills taught in each grade level and make learning more challenging for students by strengthening their understanding and extending their knowledge (NRC, 2001; Yoshida, Fernandez, & Stigler, 1993).

Students in both Japan and the U.S.A. were encouraged to manipulate numbers in a variety of situations to build their understanding and meaning about numbers using concrete objects. Both curricula addressed the use of multiple representations of numbers up to 1000 and the use of everyday objects found in a classroom to measure familiar objects (Alabama Course of Study, 1997; California Content Standards, 1997; Ministry of Education, Culture, Sports, Science and Technology, 1998; Texas Essential Knowledge and Skills, 1998). Research studies agreed that children learned best by exploring and investigating their surroundings and interacting with others in a supportive environment where they were not afraid of taking risks (Ball, 1991; Boaler, 2002; Lampert, 1990; McClain & Cobb, 2001). Young students were curious about their surroundings, thus introducing the tools to explore and investigate their environment provided authentic learning opportunities for students. The second grade curriculum in some states in the United States also included recognition and creation of patterns and recognition of money and determination of monetary value, which were not a part of Japanese second grade curriculum (Alabama Course of Study, 1997; California Content Standards, 1997; Ministry of Education, Culture, Sports, Science and Technology, 1998; Texas Essential Knowledge and Skills, 1998). This confirmed the prior findings that U.S. curriculum included more topics and skills than that of other countries (NRC, 2001; Perry, 2000; Schmidt, 1996).

In Japanese classrooms, students were encouraged to explain their thoughts and opinions about mathematics and come up with multiple solutions for a problem (Perry, 2000; Stigler & Hiebert, 1999). During a typical mathematics lesson, a Japanese teacher posed a problem at the beginning of the class period and students tried to come up with their own solutions either individually or with their peers. Then, students were asked to share their solutions and explain their rationale for choosing a particular approach to solve a problem. By explaining and debating

with others in the classroom, students developed a deeper understanding of mathematical concepts, constructed their own meaning, and learned what it meant to do mathematics (Ball, 1990; Boaler, 2002; Gutstein, 2003; Lampert, 1990; Resnick, 1988; Stigler & Hiebert, 1999). Students in such classrooms developed their mathematics identity as confident problem solvers, which was one of the important goals suggested by the NCTM Standards (2000).

Stigler, Fernandez, and Yoshida's (1996) study found that Japanese teachers valued students' thinking and problem solving process in planning and implementing mathematics lessons. A typical Japanese mathematics lesson in the study consisted of a teacher posing a problem, and students attempting to solve the problem on their own for an extended period of time, discussing and debating their solutions to a problem as a whole, and coming to an agreed answer for a specific problem. In U.S. classrooms, teachers acted as authorities who provided needed mathematical information. Students in the U.S.A. did not have opportunities to express their thought and understanding and to construct their knowledge as did Japanese students. Instead of building onto students' mathematical thoughts and knowledge, the teacher demonstrated the "right way" to solve the problem. Japanese students were challenged to construct their own understanding of mathematics whereas U.S. teachers tended to supply the formula for students to use in order to solve problems (Perry, 2000; Stigler & Hiebert, 1999; Yoshida, Fernandez, & Stigler, 1993).

Another factor that might contribute to the way in which Japanese teachers teach was the number of mathematics topics taught in a year. The Japanese mathematics curriculum contained fewer topics than did the U.S. curriculum (NRC, 2001; Perry, 2000; Schmidt, 1996). Japanese teachers spent more time teaching the most critical mathematics concepts and skills to their students, whereas U.S. teachers spent less. Teachers in the U.S.A. were under enormous pressure

to cover all of the content in their standards and textbooks. The fast-paced lessons in U.S. classrooms could be one of the reasons for poor achievement among U.S. students. Yoshida, Fernandez, and Stigler (1993) contended that U.S. students had difficulty in distinguishing teachers' statements that were relevant to mathematics from those that were not. The reason for such confusion might be a result of the mathematics curricula used in U.S. classrooms.

According to studies, U.S. mathematics curricula included many more topics to be taught in a particular grade level than did those of other countries, resulting in fast paced lessons that covered more than one concept at a time (Yoshida, Fernandez, & Stigler, 1993). Teachers in the U.S.A. switched from one mathematics concept to another during the same lesson without explaining the connection between those concepts to students in order to cover all the content specified in their curriculum, thus U.S. students often did not recognize the relationship between the mathematics concepts they learned.

According to the Standards produced by NCTM (2000), problem solving, reasoning and proof, communication, connection, and representation were regarded as important mathematical skills students need to master in order to become mathematically literate. Even though U.S. classroom teachers recognized the importance of the standards, there seemed to be a gap between current practice in classrooms and teachers' knowledge and ability to teach standards-based curriculum (Cuban, 1993; Good & Brophy, 2000; Nieto, 1999; Payne, 1996, Wright, Horn, & Sanders, 1997; Stigler & Hiebert, 1999). The teachers often were left on their own to interpret research findings and implement the curriculum with minimal support from administrators and policy makers. Even though many states developed standards that closely related to the Standards recommended by NCTM to help classroom teachers in their effort to improve student

achievement, most teachers often chose to teach the way in which they had been taught behind the closed door (Cuban, 1993).

Japanese teachers were able to implement the national and local standards in their classrooms more effectively than their counterparts in the United States because of their professional development practices such as lesson studies (Stigler & Hiebert, 1999). Japanese teachers collaborated with others in a lesson study group formed to improve their teaching. These study groups focused on a few lessons each year to examine their effectiveness by observing a lesson taught by a team member and offering constructive suggestions afterward. During their meetings, teachers came up with possible reactions and comments from students in order to prepare the best responses to address each issue. Modified lessons were submitted to a central location where the archives of different lessons were accumulated to share with other educators. Because Japanese schools strictly based their standards on the national standards, the archive built the knowledge base for all teachers in the country. This collaboration between professionals helped each Japanese teacher carry out the mathematics curriculum in the classroom (Stigler & Hiebert, 1999). Curriculum, institutional support, and professional development of mathematics teachers were important elements affecting how teachers taught content.

The quantity and quality of explanations used in mathematics classrooms in Japan, China, and the United States were investigated by Perry (2000). This study found that Japanese teachers provided more explanations about how and why certain mathematics procedures worked than U.S. and Chinese teachers. This practice enabled Japanese students to understand concepts and procedures better than Chinese and U.S. students and prepared them to generalize and apply these concepts when solving problems in new situations. Students in the U.S.A. were presented

with one possible solution for each problem, thus making it hard for those students to generalize what they had learned in one lesson to another. Because Japanese mathematics curriculum focused on fewer topics than U.S. curriculum, it allowed Japanese students time to master the most important skills in order to develop a deeper understanding for each topic that was covered (NRC, 2001; Perry, 2000; Stigler & Hiebert, 1999; Yoshida, Fernandez, & Stigler, 1993).

Findings of earlier studies generally agreed that there was a relationship between mathematics teaching practices and student learning. Japanese mathematics classrooms generally engaged in many teaching and learning practices that were encouraged by the NCTM Standards (2000). Classroom teaching practices greatly influenced the way in which students perceived mathematics and themselves as doers of mathematics. If students in different communities developed different mathematics identities, it could be assumed that those students with different mathematics identities could become teachers who held different ideas about what mathematics was and about what it meant to do mathematics. Because classroom teachers' beliefs, views, values, and beliefs toward mathematics were shaped by their own learning and teaching experiences within the communities in which they participated, it could be hypothesized that teachers' professional identities in different communities and cultures would differ in some ways. It was only recently that researchers began to examine systematically the relationship between teaching practices and teacher identity (Flores & Day, 2006; Lasky, 2005).

Teacher Identity in Mathematics Classroom

The underlying rationale for the use of a sociocultural perspective in a study of mathematics education is that individual conceptual development is closely related to the society or community in which individuals participate. This culturally shaped concept of self is the

foundation for one's identity. Wertsch (1991) drew on Vygotsky's work on language and thought in order to describe a sociocultural approach to mind. He asserted:

A fundamental assumption of a sociocultural approach to mind is that what is to be described and explained is human action...When action is given analytic priority, human beings are viewed as coming into contact with, and creating, their surroundings as well as themselves through the actions in which they engage. Thus action, rather than human beings or the environment considered in isolation, provides the entry point into the analysis. (p. 8)

A sociocultural approach examines various interactions among individuals, institutions, communities, and cultural practices. Individuals and their environment continuously interact while shaping and reshaping each other. In this recursive system in which humans and communities interact, one affects the other (Lave & Wenger, 1991; Wenger, 1998; Wertsch, 1991; Vygotsky, 1962). Individuals think and act according to what is appropriate and accepted within a cultural structure by using cultural tools such as language, numeracy systems, and technology (Wertsch, 1991; Vygotsky, 1962). Cultural tools are products of each culture found through much of its history that continue to evolve as people use them. In a school setting, teachers belong to the community called "school" which is located within a broader society and they use cultural tools available to them to teach. Individuals develop different identities such as wife, mother, daughter, teacher, learner, gardener, reader, hiker, and so on depending on a given situation. As teachers participate in school communities and in the larger communities that surround them and incorporate the school community, they develop their professional identity as a "teacher" since individual identities are situated within the community and culture in which they belong (Rogoff, 2003). Teacher identity was how teachers defined themselves to themselves and to others regarding their teaching approaches and ultimate goals as a teacher that evolved over time in a study reported by Lasky (2005). Because schools and classrooms provided unique

learning communities for participants, different school and classroom settings provided different backgrounds that shaped teachers' beliefs, values, and preferences toward mathematics and teaching. Figure 1 represents a summary of ideas about how teacher identities are connected to factors in the social environment discussed in this section.

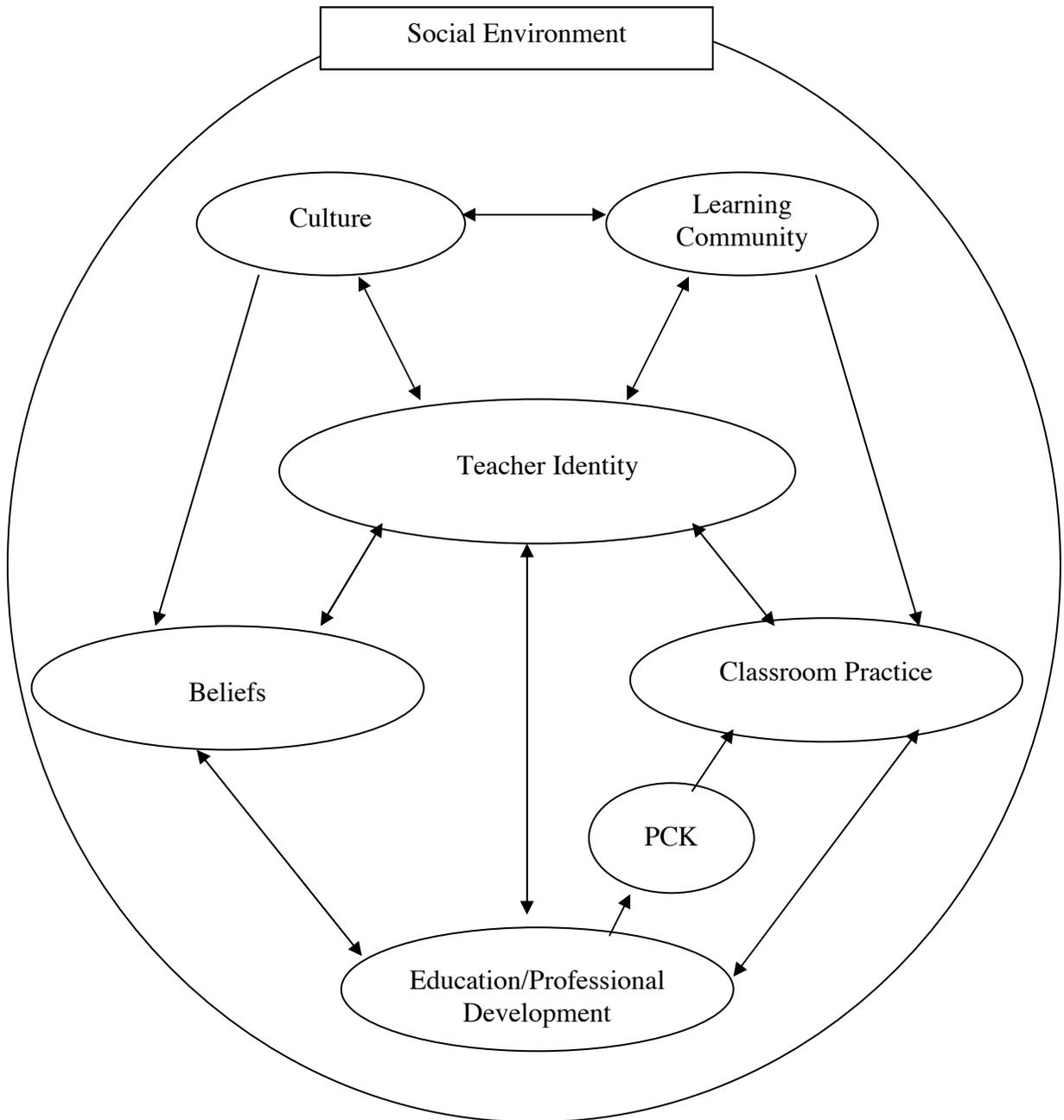


Figure 1. Teacher identity.

Thompson (1984) conducted case studies of three middle school teachers to examine how their beliefs, and preferences about mathematics and teaching, affected their teaching practice. This research study was the first of its kind focusing on teachers' cognition rather than on their behavior in classrooms. The study was conducted over four weeks in each of the three classrooms to observe classroom practice. After two weeks of observations, participants were interviewed daily discussing events that took place during mathematics lessons to clarify conversations and interactions in the classroom. Surveys also were used to determine teachers' views on mathematics and teaching. The questions on the survey included teachers' views on goals for math instruction, instructional objectives, pedagogical practices, students' difficulty with math, and effective math teaching. The results of the study revealed that teachers' views of mathematics affected their teaching process and student assessment, planning and preparing for instruction, and overall teaching practice. Reflectiveness, which was the tendency to reflect on one's actions relating to math teaching of teachers, resulted in integratedness. Integratedness refers to the actions that one takes in mind in order to modify one's beliefs to match beliefs that are inconsistent with one another. One teacher in the study expressed her beliefs on individualized math lessons to provide each student with appropriate math learning materials. However, this teacher consistently used the same worksheets for all students in her class. This practice posed a conflict between what the teacher believed to be an important aspect of math teaching and her classroom practice. If this teacher had attempted to modify the classroom practice in relation to her expressed beliefs after reflecting on her beliefs and classroom practice, her conceptual system would be considered as integrated. Whether consciously or unconsciously, the reflectedness and integratedness of teachers resulted in differences in their teaching practices. This study is significant as it has shifted the focus away from teachers' instructional behavior in

mathematics classrooms to teachers' beliefs. Even though the study opened up a new perspective from which to explore mathematics teaching, Thompson (1984) gave little theoretical attention to how teachers develop their professional identity as mathematics educators.

Teacher identity is mediated by professional training along with social and political contexts (Flores & Day, 1996; Gee, 1999; Lave & Wenger, 1991; Wenger, 1998). Teachers' beliefs about teaching often were affected by their work settings and reform policies. Reform policies challenged teachers' professionalism many times, but they refused to change their teacher identities because of their beliefs about the ways in which to teach and the goals of teaching (Lasky, 2005). Flores and Day (2006) emphasized the influence of workplace that shaped and reshaped "teachers' understanding of teaching, in facilitating or hindering their professional learning and development, and in (re) constructing their professional identities" (p. 230). Thompson's (1984) study extended the understanding of teacher beliefs and teaching practice in mathematics classrooms, but the influence that teacher identity might have on teaching practices in a mathematics classroom was in need of further study and clarification. Studies began to examine teacher identity in other content areas (Flores & Day, 2006; Lasky, 2005; Richards, 2006), but teacher identity in a mathematics classroom continued to warrant a further investigation. Teachers developed their professional identities through their learning experiences as students. They constructed ideas about what it meant to do mathematics in a variety of classrooms that they participated in either as a student or a teacher. Because of this powerful relationship between teacher identity and the contextual influence on teacher, the current study focused on sociocultural aspects of mathematics teaching and teacher identity. The study focused on teachers' educational and cultural backgrounds and their relationship to their teacher identities and to how they taught mathematics in the United States and Japan.

Chapter Summary

The review of literature suggested there were many aspects to mathematics education when considering student learning. Creating a learning community within a classroom, understanding the history of mathematics education and curriculum, different teaching approaches to mathematics, and students' beliefs along with their mathematics identities played a large role in making an informed decision regarding what mathematics students should learn and how it should be taught. Apparently, there is no one right way to teach mathematics to all students. It is imperative that we learn more about the differences and similarities among mathematics teaching in different communities such as are found in the United States and Japan since the results might provide us with ideas and strategies to make positive changes toward more effective mathematics teaching. The subject of teacher identity in relation to effective mathematics teaching has received minimal attention. This study was designed to extend Thompson's (1984) work on teachers' beliefs about mathematics and teaching. The specific objectives of this study were to investigate the teacher identities and teaching practices of a small purposive sample of early grades elementary mathematics teachers in Japan and the United States of America in relation to their educational and cultural background.

CHAPTER 3

Methodology

Introduction

The purpose of this chapter is to discuss the methods and procedures used in conducting this study. This chapter includes a brief description of the design of the study, context and participants, data collection procedures, and data analysis procedures.

This study compared teacher identities and teaching practices in four primary grade classrooms, two in Japan and two in the United States. The following questions guided the research study:

1. What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
2. What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
3. How can the relationships between the identities and mathematics teaching practices of four second grade teachers, two in the United States and two in Japan, be explained locally and globally?
 - a) What is the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community?

- b) How can the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community be explained in terms of its relationship to the broader culture in which the mathematics classroom is situated?

Research Design

The research design chosen for this study was a case study method. Stake (1995) describes a case study as providing a detailed study of a system based on a variety of data collection in order to situate this system within a larger context. A case study method was used for the current study in an attempt to build an in-depth picture of teacher identity and classroom instructional practice in four primary grade mathematics classrooms. The use of multiple forms of data collection such as observations, interviews, and surveys conveys the complexity of teaching. This data collecting process is called triangulation (Stringer, 2004). The variability between and among teachers' identities and classroom instructional practices and their complexity warranted a qualitative case study research approach, which could show different perspectives on mathematics and teaching. Each of four case studies identified various aspects relating to a professional identity as a mathematics teacher in a primary classroom. Four primary grades teachers, two from Japan and two from the United States, participated in this study. Each teacher was observed daily while teaching a mathematics class over a period of four weeks. During the first two weeks of the four week period, only the classroom observation was conducted so the researcher could become acquainted with the social context of each classroom before starting teacher interviews. The data collected during this time initial two week time period assisted in generating conjectures about teachers' dispositions toward mathematics and teaching. Classroom events, teaching materials, interactions between students and the teacher, and instructional procedures were recorded in detail during this initial two week period to

capture the essence of each classroom. Daily observations continued and interviews were conducted in the last two weeks of the study. It was important to note that paraphrasing is used in the results section when quotations are shown because of the Japanese participants' wish not to be audio or videotaped during the study.

Interviews were conducted after the daily observation of the mathematics lesson so that the researcher could make accurate inferences about teachers' daily classroom practices and beliefs during weeks three and four of the study. Interview questions were based on what the researcher observed in the classroom during the daily mathematics lesson in order to clarify any events, conversations, instructions, and intentions for using a particular teaching strategy. Data collected during the two phases of the study were examined for consistency.

The study was bounded by time, four weeks, and by cases, the classroom communities. Assertions were made at the end of the study based on the data collected, which provided an interpretation of the "lessons learned" (Lincoln & Guba, 1985; Stake, 1995). The study employed "maximum variation" (Miles & Huberman, 1994) as a strategy to represent diverse cases to fully display multiple perspectives on mathematics and teaching. In the process of analysis, an inductive approach was used as significant themes emerged from the collected data. The principles of grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1990) were applied. The participants' interviews were analyzed separately in a vertical analysis, then they were analyzed in a horizontal analysis (Miles & Huberman, 1994) in order to compare the data to look for similar patterns as well as differences. This process allowed the researcher to ascertain the meaning of the data, generate questions, develop categories for coding, and identify the key themes.

All participants who chose to be involved in the study signed the IRB consent form, indicating he or she could refuse to answer any question and could withdraw from the study at any time. Confidentiality measures were included to protect participants and their students' personal rights.

Context and Participants

School Context and Participants

The participants were one second grade and one third grade teacher from a public elementary school located in North Alabama and two second grade teachers from a public elementary school located in central Japan. From the population of all teachers in each school, four were selected to participate in the study. Participating teachers were recruited according to the following characteristics: having taught at least five years in a public elementary school, one teacher from each country with five to 10 years of teaching experience and another with more than 15 years of teaching experience, and willingness to be observed for four weeks. The selection of participants was purposive (Erlandson, Harris, Skipper, & Allen, 1993), rather than random.

The teachers who participated in this study were qualified elementary school teachers who expressed a willingness to participate. The four teachers were Lisa, Ken, Mary, and Christy (pseudonyms). The Japanese teachers were Lisa and Ken. Lisa had 30 years of teaching experience as an elementary school teacher in Japan. She had taught a variety of grade levels from first through sixth. Ken had six years of teaching experience as an elementary school teacher in Japan. Lisa and Ken both held Baccalaureate of Science degrees. The U.S. teachers were Mary and Christy. Mary had 32 years of teaching experience as an elementary school teacher in the United States. She had taught various grades from kindergarten to fourth grade and

had been teaching second-grade for the past 10 years. She had a Master’s degree in elementary education. Christy had taught eight years in the U.S. elementary school. She had taught third grade and first grade previously, and had taught second grade for the past three years. She held an Educational Specialist degree and was a national board certified teacher who was working on her doctorate in elementary education. Table 1 shows the description of participants.

Table 1

Descriptions of Participants

<i>Teacher</i>	<i>Years of experience</i>	<i>Degrees held</i>	<i>Number of students in the classroom</i>
Lisa	30	Baccalaureate of Science	32
Ken	6	Baccalaureate of Science	31
Mary	32	Masters of Arts	17
Christy	8	Educational Specialist	16

Procedures

The observations were conducted over four weeks in each classroom as mentioned above. The principal investigator was an elementary school teacher in the United States, who traveled to Japan in June when the U.S. schools were out of session but Japanese schools were still in session. Because the school in which the researcher was employed completed the school year on June 1st, 2007 and the Japanese school began its summer vacation on July 20th, 2007, this allowed the researcher to travel to Japan and conduct the study in the Japanese school before Japanese schools began their summer vacation. Field notes were used to record classroom instructions, procedures, interactions, and other events during mathematics lessons. The first two weeks of the study were limited to daily observations of the mathematics lesson so that the researcher’s inferences about classroom contexts did not interfere with assertions. The last two

weeks of the study consisted of daily observations of the mathematics lesson, interviews, and surveys. The interview questions clarified specific events and interactions observed during mathematics lessons along with teacher beliefs and beliefs regarding mathematics and lessons taught. The daily interviews were conducted immediately after each mathematics lesson. The survey included open-ended questions related to teachers' views on teaching and mathematics.

Data Collection Procedures

Table 2 shows the sequence of data collection. Multiple data sources included observations, interviews, and surveys (Appendix A).

Table 2

Sequence of Data Collection

Research questions	Data Source	Data Collection	Analysis
<i>(1) What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?</i>	Observations	Weeks 1 – 4	Descriptions, themes, and assertions
	Interview	Weeks 3 and 4	
	Survey	Week 3	
	Follow-up Interview	Weeks 3 and 4	
<i>(2) What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?</i>	Observations	Weeks 1 – 4	Descriptions, themes, and assertions
	Interview	Weeks 3 and 4	
	Survey	Week 3	
	Follow-up Interview	Weeks 3 and 4	
<i>(3) How can the relationship between the identities and mathematics teaching practices of four primary grade teachers, two in the United States and two in Japan, be explained locally and globally?</i>	Observations	Weeks 1 – 4	Descriptions, themes, and assertions
	Interview	Weeks 3 and 4	
	Survey	Week 3	
	Follow-up Interview	Weeks 3 and 4	

Observations

An observational protocol was used as a method for recording notes in the field. The protocol was a predetermined sheet on which the researcher logged information learned during the observation and included aspects such as portraits of the participant, a drawing of the physical setting, specific events and activities, the researcher's reflections on activities, and summary conclusions about activities for later theme development (see Appendix B). The protocol was adapted from Staffordshire University's "Guidelines for the Observation of Teaching" (2000) that was included in the university's quality assurance handbook to provide a means to assure the quality of its educational provision and its relevance to its students. The rationale Staffordshire University gave for developing this guideline was to provide high quality training for all students. The protocol was used in this study to identify the instructional practices by identifying classroom aspects such as learning objectives, selection and use of instructional materials, educational climate for learning, variety of instructional activities, preparation for class session, instructional methods, opportunities for student participation, individualization of instruction, responsiveness to student feedback, and learning difficulties during each mathematics lesson. In order to capture the essence of each classroom, a physical layout of each classroom was included in the protocol.

Lofland and Lofland (1995) recognize the most essential process of observations as "logging data." The focus of the observations for the first two weeks of the study was to become acquainted with the sociomathematical norms of each classroom and to develop conjectures about teachers' dispositions toward mathematics and teaching. The conjectures made during this observation period assisted the researcher in comparing how the subject teachers taught mathematics and what they believed to be successful and effective mathematics lessons. This

procedure assured that teachers' professed dispositions toward mathematics and teaching did not influence the actual classroom teaching practices observed by the researcher. Field notes were used for accuracy and as an aid for stimulating recall of specific events during later interviews.

Interviews

Daily interviews were conducted in the last two weeks of the study in order to access teachers' dispositions toward mathematics and teaching. According to Cresswell (1998), the interview process allows the researcher to obtain greater depth of information and clarify statements. The teacher interviews provided an in-depth exploration into the ways in which the subject teachers perceived and valued mathematics and teaching. The interviews focused on teachers' reflections on the lessons just taught, the students, and their view of their own teaching and thinking. The interview questions were related to classroom practice and interactions observed during the day's mathematics lesson to clarify any events or activities taken place. The protocols (Appendix C) were used during the interviews to record participants' responses along with information that helped the researcher organize her thoughts about starting the interview, concluding ideas, ending the interview, and thanking the participants. The interviews were conducted in a location chosen by each participant and included their classrooms during the recess and after school, teacher's lounge, and hallways. They lasted approximately 10 to 15 minutes each day. Participants validated interview data by verifying that their thoughts and actions were accurately represented.

Surveys

Participants were asked to complete a survey regarding their beliefs and views on mathematics and teaching. Teachers' dispositions toward mathematics and teaching were the focus of the questionnaire developed for use in this study. It contained eight statements. The first

three were intended to get at teachers' conceptions and views regarding characteristics thought to contribute to being a successful mathematics student; the fourth question dealt with the participant's background as a mathematics learner; the fifth and sixth questions dealt with teachers' conceptions and views on effective mathematics teaching; the seventh question dealt with the participants' background as mathematics teacher; and the eighth question dealt with teachers' conceptions and views on teaching mathematics in a particular society and culture. Participants answered each open-ended question. The following questions were included in the survey:

1. Which students are good at mathematics in your class?
2. What makes "good" mathematics students?
3. What contributes to students' success in mathematics?
4. How did you learn mathematics as an elementary student? Please describe briefly usual mathematics lessons experienced as a student in elementary school, middle school, high school, and college and your thought on them.
5. What does a successful mathematics classroom look like?
6. What is good mathematics teaching?
7. How did you learn to teach mathematics the way you do now?
8. What is it like to teach mathematics in rural Alabama or in Japan?

Follow-up Interviews

Follow-up interviews were conducted after participants completed the survey. Interview questions consisted of verifying, elaborating, and clarifying the data taken during the observations and the responses on the survey because the researcher assumed that the written responses were brief since the lack of free time teachers usually experienced during the school

day was a common concern among educators. The participants elaborated and clarified initial responses given on their surveys during an interview.

Data Analysis

Table 2 presented an overview of the research questions, the data sources, and the data analyses that were used to analyze the data. An explanation of the analysis for each of the instruments follows.

After the data were collected, a detailed description of cases emerged (Asmussen & Cresswell, 1995). The data were then aggregated into categories in order to identify themes. The data from the observations, interviews, and survey, for example, were categorized into different aspects of teaching such as group instruction, individual instruction, seatwork, and class discussions that the researcher assumed to be important when determining classroom instruction practices related to mathematics. Those categories were used for probing questions during teacher interviews to confirm the researcher's observations as well as initial codes for organizing data. The common themes were captured from analyses of individual data about mathematics and teaching and from the comparison of data sets. Overarching themes were identified to describe the professional identity of a primary grade mathematics teacher with regard to his or her educational and cultural background. Finally, assertions were made about each teacher's dispositions toward mathematics and teaching and generalizations about the teacher identity were discussed.

Cresswell (1998) proposed the use of the following procedures to ensure quality and verification in qualitative research: prolonged engagement and persistent observations, triangulation, peer review or debriefing, clarifying researcher bias, member checks, and rich, thick description of a case to allow readers to transfer information. I was engaged in the field in

both countries over a period of time in order to make decisions about “what was salient to the study, relevant to the purpose of the study, and of interest for focus” (Cresswell, 1998, p. 46), which gave validity. The use of triangulation via multiple data sources such as observation, interviews, and surveys, also provided validity to the study. A number of steps were taken to triangulate the data. First, the researcher compiled written field notes during and immediately following each classroom observation. Second, both written and verbal responses were obtained from the participants. Verbal responses were transcribed into written form later. Paraphrasing was used when quotes were shown in the results section because participants did not want to be audiotaped or videotaped during the study. There were consistent themes cutting across the verbal and written data. Third, researcher interpretations were checked for accuracy by asking participants to confirm the data and provide clarification when necessary. The fourth step was to have two doctoral students review the written responses and field notes and make a separate determination of themes and interpretations for peer review. Rich, thick description of each participant allowed readers to decide whether information and findings could be transferred.

The researcher conducted a qualitative research on the ways kindergarten students expressed and represented their understanding of mathematical ideas and knowledge in 2004. Data was collected from 18 kindergarten students during a 4-week period using observation, audiotaping, informal interviews, children’s journals/conferences, and field notes. The study developed an in-depth view of how young children communicated mathematically.

Summary

Chapter Three presents a discussion of methodologies that were used in this study. Context and participants were discussed. The sampling strategy, data collection procedures and analyses were also presented. Chapter Four presents the role of the researcher in the current study.

CHAPTER 4

The Researcher as the Instrument

This chapter presents the cultural and educational background of the researcher and issues related to subjectivity and researcher role in the current study. According to Lincoln and Guba (1985), a researcher must develop the skills necessary to act as a human instrument and interpret the collected data. Strauss and Corbin (1990) explained this notion further:

Theoretical sensitivity refers to a personal quality of the researcher. It indicates an awareness of the subtleties of meaning of data. [It] refers to the attribute of having insight, the ability to give meaning to data, the capacity to understand, and capability to separate the pertinent from that which isn't. (p. 42)

My cultural background and personal experiences were helpful in selecting research sites in Japan and the United States and interpreting collected data at both sites. Because my personal experiences prompted me to conduct the study, it was imperative to monitor my subjectivity as a researcher. This chapter clarifies researcher biases and assumptions related to the current study by describing the researcher's position.

School and Home Life in Japan

I was born and raised in Japan. Both my parents worked, so I started to go to a day care program when I was about two months old and continued there until I was five years old. My older brother had been attending the same program since he was a baby. I don't have any memory of "learning activities" from that day care experience; all I remember was how I enjoyed playing with my friends on the playground every day. Children who were in a day care program then were the ones with working parents.

By the time, I was five, public kindergartens had begun to be built across Japan. I was one of the first children to attend the new public kindergarten in Osaka when I turned six. I remember playing, singing, and drawing pictures when I started kindergarten. I also remember reading and writing in a classroom where there were around 20 children with an assigned teacher. There were counting activities, crafts, and learning how to swim in a small pool that was on the school grounds. When I think of my kindergarten, I have only memories of fun.

My elementary school memories also are positive. Public kindergarten usually was not a part of an elementary school at that time in Japan, so elementary schools housed first grade to sixth grade. There were around 40 to 45 students in each classroom when I was in school during the years from 1977 to 1983. The school day in Japan started out quite differently from that of today's typical elementary school in the USA. Because children in Japan attended kindergarten, elementary, and middle schools in their neighborhood, we usually walked to school. A typical school day began at 8:30 and ended around 3:00 in Japan. The gate to the school was open at 7:30. Our principal stood at the front gate to greet and shake hands with each student every morning. As soon as we arrived at school, some of us went straight to the playground and played, while others went to the classroom and unpacked. We all chose different activities to do in the classroom such as reading, talking with friends, going to the restroom, going outside, playing with origami, and taking care of classroom plants and pets. These were the same activities we did in between classes when we had 10- to 15-minute breaks. Some classes had different groups of students taking care of different aspects of the classroom every day. Some students, for example, took care of a classroom pet by cleaning its cage and feeding it, while others were in charge of taking care of flower and vegetable gardens. Teachers usually were on campus by this time, but they were occupied, having a meeting or preparing for the day in the school office where all the

school staff and faculty had their own desks. Teachers went to the office each morning after changing from their street clothes to their inside-school clothing. Many Japanese teachers wore casual clothes such as tee shirts and sweatpants in school because they taught all subjects including physical education. The changing rooms for male and female teachers were located near the office.

Teachers had a daily morning meeting with administrators. Some meetings were longer than others but most began with daily announcements about students and school activities, and Parent Teacher Organization (PTO) and community activities. Teachers were assigned to different committees to take care of all of the school functions such as school safety, cleaning, parent communication, and professional development, as well as others. After the morning meeting, they also might have a grade level meeting.

While teachers took care of their business in the office, we students knew what we could do and when to return to our classroom, since this was the routine in our school. Japanese schools did not serve breakfast on campus. Everyone headed to his or her classroom to begin the day when the bell rang at 8:45. At 8:45, teachers were in each classroom, took roll, and started the first period. A daily schedule was different from classroom to classroom. There were four 45-50 minutes class periods in the morning before lunch and, on some days, there were one or two periods in the afternoon before dismissal. Japanese schools staggered the departure time of different grade levels of students. First and second grade students, for example, might be going home after the fifth period of the day, while students in older grades stayed for another period. Older students also had after school activities in which they might choose to participate with teacher supervision. These activities included sports and academic activities and were called “clubs.” These clubs usually met for an hour or two after school two to three times a week.

Many students started extracurricular activities when they entered kindergarten or elementary school. Popular extracurricular activities included playing musical instruments such as the piano and violin, using the traditional Japanese abacus, and learning Japanese calligraphy. I took Japanese abacus and calligraphy lessons while I was in elementary school. Japanese students often attended “jyuku” where they had private tutoring sessions to improve their school grades and to prepare for various entrance examinations to upper levels of schooling. An increasing number of parents were paying extra money for their children to learn outside of school so that they could attend a famous and prestigious kindergarten, elementary, middle, and high school. Parents’ believed that attendance at such prestigious schools would make it easier for their children to attend a good university thus having a promising job later in life. My parents were not among these parents, so my brothers and I were never under pressure to study unless we wanted to do so. My parents had high expectations for us, and wanted us to have a good life, but they seemed satisfied with the quality of public education we were receiving. They both had attended public schools while they were children and so had their parents and siblings other than my mother’s brother who was much younger than his sisters. This uncle was the only family member I knew who had graduated from a private high school at that time.

Japanese children attended schools in their neighborhood until they graduated from a middle school at the completion of the ninth grade. Students then and now must take an entrance examination if they plan to continue their education through high school. We could choose a public high school in our school district at that time, or we might choose a private school. High school entrance examinations were considered to be one of the first big challenges every Japanese must face during his or her lifetime as the examinations decided what the individual might do in the future. Most Japanese students did choose to go to high school. Elementary

and middle school classes were grouped heterogeneously, but high schools were ranked by academic performance and most classes were leveled. Students who wanted to go to college needed to choose an appropriate high school in order to reach that goal. The national ranking of Japanese high schools was based on students' academic performance on the standardized tests taken in middle school and on the number of the graduates who were admitted to certain universities and colleges after attending a particular high school. Students who did not do well academically in middle school might choose to attend school in order to earn a high school graduate diploma and concentrate on getting a job after graduation, or they might go to a vocational school.

I had good grades in elementary school, but I did not do well in middle school. My memory of middle school was good as far as my social life was concerned, but learning was not my priority. I was an average student who enjoyed Japanese language and history. English and mathematics were my least favorite subjects. I only made good grades in English when I memorized the whole story we were studying by reciting all the words in a story for a test. Even though I liked mathematics in elementary school, it became a subject with which I struggled a great deal in middle school. Mathematics procedures made sense in the classroom when my teacher was going over them on the chalkboard with the class, but when it was my turn to practice by myself at home, nothing made sense. Even though my parents didn't pressure me to study, I decided to join "jyuku" when I was in eighth grade because all my friends were going to jyuku. Looking back, it was a good choice because it made me review skills and concepts taught at school and practice more. If not for jyuku, I would not have taken the necessary time to practice and review.

After attending jyuku for a year, I was able to pass the high school entrance examination. I ended up in a public high school where 80% of the graduates went on to average colleges and universities and only the top students of each class went to the nation's best colleges and universities. My high school was ranked in the middle of the range in the school district. It had many unique teachers who taught their subject with great passion and enthusiasm. My English teacher, Mrs. A, was very easy to talk with and her lessons were interesting. I became interested in English even though I still struggled with tests. Mathematics remained as one of my least favorite subjects along with chemistry. I especially hated word problems.

Summer and winter jyuku seminars were popular among Japanese students who were preparing for high school and college entrance examinations, so I attended one of them before taking a college entrance examination when I was a senior in high school. I didn't pass the entrance examination for the university that I really wanted to attend that year. Even though it was common for Japanese students to stay at home or go to jyuku after graduating from high school in order to prepare for the next year's college entrance examinations, I decided to come to the United States to learn English instead. My original plan was to stay in the United States for six months and study English, then return home in time to prepare for the following year's college entrance examination. My plan changed, and I chose to attend a community college in the U.S.A. After graduating from a community college, I enrolled in a nearby state university. Because I had always wanted to become an elementary school teacher while I was growing up, I majored in elementary education and received a degree and a state teaching certificate. After graduating from college, I substituted in many elementary schools in the United States for two years. Then, I was hired as a classroom teacher in a nearby town. I have been teaching in public elementary schools for 10 years now.

As I worked with U.S. students and parents, I noticed that the expectations parents place on their children academically and socially were different from what I remembered from my schooling in Japan. In my memory, Japanese teachers were more respected socially and held in higher regard. My parents would tell me to mind my teacher and do what she told me to do at school. If I got in trouble at school, I knew I would be in trouble at home. Most of my friends' parents were similar to mine and made sure their children knew how to behave appropriately and "do good" in school. Japanese students also were expected to review what they had learned in school when at home as a part of their daily homework and to prepare for the next day's lessons. We were told to read the next chapters in a textbook and write down any questions that came to mind, so we could discuss them further with a teacher during the next day's lesson. This practice started in first grade. Any students who gave teachers problems in school were viewed as "bad kids" and their parents were looked down upon in Japanese community.

This is my memory of Japanese schools from 1970s to late 1980s. When I arrived at the elementary school in which I was to conduct my research study in June 2007, it was obvious to me that Japanese schools had gone through some changes since I graduated from high school. What I saw on a school campus was shocking to me. I saw unruly students talking back to teachers, ignoring teacher's directions, and getting out of their seats during class. The first thing that came to my mind was "gakkyuu houkai," "a broken classroom," words that became popular in the past 10 years in Japan describing a situation in which teachers had lost control of their students and of the classroom. This particular elementary school had had a reputation of having rough students ever since my family moved to this town in the 1980s. My younger brother transferred to this school as a second grader, but I had never attended this school. It was located

in a blue-collar community with many small businesses and factories. My younger brother was considered to have had good teachers while he was a student at that school.

Gakkyuu houkai, a broken classroom, has had a huge effect on Japanese education in the recent years (Fenwick, 2004; Seto, 2003). There were a large number of teachers, ranging from new to veteran, taking a leave of absence, or quitting and leaving the profession, because of their physical and mental stress or illness, forcing school systems across Japan to find replacements during the school year (Fenwick, 2004; Seto, 2003). This particular elementary school had its share of problems and had several teachers who had left their classrooms in recent years. I learned that a sixth grade teacher and a first grade teacher had taken a leave of absence in the previous school year, and a second grade teacher had already taken a leave during the current year. Japanese schools started the school year in April. I arrived in Japan in early June, so it had only been two months since the beginning of the year. Teachers at the school did not want to talk to me about the issues the school was facing, but I was able to talk about what was happening to some of my friends whose children attended this school as well as some teachers in a same district who did not work in this school.

When I was in this school for my study, I saw students walking out of their classrooms while their teachers were still teaching on several occasions. In one case, students were climbing on the shelves around the classroom and jumping off from them. On other occasions, I ran into students wandering around the campus when they were supposed to be in a classroom. These students were arguing with teachers who were trying to get them back into the classroom. Some students were physical with teachers when confronted by them regarding their behaviors. I witnessed a few teachers being hit or kicked by students. One day, all the students and teachers were on the playground for a school-wide morning meeting when one second grade boy started

to act out. School-wide meetings are a common practice in Japanese schools during which a principal makes announcements in front of the student body. This student's homeroom teacher was trying to calm him down by pulling him aside to talk to him when he started to kick her legs over and over. She was almost in tears. Her principal, who was off the podium by this time, could clearly see what was happening as everyone was watching it. None of the teachers came to assist this teacher. They acted as they hadn't seen anything unusual. It took another five minutes before one of the male teachers came over to take this boy off of his teacher. As I learned later, administrators at this school provided a minimal support for teachers in situations such as this. Teachers had gone to them for help with problem students in the past and they were simply told to "handle it." I also learned that teachers in this school system were being evaluated by school administrators yearly and given a grade for their work. The grades were given based on administrators' observations and opinions about one's teaching and classroom management. Because only a certain number of grades were available in each school, teachers were reluctant to help and collaborate with others in fear of getting the lesser grade themselves. Teachers who had "problem students" were viewed as incapable of managing their classrooms, thus receiving a low grade on their evaluation. I was really bothered by this incident.

Another term I encountered while I was in Japan during my study was "monster parents", which referred to parents who made outrageous requests and had outrageous expectations for teachers of their children (Japan Institute for Labour Policy and Training, 2009). These are the parents who believed their children could do no wrong and it was always the fault of the school and the teachers when their children did not learn something or did something wrong. Some teachers told me children who had monster parents tended to challenge teachers' decisions and directions because they knew that their parents would support them no matter what. Many

teachers expressed their dismay and concern over the lack of respect for teachers in Japanese society in general. These were devastating changes for me as I had believed in the worth of Japanese school systems and had only good memories of them.

Even with changes, this Japanese school had many successful traditions that fostered students' independence and responsibility as a member of this school community. As stated previously, many classrooms rotated classroom jobs among students. Students also were expected, and taught, to help serve lunch and clean up the classroom and other parts of the school. Every day at lunch, about half of the students from each classroom put on their aprons and went to the lunchroom to pick up meals for their class. They carried milk cartons, pots and pans, and dishes back to their classroom and served their classmates. The students who were not on lunch duty would move the desks together in groups to prepare for lunch. Students on lunch duty took their aprons home at the end of the week and had them washed for the next group. There was a clean-up time right after lunch when everyone in school did his or her part. Some swept the floor, while others cleaned up the chalkboard and shelves. Older students were in charge of cleaning up bathrooms. Children seemed to enjoy these tasks. These school activities seemed almost the same as what I remembered experiencing as a child.

Research Site in Japan and Finding the Gatekeeper

One of my main concerns was gaining an access to a school when I decided to conduct a research study in a Japanese school. Unlike U.S. schools where teachers and staff were familiar with researchers from outside their schools conducting educational research, this was not a common practice in Japanese schools. Because my family had moved from one town to another since I had graduated from my elementary school, it was not feasible for me to travel to that particular elementary school from my family's current place of residence. Since my family still

lived in the same school district, I wrote a letter to the Board of Education to introduce myself and explain my plan for the research study. I was afraid the Board might not grant my request when it was time for me to conduct the study, so I had visited the Board to see if they would allow me to visit some schools in the district in the summer of 2006. I had attended kindergarten through 12th grade in this school district, and the board allowed me to visit the elementary school from which my brother had graduated. I spent two weeks in summer of 2006 at that school. I knew if I couldn't find a Japanese school that would allow me to conduct the study, I needed to change my research plan, so this was a very important step for my study.

First, I wrote a letter to the Board to introduce myself and ask for their support in February 2006. Mrs. Y, who worked at the Board, was assigned to assist me with my request. Mrs. Y had been an elementary classroom teacher for over 10 years before she started to work at the Board. She was very interested in my study. She had been assigned to assist me with my request because she was in charge of taking care of school related issues for elementary schools in the eastern part of the district, where my mother's new house was located. Next, Mrs. Y talked to the principal of an elementary school from which my younger brother graduated and explained what I was trying to do. The principal at that time had worked at a Japanese school in the U.S.A. for few years in the past, and he was very eager to help me. When I learned that he would allow me to visit his school, I sent a letter thanking him for his cooperation and gave an explanation of my visit, so that he could share this information with teachers at his school before I visited. As soon as I arrived in Japan in June 2006, I went to the Board to meet Mrs. Y in person, and then she and I went to the school to meet the principal and teachers. The first meeting with the principal and seven first grade teachers wasn't anything like I had expected. The principal only told the teachers that the Board had requested to let a researcher come to their classrooms for two

weeks. Apparently, he did not share any of my personal information that I had sent to him earlier, and they did not know anything about me or my plan. It was obvious that the teachers did not want to be at the meeting and that they did not want me to come to their classrooms. For the next two weeks, the teachers were very polite, but cold to me. I tried to help the teachers around their classrooms and with students as much as possible. They started to warm up to me during the last days of my visit. Japanese teachers' reactions toward me, the outsider, at the beginning of my visit was just what I expected and was what I was worried about. On the last day of my visit, as I visited each classroom that I had observed during my two weeks to say good-by, the teachers told me that I wasn't who they thought I might be and they were glad that I had come. I felt that I was finally accepted as their visitor, not the visitor the Board and the principal had pressured them to look after.

When I was ready to conduct my research study in 2007, I contacted Mrs. Y at the board again because she was the "gatekeeper" the previous year. I asked her whether it was possible to conduct my study in the same elementary school that I had visited the previous year. She said that the principal had retired, but the new principal would grant me a permission to conduct my study. Japanese teachers were transferred to different schools every few years, but teachers who had been at the school remembered me from the previous year and welcomed me back to their school when I arrived in the summer of 2007. It was obvious teachers at school felt at ease with me from day one of my study. I was still an outsider to them, but they had accepted me as one of their colleagues, who just happened to teach in a different place. One of the teachers I had met during the previous visit acted as a "gatekeeper" this time in the school and introduced me to new teachers. Because of her and Mrs. Y, I was able to gain the trust of others in the school in order to conduct the study smoothly.

In this chapter, I shared my educational and cultural background as related to the study, along with issues I faced while finding a Japanese research site. As a researcher, the differences that I noticed in my school experiences in the United States and Japan warranted me to investigate this issue further. The next chapter presents the data collected from teachers regarding their mathematics identities and mathematics teaching in the two countries.

CHAPTER 5

Representations of the Study

In this chapter, the data collected from Japanese and U.S. teachers are presented. Each section includes a description of the participating teacher's background, beliefs about teaching mathematics, and a description of a classroom including examples of mathematics lessons. The thematic analysis between two teachers from each country follows the description of teachers.

Three themes are used to compare two teachers:

- (1) Beliefs about mathematics and teaching.
- (2) Criteria and rationale for choosing mathematics instructional activities.
- (3) Self-reflection.

The following research questions guided this inquiry:

1. What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
2. What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
3. How can the relationships between the identities and mathematics teaching practices of four second grade teachers, two in the United States and two in Japan, be explained locally and globally?
 - a) What is the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community?

b) How can the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community be explained in terms of its relationship to the broader culture in which the mathematics classroom is situated?

Four teachers are described in this chapter: Lisa, Ken, Mary, and Christy. As indicated in chapter 3, the data came from several sources including observations, an observation protocol, the field notes, interviews, survey, and post-observation interviews.

Research Site: Japanese School

The Japanese elementary school was located in a city of 510,557 people and served first grade through sixth grade with a student population of 1,400 in Osaka prefecture. Osaka is the second largest prefecture in Japan. This school was one of the largest elementary schools in Osaka. Nearly 99% of students were Japanese. The school had very few Chinese students whose families immigrated to the area in the past several years. Parents of those students usually did not speak fluent Japanese. Chinese students received Japanese lessons at school to help them become fluent and competent in Japanese. There were 65 certified teachers, one music teacher, and two administrators. One translator served Chinese students and she was in charge of their Japanese lessons. The average pupil ratio was 36:1. There were no computers in the classrooms and the school had one computer laboratory for each class to use twice a week for 45 minutes.

The case study teachers utilized a textbook that the school system had adopted but added materials they made for a lesson or that had been shared by colleagues for a lesson. The average length of mathematics lessons was 45 minutes, which was the allotted time for any one subject at this school. There were seven second grade units with 32 to 35 students in each unit. Second grade teachers varied in their age and teaching experiences, but they met at least once a week to discuss their lesson plans and school events. Teachers did not teach the same lesson and did not

teach lessons in the same way, but they collaborated and shared teaching materials. Each teacher decided what, when, and how to teach his or her students.

Second grade teachers stated that this group of students had many behavior problems in the previous school year. Out of the seven second grade teachers, four of them taught first grade during the previous year at this school so they were familiar with many of the students and their issues. One of the teachers was an “instructor” who was hired by the board to fill in a teaching position only for the rest of the year. She was filling in the position because a teacher took a leave of absence due to her illness that was caused by job related stress two months into the school year. This was not the first of these problems this school had faced. A first grade teacher took a leave of absence a month after school started the previous year. Another teacher took a leave of absence before the second semester began. Both teachers suffered from physical and mental problems caused by job related stress. I was told by teachers in the district that this school’s students have a reputation for being “rough” and “hard to teach” among teachers. Teachers in the district could request transfers if they wished, but it was ultimately the decision of the principal and board to transfer teachers. It is very common in Japan for teachers to transfer to another school in the same district after four to five years in a school.

As a whole, teachers in this school seemed to work collaboratively within their grade unit. The administrators were visible and available during the day around the campus. They walked around the campus and within the community when students were arriving at school in the morning and when they were dismissed in the afternoon to ensure safety. Teachers and parents at the school stated that recent crimes involving young children in Japan had resulted in adults keeping closer attention on children in the community. It always had been common for Japanese children to walk to their school, friends’ houses, and other places in their community

by themselves, but it was no longer considered safe to do so. This school had parent volunteers who stayed in different spots in the community in the morning and afternoon to make sure students get to and from school safely. On some days, students were dismissed in groups according to where they lived and teachers chaperoned each group home.

Even though, the administrators were available on campus most of the time I was there, teachers explained that they were not involved in taking care of students' discipline problems when teachers needed help. Most of the teachers stated that they were "on their own" when taking care of any problems.

Teachers at this school got to school around 7:15 – 7:30 in the morning and do not leave until 5 or 6 o'clock in the afternoon. Many teachers did not leave school until 7 o'clock in the evening. Some teachers said that even when they didn't have much work to do in the evening, it was frowned upon by others if they left school any earlier than 5 o'clock because everyone else was still at school. Teachers might have schoolwide or grade level meetings after school, and some teachers were in charge of supervising after school sports and academic clubs such as basketball, volleyball, reading, and mathematics.

The observations reported here of Lisa and Ken's mathematics lessons were conducted from June 8, 2007 to June 29, 2007. The participating teachers asked not to be videotaped or audio-taped during observations and interviews during the study. Paraphrasing, therefore, was used in constructing the quotations, in particular, lengthy quotations, since it was not always possible to record each word used in a teacher statement. Repeating notes back to the teacher was a means of ascertaining whether the notes sufficiently stated the teachers' response. The format of a quotation, thus, is used.

Case One: Lisa

Lisa's Background.

Lisa was a second grade teacher with thirty years of teaching experience. Before teaching second grade, she taught a variety of grade levels from first through sixth. Since she taught first grade at the same school during the previous year and had had some students as first-graders in her class, she was familiar with many of the students in second grade this year. She stated that she really enjoyed teaching first grade because “it was fun to teach.”

Lisa did not remember much about learning mathematics as a student other than memorizing multiplication tables, but she remembered that she did not like mathematics. She said:

I really liked Japanese and social studies when I was in elementary school. I enjoyed reading...things like history. I just didn't think I was smart enough to do well in math and didn't have 'math sense.' I never thought of things in terms of numbers. Like when you asked me during one of the interviews, how long I have been teaching. I had to think really hard. I knew when I started to teach, but I didn't keep count of how many years it had been. It's just the way it is with me. I know when but I don't think about how long. About math in school, I never liked it but I did fine in school. I think it was because I went to a country school in a small town. I didn't like math but I didn't struggle with it. It's just I'd rather do something else. It wasn't my favorite subject. It was the same story in middle and high school. I did well enough but didn't like it.

Lisa liked her first grade teacher and always felt that becoming a teacher might be a possibility for her future. While in high school Lisa's teacher suggested she become a teacher, and she started to pursue that goal. She became convinced that was what she wanted to do during her student teaching in college.

Teaching Mathematics.

Lisa showed a high level of confidence in teaching mathematics. From the beginning of her teaching career, she wanted to improve her mathematics teaching by thinking about how to teach mathematics concepts and how to make students think critically. She preferred class

discussions rather than lectures in her classroom. She admitted that she lectured more at the beginning of her teaching career. But, she knew she wanted students to be able to explain their thinking process and ideas to others.

Lisa explained that when she first started to teach, there weren't any workshops to guide and support new teachers as is now the case in her district. New teachers in this district are now assigned to mentors to learn how to teach. She said that she felt unprepared when she first started teaching.

Lisa felt parents were more supportive and willing to help new teachers at the beginning of her teaching career as compared to the parents with whom she now worked. She noticed today's parents were complaining more about what teachers and schools were not doing for their children. She expressed the belief that parents don't support and respect teachers and schools as much as they used to.

Being able to explain so that others could understand was very important for students in Lisa's view. One of her main goals was to provide learning opportunities so that students could explore and discover important mathematics concepts on their own. She said she did not believe that teachers should tell students everything. They were there to guide students so that they could think for themselves. She said she always reminded her students to use "their T.V. screens in their head" to picture what mathematics questions were asking for them to do. Being able to create those images meant that they could apply what they learned in previous lessons in different situations. Lisa claimed that this ability to think critically was what she meant when she said someone had "math sense."

A Description of Lisa's Classroom.

There were thirty-two students in Lisa's class. All of the students sat in rows facing toward the front of the classroom. Two sides of the classroom had windows, one faced the hall and another faced the schoolyard. There were doors at the front and the back of the room. The back wall had shelves on which students could place their bags and other personal belongings. A bulletin board above the shelves was covered with colorful origami arts of hydrangeas the students had made. The chalkboard and Lisa's desk were at the front of the classroom facing the students. Bookcases at the front and back of the room were filled with children's books and there was a compact disc player sitting on top of one of the bookcases. There also was an organ in the front corner of the room on which students played music during recess.

Lisa noted that her students' academic abilities varied tremendously this year. Some students had not mastered the basic skills from the previous year whereas some students were exceptional in mathematics.

Mathematics Lessons.

The mathematics lessons generally lasted forty-five minutes daily. Lisa usually began the lesson by reviewing previous lessons, practicing math facts with the students, and/or checking their homework. The students were instructed to move their desks to form cooperative groups on nine days during the study. Lisa called on students as they checked homework together from the previous day. She asked, "What do you think, or does it make sense?" after each question.

On June 8, 2007, the first day of observation, Lisa started the lesson by checking homework. As she called on different students, she circulated around the room checking each student's work. When a student said 38 plus 59 was 87, many responded that they did not agree with him. Lisa asked if the answer given made sense. Several hands went up and she called on

one student to explain why he did not agree. He stated that eight plus nine equaled 17 so 10 had to be carried over to the tens place. He then added one, three, and five and got nine, not eight, so the answer was 97 not 87. They spent 12 minutes checking homework. After that, Lisa reviewed how the class learned to make a group of 10 when counting a large quantity of things in the last lesson. She passed out a worksheet “numbers up to 1000” and said, “Please sit up straight. Breathe deeply and get some fresh oxygen in your brain. You are going to estimate how many fish are on this page in 30 seconds.” She had different students share their estimates after 30 seconds. She then instructed them to count all of the fish on the page by making groups of 10. She explained that they needed to count 10 fish and draw a circle around them to make each group clear. She asked if it was all right to make mistakes. Students responded, “Yes.” She agreed by saying, “Yes, it’s all right to make mistakes.” The students spent the rest of the class time making groups of 10 as Lisa walked around the room and checked each student’s work. At the end of the lesson, she instructed students to take the worksheet home and to complete making groups of 10 as their homework.

On June 18, 2007, in the second week of observation, Lisa instructed the class to move their desks to make cooperative groups before starting the lesson. The students then were told to get out the magnetic tiles that they had in a toolbox they kept in their desks. The students at the school had to purchase toolboxes at the beginning of the year containing math facts flashcards, magnetic tiles, and plastic counting beads among other things to be used for mathematics lessons.

Magnetic tiles were used to show place value. They included small squares to represent ones place, sticks to represent tens place, and large squares to represent hundreds place. Two students had taken their magnetic tiles home and did not have them so Lisa told them to watch

others during this activity. When students got the tiles on their desks, Lisa asked them to make “75” with their tiles in 30 seconds. After 30 seconds, she asked how many ten-sticks and ones squares were used. She had all students stand up before checking their response, then she had them sit down if they were correct. She next asked the ones standing up to make “65” with tiles in 20 seconds. She reminded them this was a review of what they had learned in first grade. She stated that they were going to do the same with larger numbers. Each cooperative group had four students and each student was assigned numbers from one to four. Number 1 in each group was to make 287, number 2 was to make 234, number 3 to make 239, and number 4 to make 102 with tiles in 45 seconds. She instructed the two students with no tiles to mentally picture tiles in order to make their number in their head. After 45 seconds, she called on students to share their work.

She next asked students to explain why they used particular tiles to make their number. The students went to the chalkboard and put their tiles on the board when some other students didn’t get the right tiles for their number. She then asked number 1 in each group to make 898 with his or her tiles. She told the students other members of the group could help a person if they did it silently. They repeated this step three more times. After this activity, she had students review what they learned in the lesson by pointing to the number 898 written on the board and asking them to hold up the right tile to represent “8” in the hundreds place and so on. She instructed students to put away the tiles and clean up in 120 seconds.

To end the lesson, she pointed to the numbers written on the board from the lesson and asked what the smallest and the largest numbers were. When a student answered the smallest number was 75, she asked a volunteer to explain why 75 was the smallest number. One student stated, “Seventy-five didn’t have any number in hundreds place, but other numbers did.” Another student responded that the largest number was 974. Lisa asked why 974 was the largest number,

and one student said that 9 was the largest number in all of the numbers used in hundreds place. But, student A disagreed with this answer and said that 234 was the largest number. Lisa asked the class if anyone wanted to explain why 974 was larger than 234. One of the students explained that 900 was larger than 200, and another student stated that 9 was bigger than 2. Lisa asked the student if that made sense to him and he nodded in agreement.

Lisa's mathematics lessons included many hands-on activities and students' explanations. She asked students to demonstrate their mathematics knowledge and understanding in a concrete manner using different manipulatives including tiles, newspaper cut-outs, and counting beads. She encouraged students to explain and debate their thought processes. Her students were very active during the mathematics lessons. They talked about how they got their answers, why they agreed or disagreed with other students, and what they had learned in each lesson. They seemed very comfortable in discussing mathematics topics in this classroom.

Lisa's themes were continual trial and error, personal desire to become a better mathematics teacher, feeling of competence, and discouragement over a lack of parental involvement and administrative support. Lisa repeatedly expressed her desire to make mathematics lesson stimulating and interesting for her students during the study. Her views of mathematics and teaching are summarized as follows:

- (a) The teacher must encourage the students to think, discuss, and debate their understanding of mathematics ideas.
- (b) The teacher should provide a variety of learning activities to meet students' needs.
- (c) The teacher should continue to learn in order to become a better teacher.

Lisa's views on mathematics and teaching were consistent with her classroom practices. She continuously reflected on her teaching and student learning and made adjustments accordingly to plan future lessons.

Case Two: Ken

Ken's Background.

Ken was a second grade teacher with six years teaching experience. He had taught sixth grade for two years, fifth grade for a year, and fourth grade for two years. This was his first year teaching second-grade. His major in college was middle school physical education and he wanted to become a basketball coach but he decided to add elementary degree work before he graduated because there was a demand for male teachers in elementary schools. It took him two years to complete the coursework needed to add the elementary education teaching degree. He was hired as an elementary school teacher after graduating from college, but was still planning to teach middle school in the future. During the interview Ken stated that he believed that he might stay in elementary school after all.

Ken claimed that he neither liked nor hated mathematics in school. His favorite subjects had been physical education and art throughout the school years. He remembered listening to a multiplication song on a tape and adding angles of a triangle in mathematics lessons in elementary school. He couldn't remember anything particular about mathematics lessons in middle or high school.

Teaching Mathematics.

Ken said he believed students who were good at mathematics had computational skills. If students were confident that they could do mathematics, they usually were good at mathematics. He wanted to teach students to listen to verbal clues and comprehend what was being asked and to think critically in mathematics. He noted that he felt the mathematics textbook that they were using showed the entire problem solving procedure, so it might be boring for some students. He stated that he wanted to create a learning environment within the classroom where students were

asking questions and actively thinking about the process. He expressed the belief that good mathematics lessons would make learning fun for students. Although it might not be fun all the time during the lessons, Ken said he wanted students to be able to explain what was happening in details of solutions and think for themselves.

Ken studied the teacher's guide to prepare for mathematics lessons. He also collaborated with veteran teachers. Second grade teachers in his school sometimes met to plan lessons together. They also had professional development opportunities in school during which they were able to observe other teachers. The professional development activities called *juyou kenshuu*, lesson study, consisted of a team of teachers in school meeting regularly to design lessons to study over a long period of time according to a topic selected by the team, planning a lesson, teaching a lesson, evaluating a lesson, re-teaching and reevaluating a lesson, and sharing the result with others in the country to add to the collective data base designated by the government. Ken credited those collaborative works as the foundation for his mathematics teaching style.

A Description of Ken's Classroom.

The class had thirty-one students sitting in eight rows and two columns. Each row had four students. All of the students were facing toward the chalkboard, which Ken used during the lessons. The two sides had windows from the front to the back of the room. One side faced the busy street and the street noise trickled into the room when the windows were open. Another side faced the courtyard and the school's swimming pool. All students in the school had swimming lessons during their physical education time in June and July and the sound of splashing water and children's excited voices were heard in the classroom. The back of the room had shelves for students' bags and other materials with a bulletin board on top. Students' calligraphy works were

displayed on this board. The teacher's desk was located at the front of the room facing the students.

Three students received small group instruction during some mathematics lessons in another part of the building by a certified teacher. Ken referred these students to the program at the beginning of the school year that started in April. He observed these students struggle in mathematics lessons, and he had had telephone conferences with the parents of those students to discuss the problems and recommended the program to them. He thought these students would benefit from being physically close to a teacher and get more one-on-one practice, which was hard to do with thirty-one students in a room. He stated that all three students struggled in basic computation skills. He described sixteen of his students as advanced in basic computation, five as proficient, and ten as needing extra support. The three students in the intervention program were the ones who needed intensive support according to Ken's observation. He stated that sixteen students in his class had received small group instruction when they were in first grade because of their low achievement in mathematics.

Mathematics Lessons.

Mathematics lessons were forty-five minutes daily. Ken began each lesson by stating the lesson's objective or reviewing the previous lesson. The lesson sometimes started with practicing addition and subtraction facts using a workbook or checking homework. As the class checked homework together, Ken walked around the room to check each student's work and made comments such as "Why did you do it this way?" and "How did you get that?"

On June 11, 2007, in the first week of observation, Ken started the lesson by stating that they were going to learn something new that day. He instructed them to take out the notebook, open a new page, and write down what he was going to write on the board. He wrote, "Let's

investigate the large number,” on the board. He told the class to open pages fifty-two and fifty-three in the mathematics textbook. There was a picture of birds on page 52. “How many birds?” he asked the class. “How are you going to answer this? Please tell us how you are going to solve this.” One of the students said she could cross out [a bird] and circle [birds.] Another student stated he would cross out the birds he counted and when there were ten, he would circle them together. Ken asked, “Does that mean you are making a group? A group of ten?” and the student nodded “yes”. Ken nodded “yes” and said, “Let’s try this worksheet.” He then passed out the worksheet “The number up to 1,000” and told the class that they would go over what they were going to do. He looked at the worksheet, paused for a second, and said, “It seems a little too hard...let’s try something from the textbook.” There were two groups of items on the textbook pages. He had students look at the first group of items, which were pencils, and how the page had some pencils crossed out and a group of ten pencils were circled as an example. They then looked at the next group of items, which were bananas, and talked about how they were in groups of ten. He instructed the class to finish counting the rest of the bananas and find out how many bananas were on the page in five minutes. As students worked on the problem, he walked around the room and gave pointers to students who were struggling with counting.

After five minutes, Ken asked how many groups of ten there were and many students said there were twenty-three groups of ten and with five left over. Ken reminded the class that ten groups of ten made one hundred and placed ten ten-stick magnetic counting tiles on the board. He told the students this was the review of what they learned in first grade. He circled ten ten-stick tiles and wrote “100” on the board and asked the class how many groups of one hundred, how many groups of tens, and how many ones there were. Students answered 235. Ken nodded yes and said, “Let’s use the information from this practice and work on the worksheet. Please

read [the problem] silently and make groups of tens and hundreds. There were 15 minutes left for the lesson so he told the class to complete the worksheet and then they could take a break. He said, “You should be able to do this [kind of task] easily in a couple of days. This is something you do all the time, like counting milk tops [from milk bottles they get during lunch.] You need to do this...it’s really important that you count things yourself.” Most of the students completed the worksheet in 10 to 15 minutes but five students struggled and worked through their break.

On June 18, 2007, Ken passed the mathematics fact test papers from the previous day back to students at the beginning of the lesson and stated that they were going to correct their own test paper. He instructed them not to erase anything and not to look at someone else’s papers. There were two one-page tests of one page; both of whom were addition and subtraction problems. The three students in small group intervention instruction took their test paper with them to go over with the teacher during the intervention time. Ken told the class to take out a red pencil and correct their papers in two minutes. After two minutes, he started calling on students to check answers. He said,

This was easy [addition problems] but there were a lot more people who didn’t do well than I thought there might be. You didn’t have to do all the problems on paper but you all needed to check your answer when you were finished. It’s just careless mistakes. You could add number in your head but you needed to check your answer.

There were ten addition problems and six story problems in the test. He stated there were students who did not write down the unit of measure such as 23 “people” in one of the story problems. He marked the answer wrong if it did not have the word “people.” The next problem was “There were 40 strawberries in a basket. You ate nine strawberries. How many strawberries are left?” He asked the class if the problem was addition or subtraction since the word “ate” was used. One of the students answered that it was subtraction. They continued checking problems together. Ken asked what was wrong with $20 - 36$ on one question. A student said numbers were

in the wrong place. Ken paused for a moment and asked, “Why?” Another student responded by saying, “You can’t take a large number from a small number.” Ken agreed and praised the student for being smart. He told the class that you could not buy 50 cents of juice when you only had 10 cents.

There were many students who made mistakes on subtraction problems when there was a need to regroup numbers. Ken went over each problem with the class while asking questions such as “What do we do next?” “Why can’t we take 7 from 0?” and “Can we take 9 from 5?” When the class was checking $63 - 25$, he mentioned that many students tended to look at $3 - 5$ and came up with 2 as an answer. He wrote $63 - 25$ on the board and stressed that you only subtracted from top to bottom. He told the class to rework the problem if they didn’t get it correct. After they completed checking both tests, Ken said, “You need to read the questions carefully. Please make sure you circled all the questions that were correct and wrote down the answer if it wasn’t correct. I saw some people just crossing out the wrong answer, you need to write the [correct] answer on your page.” He then announced that they were going to work on more mathematics after a break because they needed to learn more about large numbers and dismissed the class.

Ken’s mathematics lessons usually consisted of the following: checking homework as a class, practicing mathematics facts using a workbook and checking answers, introducing a new lesson, and practicing a new skill. His students were active in class. There were not many class discussions or much small group work during the observations. Ken used a lecture style lessons most of the time.

Ken's themes were day-to-day survival, feeling of competence, discouragement over a lack of parental involvement, and difficulties in teaching other than by lecturing. His views of mathematics and teaching are summarized as follows:

- (d) The teacher should maintain order in his classroom.
- (e) Mathematics is a logical system of procedures.
- (f) It is the teacher's responsibility to direct and control instructional activities.

Ken's views on mathematics and teaching were consistent with his classroom practices. His lessons mostly consisted of lecturing, but because he collaborated with colleagues to incorporate additional teaching materials time to time, there were opportunities for the students to discuss and debate with others while exploring new mathematics ideas. Ken asked some higher order thinking questions such as "How do you know?" and "What did you do to get the answer?" when the students worked on different problems during such lessons.

Thematic Analysis: Japanese Teachers Lisa and Ken

Beliefs About Mathematics and Teaching

Lisa expressed beliefs indicating that mathematics should be taught in a manner relevant to her students. She sought out and used different learning activities with which to make learning mathematics fun. Her classroom practice was consistent with her expressed belief and demonstrated as she provided many hands-on activities during her mathematics lessons. Lisa's identity included "mathematics teacher and learner." Her statements indicated this is how she had perceived her identity throughout her teaching career. Her rationale for creating interesting and stimulating mathematics lessons was a strong belief that mathematics was a subject every student needed and applied in real life. Lisa, therefore, continuously sought ways to improve her mathematics teaching.

Ken was developing some of the same traits discussed and demonstrated by Lisa, such as asking open-ended questions, but he did not indicate that he viewed himself as a mathematics learner. He expressed the belief that mathematics should be taught in a logical manner. His classroom practice was consistent with such a belief and included many seatwork assignments during mathematics lessons. Ken did not seem comfortable when his students asked questions such as “But, why do we do that?” or “How did you get that answer?” He usually did not allow his class to have discussions; instead he would go over the problem solving procedures and explanations given at the beginning of the lesson. Ken stated that he was comfortable teaching second grade mathematics content, but he did not understand how to present the content to students in a manner that was easy for them to understand. The differences between these two teachers might be explained by the ways in which they had participated in school communities as new teachers. Lisa said she had learned how to teach by participating in the informal professional development that was in her school whereas Ken did not describe such participation. Lisa took advantage of opportunities to develop her mathematics pedagogical content knowledge.

Criteria and Rationale for Choosing Mathematics Instructional Activities

Lisa and Ken used the mathematics textbook to guide their lessons. They participated in a weekly grade level meeting to discuss lessons and share ideas and teaching materials. The students purchased a box of mathematics manipulatives including counting beans, flash cards, magnetic number tiles, and counting blocks at the beginning of the school year and all of the grade level teachers were reported by Lisa and Ken as planning mathematics lessons to include these materials. Lisa and Ken incorporated teacher made worksheets that they or their colleagues had made to enhance students’ mathematics learning. Both teachers reported utilizing the grade level meetings to study and plan their mathematics lessons. Ken noted that he studied the

teacher's manual before the lessons and often asked questions on how to present the content during the grade level meetings.

Lisa used real life materials such as pencils, to aid counting activities and a newspaper to help visualize the concept of area. She indicated she constantly was looking for teaching ideas in her environment. She stated that the students needed to know that mathematics was "all around them." Ken did not use such items in his lessons.

Self-Reflection.

Lisa described how she adjusted and modified her mathematics lessons in order to meet the needs of a changing society. Her identity continues to be a mathematics teacher and a learner whereas Ken's stayed solidly as a teacher. The possible explanation for this could be Lisa's identity as a teacher was based in experiences during which she had struggled to develop her teaching style by continuously learning and trying out different teaching strategies from the beginning of her teaching career. She commented that other teachers were helpful and worked together on many lessons when she first started to teach. She learned from others in her school communities by participating in professional development. She said her current school was "not like that." She explained:

Now, we are graded yearly by administrators on how we teach. Because there are certain numbers of teachers who can make a certain grade, teachers are not willing to help other teachers. I mean, if you help someone and that person does a good job, there is a chance that your grade might get lowered. We don't collaborate as much as we used to. Teachers don't work together like we used to. I don't think that's right, but it's just the way it is.

Lisa stated that she did not collaborate with her colleagues as she had when she first started to teach. She continued to reflect on mathematics lessons from the beginning of her teaching career. She described, in detail, how each student in her second grade class was doing compared to how he or she had performed in first grade. She had a deep understanding of each

student's strengths and weaknesses and of how to support him or her. She often included a student's background when she talked about his or her mathematics ability and progress. This background knowledge along with her reflection on mathematics lessons allowed her, she said, to provide individualized instruction for each student in her class.

Because Ken started teaching only six years ago, he might not have had the same kind of learning experiences as a new teacher as Lisa did. The change in a school community and in how new teachers learn to become a mathematics teacher, to develop their pedagogical content knowledge in mathematics teaching, could explain the difference between Lisa and Ken's teacher identities. Ken was less knowledgeable about his students' backgrounds. He talked several times about students in his class who "didn't have family to help them at home with school work," but he did not elaborate any further. He arranged assistance for four of his students who he felt needed the extra help the most, to receive 30-minute small group mathematics instruction daily by a resource teacher. He also kept some students in the classroom during recess to help them with their mathematics and other subjects. Ken did not express how he adjusted and modified mathematics lessons. He checked homework with the class to review skills and concepts and helped those who didn't get them during the recess.

Research Site: The U.S. School

The U.S. participants were two teachers from a public elementary school located in North Alabama. Nearly 50% of the student body in this school received free or reduced lunch. The school served kindergarten through fourth grades with a student population of 566 in a rural part of this southeastern state. Of the 566 students, 99% were Caucasian, 0.08% African American, and 0.02% Hispanic and others. The special education population was approximately 7.3%. There were 41 certified teachers, one counselor, one media specialist, one reading coach, and

two administrators in the school. Thirty-three percent of teachers held Bachelor's degree, 58% held a Master's degree, 7% held Educational Specialist or Doctorate degrees, and 2% hold alternative degrees. The average pupil teacher ratio was 22:1. The average numbers of computers with Internet access in a classroom was three. There also were two computer laboratories for each class to use 30 minutes daily.

A second grade and a third grade teacher were selected to participate in the study to align the mathematics contents with that taught in the Japanese school. In Japanese second grade classrooms, students were learning multi-digit addition and subtraction, multiplication facts, numbers up to 1000, the number line, and area during the study. The U.S. second graders were learning multi-digit addition and subtraction, numbers up to 100, and the area during the study. So, to observe the similar mathematics lessons in the U.S.A., the researcher had to include a third grade class. The observations in Japan were conducted at the beginning of their school year and the observations in the U.S.A. were conducted at the beginning of their school year. This is not consistent with research findings that the U.S. schools teach many more mathematics concepts compared to Japanese schools (Schmidt, McNight, & Raizen, 1996). However, this confirms previous studies' findings (Ma, 1999; Stigler, Fernandez, & Yoshida, 1996) that U.S. schools spend many hours reviewing previously taught skills and concepts.

The case study teachers utilized the Saxon Math program (Larson, 2004) which the school system had adopted several years ago. The Saxon Math programs typical lesson consists of a daily meeting board, timed fact practice, a lesson introduction, a guided and independent practice, and a closure. The daily meeting board provides a whole class lesson for a pattern and date activity for second grade students and a pattern, date, time, and money activity, and a word problem for third grade. Worksheets provide class practice on one side and homework on the

other side. The average length of mathematics lessons is between 40-50 minutes. Both teachers in this study collaborated with their colleagues at their grade level to plan lessons. They followed the lesson plans that are provided with the Saxon Math program and taught one lesson a day, so most of the teachers in each grade were on the same lesson on the same day during the year. Both teachers strictly followed the program's script and lesson format.

The study was conducted from August 22, 2007 to September 13, 2007. Because videotaping and audio-taping were not used as data collecting tools in the Japanese research site to respect participating teachers' wish, the researcher used only field-notes, interviews, surveys, and observations as well in the U.S. research site.

Case Three: Mary

Mary's Background.

Mary was a third grade teacher with thirty-two years of teaching experience. She taught special education for two years when she first started teaching and then moved to third grade which she taught for the past thirty years. She stated that she liked teaching third grade because students were somewhat independent compared to the lower grades and she was familiar with the contents of all subject areas in this grade. As a child, Mary wanted to become a doctor or a librarian. She suffered from allergies, which caused her to frequent a doctor's office and made her think that would be a good job for her to have when she grew up. She also dreamed about becoming a librarian because of her love of reading. She stated that she had a group of great teachers in high school and started to think about teaching as her future career.

When asked about her mathematics learning experience in school, she stated:

I remember learning mathematics “from the book” from first grade through college. I hated mathematics as a student even though I made a good grade. I just thought mathematics was too abstract and I didn’t get it. I liked things that were “concrete.” I don’t recall any hands on activities that were used in the classrooms. It was basically solving problems from the drills and textbooks at school and home. I heard the word “hands on approach” in one of the college courses I had, but it was just a terminology in the book. I remember mathematics lessons in third grade when I learned to tell time. I just didn’t get the concept. My mother would work with me at home and say, “Why can’t you get it?” I had a hard time telling time, like when something starts at a certain time and I’m supposed to figure out when it ends. I just didn’t understand it. I remember my sixth grade as the first distinctive experience where I struggled with mathematics. I felt that mathematics had “lots of rules” and learning cumulative property was horrible. I never had fun in a mathematics class.

When probed for more mathematics memories, she remembered her third grade teacher, her fifth grade teacher, and a principal from her first school where she started to teach as being good mathematics teachers. She didn’t remember details of mathematics lessons she had had, but she said all of these individuals were energetic and very knowledgeable in mathematics. She also mentioned a high school mathematics teacher whom she felt was very smart but was not a good instructor. She said that this high school teacher could not relate to his students because he was “too smart.”

Teaching Mathematics.

Mary was confident in teaching mathematics in third grade. She commented that she could teach third grade “with her eyes closed.” She believed that students needed to become problem solvers and abstract thinkers in order to do well in mathematics but the abstract thinking was not fully developed at this age. She stated that using pictures might help those students. She thought the ability to break apart problems was an important skill in mathematics. This ability helped students “not to give up.”

She emphasized that parental involvement was a key factor if a student was to succeed in mathematics. She claimed that most parents would want their children to do well and be

successful, and it was her job to try children to see how important and useful mathematics was in everyday life. She also pointed out that consistent support from a teacher and the provision of [learning] opportunities were imperative factors in students' success. Mary felt that teaching mathematics in a rural school was not much different from teaching in any other parts of the world because there were "good and bad families everywhere," lack of funding, resources, materials, and so on that posed issues for all educators. She believed that having the "latest [teaching] materials" didn't make teachers effective. She learned how to teach mathematics through "the years by trial and error" and from the teachers with whom she worked years ago.

Mary commented that she liked the Saxon mathematics program that the school system adopted eight years ago. The program consisted of two to three pages of worksheets per lesson. Usually one worksheet provided timed practice for mathematics facts and another gave practice in different mathematics skills that had been taught in previous lessons. Another one or two worksheets were included when a new mathematics concept was introduced. Counting tips, geometric solids, mathematics facts charts, calendar materials, teacher and students' clocks, and other materials were provided for the class with the program.

Mary believed the program provided plenty of opportunities for students to practice and review important mathematics concepts and skills throughout the year. Her only concern about the program was that not using the textbook might cause some students to view worksheets as something to throw away after each lesson and thus lead them to think of mathematics as something they did not have to seriously practice. In all, she was very satisfied with the program.

A Description of Mary's Classroom.

Mary had seventeen students in her class all seated facing toward the front of the room. They were placed in a group of four to five by having an extra desk in the middle and placing

students' desks around it. The extra desk held a basket of student materials such as markers, pens, a dictionary, wipes, and a box of tissues. There were white boards on the front and one side of the room. Shelves and a closet were located at the back of the room. There were windows on one side of the room and shelves under the windows on which to keep books and other materials. The teacher's desk was located in front of the windows and three computers were placed on the table in front of the room. Students' art works were displayed on the wall in and outside of the classroom. There was a rolling cart filled with classroom books.

Mathematics Lessons.

Mathematics lessons generally were 40 to 45 minutes long depending on a lesson. Mary usually started the lesson before lunch and completed the lesson after the class came back from lunch. The class began with checking homework together by calling on different students to give an answer. If the answer was wrong, she asked another student to respond. After checking all the answers, she passed out a worksheet for fact practice. She would time the students as suggested in the teaching guide and they would check the answers together. Mary then started a lesson by reviewing previous lessons or introducing a new skill and concept. At the end of the lesson, the students were instructed to place their worksheets in their folders and take them home for homework.

On August 22, 2007, during the first week of observation, Mary started the lesson by reviewing the word "sum" from the previous lesson and introducing the word "difference" for the new lesson. She passed out the fact practice worksheet "Subtracting 0" to the class and asked, "What happens when you subtract zero [from a number]?" One student responded, "It doesn't change." Mary nodded approvingly, then started calling out the problems on the worksheet. The students answered orally as they recorded the correct answer on the worksheet. Mary next stated,

“Difference of zero. They are doubles. They are all the same number. You have three pencils, take away three. How many do you have [left]?” The students answered, “Zero!” She then instructed students to move their eyes to the next group of problems on the worksheet and said, “Subtracting one. What pattern do you notice?” One student said, “They are in order.” Mary continued, “That’s right. You are counting backward. $10 - 1$ is?” The class responded by saying, “9,” in unison. Then she asked, “ $38 - 1$ is?” and the students answered “37.” She stated to the class, “Whatever you are subtracting from, count backward. Difference of one. I have four apples. I gave three away. How many do I have [now]?” as she wrote the number sentence on the whiteboard. The class responded, “1.” She nodded and said, “What is $1 + 3$?” and the class answered “4.” She explained that was how you would make sure you had the right answer. She told the class to turn the page over and underline the words “1 minute,” “check,” “correct,” and “sign.” She said, “Remind your study buddy to follow those steps tonight. Put the sheet in the binder. Put your binder up and get your folder out.”

The students took out the folders they used during the assessments as she passed out the paper. She asked for a volunteer to read the statement on the paper. Mary asked the class if there was any important information needed in order to solve the problem and called on one student. As the student answered, she nodded and instructed the class to place brackets around the important information. She praised students by saying, “Very good,” while circulating the room and they repeated the same procedure for the rest of the problems. She explained that the “sum” was the answer so they needed to underline that part [on the paper] as she turned the overhead projector on and placed a transparency sheet already marked accordingly. She continued by saying, “Go over dates between May ninth to May twenty-third. Go over odd [numbers]. They are not going to be odd. Let’s copy down the dates.” She went over one day at a time as students

wrote them down and asked if it was odd or even. She told the class to mark out odd numbers as she asked, “What did our question say?” A student said, “To find the date.”

Mary then wrote down “First, next, then, finally,” on the whiteboard and explained that the time order words they had talked about during the previous week would be used in mathematics. She mentioned that the state test would be administered in spring, and they needed to use those words to answer questions on the test. Finally, they wrote down the steps they had taken to get the answer on the page to conclude the lesson.

On August 27, 2007, during the second week of observation, Mary passed out small zipper bags and instructed students to write their names on them and to keep them inside of their math folders. She then passed out the fact practice worksheets with 50 problems and said, “I’m going to give you a minute to study the fact problems.” After a minute, she told the class to begin writing down answers. When the time was up, she called out answers as students checked their worksheets with a pen.

Mary started the lesson by saying, “Today we have a new math term, ‘congruent’.” She held up a piece of square paper and asked how this square could be divided in two. A student responded that “It could be folded,” and another student said, “Slant it.”

Mary passed out two square sheets per student and instructed them to fold their paper in half and draw a line with a ruler. She asked if they had two equal parts to which students answered “yes.” She then asked the class what they called the equal pieces. The students responded, “Congruent.” She continued by saying, “How do we know we have the equal parts?” Students said, “Fold it.” Mary nodded and said, “Do your pieces match up? Are they the same shape? They are congruent. Keep red squares in your math folder.” Then she passed out three

yellow squares, and the class folded each twice to make a smaller square. She then asked how many squares they thought they would see when they unfolded it. Students called out, “Four!”

Mary instructed them to trace the lines after unfolding the yellow paper and asked if the [smaller] squares were congruent and how they knew. One student responded by saying, “They are same size and shape.” She told the class to use another piece of paper and to fold the paper twice to make a rectangle by making sure the edges were even. She went through the same steps with the class and continued with the last piece of paper folding it twice to make a triangle. Mary concluded the lesson by having three students draw lines on squares on the board to represent the lines they had just drawn on their square papers.

Mary’s mathematics instructions followed the Saxon Math (Larson, 2004) teacher’s guide. She did not read the script but she paraphrased the instruction from the teacher’s guide. Most of her students were usually were on task, but some students struggled to stay focused. Mary chose not to include some small group and independent activities suggested in the teacher’s guide in some lessons because she preferred whole group instruction. She commented that she did not like the noise level when students worked with others. One activity, for example, suggested for a lesson included the use of color tiles with which for students would create a design when they were learning different shapes and students were to explore with color tiles for 10 minutes before moving on to another activity. Mary omitted this activity completely. She explained that this kind of activity was not necessary for students to understand shapes.

Mary’s themes were difficulties in teaching other than by lecturing, discouragement over a lack of parental involvement, and feeling of competence. Her views of mathematics and teaching are summarized as follows:

- (a) Mathematics is a logical system of procedures and it is unchangeable.

- (b) The teacher has knowledge to teach mathematics when she graduates from college.
- (c) Students learn best by attending to the teacher's explanations and responding to her questions.

Mary's views on mathematics and teaching were consistent with her classroom practices. Her lessons mostly consisted of lecturing. She did not incorporate additional teaching materials that were not part of the mathematics program used in her classroom. She omitted learning activities suggested in the program when she felt the students did not need them to master the skills. She felt competent in her ability and to teach mathematics and mathematics knowledge believing that she did not need to change how she taught mathematics. She stated that she did not spend much time planning mathematics lessons because the program offered everything she needed to teach each lesson.

Case Four: Christy

Christy's Background.

Christy had taught first through fourth grade since she started to teach eight years ago. This was her third year teaching the second grade. She liked this age group because they were able to do "more." Christy was a national board certified teacher and a doctoral student.

Christy's memory of the mathematics lessons she had in elementary school consisted of solving problems on worksheets. She didn't remember any type of mathematics manipulatives or hands-on activities used in a classroom. In secondary school, she remembered taking notes and completing guided and individual activities from textbooks.

Teaching Mathematics.

Christy believed providing hands-on activities and instruction with manipulatives were important when teaching mathematics. She felt students needed guided and independent practice and the use of clear and simple instructions led to students understanding. She stated one-on-one

assistance was necessary when a student struggled. Christy created a learning space with visual charts that were accessible to students.

Christy commented that females in general were discriminated against at times in mathematics. Her female students tended to be quiet during mathematics lessons, and their parents were not always comfortable helping their girls with mathematics. She emphasized that parental involvement, good behavior, and eagerness to participate in lessons contributed to students' success in mathematics. She strove to instill in students the ability to listen and follow directions, work well with numerals, and demonstrate organizational skills in order for them to become good mathematicians. Her teaching style was shaped through her course work in college, teaching experiences, professional reading, and workshops. She stated that the mathematics program her school system was currently using, Saxon Math (Larson, 2004), had "a high success rate" with her students. She explained that Saxon Math programs was very good for her students, they were learning basic mathematics skills that they needed successfully because of this program. She classified some of her students "exceptional" for extending their mathematical knowledge and understanding.

A Description of Christy's Classroom.

There were sixteen students in Christy's classroom seated in three groups of six students so that they faced each other. There were windows on one side of the room with shelves underneath filled with classroom books. Three computers sat on the counter on the other side of the room next to the teacher's desk. The shelves for students' bags and materials were located in the back and the whiteboard was in the front of the room. Christy utilized a SmartBoard for many of her lessons that she had acquired through a grant several years ago. She also used an overhead projector for mathematics lessons. The room was organized with colorful baskets full

of books and other materials for students to use at a different time of the day. The charts in the room provided clear instructions for daily activities. Students' works were displayed on the bulletin board around the windows and in the hall. Christy claimed that the majority of her students did well in mathematics.

Mathematics Lessons.

Mathematics lessons generally were 35 to 40 minutes long depending on the lesson. Lessons usually started at 11:15 a.m. They consisted of going over the meeting board with the student helper of the day as students checked their work in their mathematics folder. The meeting board had a date, daily count, and pattern. After the meeting board activity, students completed a fact sheet and corrected the answer together before starting the lesson of the day.

On August 22, 2007, during the first week of observation, Christy started the lesson with the day's pattern on the meeting board. The students sat on the floor in front of the room where the meeting board was located. The pattern was "square, triangle, circle, square, triangle, and circle." She asked the class what to label the square in the pattern and the students responded, "A." Then they continued to name the next two shapes "B" and "C" together. They added more shapes to the pattern before completing it on the meeting board and going back to their seats. They then took out the mathematics folder in which they kept their daily meeting worksheets. The student of the day was in charge of completing the daily count by counting from 83 to 92 by ones. He wrote on the meeting board on the front as he counted up. Christy said, "We stopped at 92. What number do we start with on the next row?" The students answered, "93," and Christy asked the student of the day to call out the [numbers for the] next row. She continued, "It ends with 102. 1, 0, 2. Make sure that's what you have. What does the next line start with?" Students responded, "103," and she told them that was right. She next instructed them to put away their

folders as she counted down from three. She wrote “Adding 0 and adding 1 facts,” on the board and placed a piece of paper with the following written on it: addend – numbers we are adding, sum – the answer for an addition. She also wrote “Commutative property of addition problem,” and number problems, “ $0 + 0, 1 + 0, 2 + 0, \dots 9 + 0,$ ” on the board. Christy turned around and asked the class what they noticed about the number problems. Several hands went up and she called on a student. He stated, “It’s in order.” She nodded yes and asked why they were calling them adding 0 facts and the class said that they were adding 0. She called on different students to answer the number problems on the board. She praised each student by saying, “Good,” “Nice,” and “Very good.” She asked the class what happened when they added 0 to a number before writing down more number problems on the board. She wrote “ $0 + 1, 0 + 2, 0 + 3, \dots 0 + 9$ ” and asked the class what she had done. A student replied that it was backward. She nodded yes and asked if the sum was going to be different and the students said, “No.” She continued to ask if the addends were the same and the sums were different. The class responded, “No,” to both questions. Christy asked the class what the strategy was when they added 0 to a number. A student answered, “Any number we add to 0, the number is the same.” She reviewed that these problems were called “adding 0.” The class repeated the same procedure for adding 1 problems and continued with the number problems written on the board. Christy called on all the students before dismissing them and lining them up for physical education to conclude the lesson.

On September 13, 2007, during the fourth week of observation, Christy started the lesson with the meeting board. She posed questions for the student of the day to answer and the class completed the familiar process together. The students worked on the fact sheet and checked the answers. Christy announced to the class that they were going to learn “some, some more and some, some went away” problems and draw pictures to represent story problems. She read,

“There were two fish in the basket. A fisherman caught three more fish. How many fish are there now?” She next demonstrated the process on the board by drawing two fish on one side and three fish on another as she encouraged students to give her the information from the story problem. She asked, “What happened first? Then what happened?” and wrote “ $2 \text{ fish} + 3 \text{ fish} = 5 \text{ fish}$,” under the drawing. She praised the students for listening well and reminded one of the students to pay attention. She repeated the process with “ $2 \text{ birds} + 4 \text{ birds} = 6 \text{ birds}$,” “ $6 \text{ ice cream} - 2 \text{ ice cream} = 4 \text{ ice cream}$,” “ $8 \text{ dimes} - 3 \text{ dimes} = 5 \text{ dimes}$,” and “ $5 \text{ markers} - 3 \text{ markers} = 2 \text{ markers}$.” She asked the class what kind of story it was after she read each story problem and the class responded either that it was a “some, some more,” or “some, some went away,” story. Most of the students were on task during the lesson and participated actively by responding to the teacher’s questions while four students were told to pay attention several times during the lesson.

Christy’s mathematics lessons followed the Saxon Math (Larson, 2004) teacher’s guide precisely. She started a daily lesson with a meeting board, followed by a timed fact practice, and then a new lesson. Students were engaged and active during the lessons. She rarely modified the script from the teacher’s guide and stayed with the time suggested for each activity. Students participated in independent learning activity such a meeting board and fact practice, and a whole and a small group activity such as checking a meeting board and working with manipulatives with others, as suggested in the Saxon Math program.

Christy’s themes were feeling of competence, time constraints, and discouragement over a lack of parental involvement, and difficulties in teaching other than by lecturing. Her views of mathematics and teaching are summarized as follows:

- (a)The teacher should maintain order in her classroom.
- (b)Mathematics is a logical system of procedures.
- (c)The teacher should present the mathematics lessons as they were planned in the textbook.

Christy's views on mathematics and teaching were consistent with her classroom practices. She did not incorporate additional teaching materials to the Saxon math program used in her classroom. She stated that she was glad to have a mathematics program that was "solid." She elaborated further:

"I really like Saxon math program because it offers everything you need. It comes with worksheets and lesson plans for every day. I think my students learn a lot of basic things by practicing skills over and over. To be honest, with the new reading program and all, I don't have a lot of time to plan for math lessons. So this (Saxon math program) helps me a lot."

Thematic Analysis: U.S Teachers, Mary and Christy

Beliefs About Mathematics and Teaching

Mary and Christy talked about focusing on becoming a good reading teacher when they started to teach, not on developing mathematics pedagogical content knowledge. They both commented that they loved reading as a child and loved to teach reading as a teacher. Their love of reading carried over into their reading instruction. Mathematics instruction was not their prime focus, according to their statements. They described how they developed their identity as a reading teacher by using words such as "love to read," "wanted to spend a lot of time reading," "love books," but they did not use positive words when they described teaching mathematics. They mainly talked about the Saxon Math program which they used.

Mary and Christy indicated they believed students learned mathematics skills and concepts by mastering a particular problem solving procedure. They did not see a need to include discussions and debates during mathematics lessons in order to help students explain and understand why a certain problem solving procedure worked while others didn't. This finding corresponded to a previous study that found U.S. teachers did not know why a particular problem

solving procedure was used nor how to explain multiple ways to solve a problem to their students (Ma, 1999).

Criteria and Rationale for Choosing Mathematics Instructional Activities

Mary and Christy both noted there was “a big push” to teach reading in a different way in their state which was not how they were accustomed to teaching it, so the amount of time they could spend on planning and teaching mathematics was very limited. They stated the Saxon math program was the only material they used in their classroom because it had everything they needed to teach mathematics lessons. They did not include any additional materials during mathematics lessons. They believed the program was effective in teaching what their students needed to learn. This finding confirmed a previous research study that found U.S. teachers tended to base mathematics lessons on the textbook (Schmidt, 1996).

Mary and Christy both followed daily Saxon math lesson plans set out by the program, but Mary often omitted learning activities that required students to work with others. She preferred her students stay seated in their seats in rows and not collaborate with others, because she said working with others created a lot of noise.

Self-Reflection

Mary and Christy shared similar experiences as mathematics learners and teachers and demonstrated similar traits in classroom practices, thus similar levels of mathematics pedagogical content knowledge. They did not mention any changes in school communities as did Lisa. This could explain why their teacher identities were more similar than were those of Lisa and Ken. They did not describe themselves as mathematics learners after they started teaching, and did not indicate such a role was part of their teaching identities. Their mathematics teacher identities consisted of confidence in teaching mathematics at their grade level. They did not

discuss their weaknesses in teaching mathematics nor any improvements on which they were focusing. They were satisfied with their mathematics pedagogical content knowledge although they did not demonstrate more than a basic level of such pedagogical content knowledge. It has been noted that the mathematics knowledge gap between U.S. teachers and that of others countries paralleled the mathematics achievement gap between U.S. students and that of other countries (Stevenson & Stigler, 1992). These parallels seemed to be in play among the two sets of teachers in this study.

Mary and Christy indicated they did not reflect much on mathematics lessons taught because daily lessons were prepared for them to move on to the next lesson every day. By following the mathematics program structure, teachers knew what would be done the following day and so reflection was not expected nor encouraged. When asked about how their students were progressing, they both stated that the assessment tools were included in the mathematics program. The lessons built on skills and concepts taught in previous lessons, so they did not have to plan additional activities to review them, and could just use the provided assessments.

Cross-Sectional Analysis

The discussion in this section looks across the four participating teachers. Three themes are used to examine the differences among them:

- (1) Beliefs about mathematics and teaching.
- (2) Criteria and rationale for choosing mathematics instructional activities.
- (3) Self-reflection.

Beliefs About Mathematics and Teaching

All of the participating teachers except Lisa saw themselves as only mathematics teachers. Lisa continuously expressed her passion for learning to improve her mathematics teaching, and she was the only participant who had had informal professional development

opportunities to do so. It seemed that teachers' individual participation in a certain culture and community, in this case a school community, was related to their beliefs, mathematics teaching practices, and pedagogical content knowledge. A teacher working in a strong professional community formed a mathematics teacher identity that was aligned with the Standards (NCTM, 1989). At the same time, a teacher working without a strong professional community formed a teacher identity that was similar to that of the traditional mathematics teachers she or he had had as a student. The current study suggested that the sociocultural background of mathematics teachers mattered in relation to teachers' beliefs about mathematics and teaching, and their mathematics pedagogical content knowledge.

Ken's beliefs about mathematics and teaching were similar to those of the U.S. teachers, but some of his lessons included open-ended questions and some class discussions, which were not found in the U.S. classrooms. This difference in Ken could be because he participated in the grade level meetings and had conversations about teaching mathematics with his colleagues. Teachers selected and interpreted teaching materials differently depending on their understanding of the mathematics content, but the meetings that Japanese teachers had provided opportunities for them to share their thoughts and ideas. In those meetings, mathematics teaching became a cooperative activity within a context similar to the learning community that Lisa had described. The teachers learned more about mathematics and teaching from one another during the meetings in the Japanese school. This might explain why Ken sometimes taught in the same manner in which Lisa taught even though his beliefs were more closely related to those of the U.S. teachers.

Criteria and Rationale for Choosing Mathematics Instructional Activities

Japanese teachers had a weekly grade level meeting to discuss issues related to all subject areas. They collaborated to study, plan, and revise mathematics lessons. The U.S. teachers did not have such occasions during which they worked with their colleagues. The meetings helped Japanese teachers to decide how to present mathematics content and determine what instructional activities should be used, whereas the U.S. teachers depended on the textbook series they used to make those decisions. The teachers had learned how to teach mathematics in teacher training, but the U.S. teachers did not have enough knowledge to enable them to add new strategies and information for choosing mathematics instructional activities that aligned with new standards. The U.S. teachers were not unwilling to do so, but they didn't have the support system needed to guide them in doing so.

The U.S. teachers lacked motivation to further their mathematics pedagogical content knowledge after they started to teach. They were satisfied with their mathematical knowledge and PCK acquired during their schooling and did not believe they needed to continue their professional development. They were both confident in their ability to teach school mathematics to their students. Japanese teachers continued to study mathematics and teaching, further developing their PCK, and had conversations with colleagues in which they shared ideas and asked questions regarding the mathematics lesson they taught and/or were planning to teach. These activities helped them to develop criteria for choosing mathematics instructional activities that most benefited their students.

Self-Reflection

In describing their current teaching experiences, the U.S. teachers spoke of the Saxon Math program, of students' characteristics such as not paying attention and not doing homework,

and of parental involvement. Japanese teachers also commented on the mathematics program used at their school, students' characteristics such as inattentiveness and declining social skills, and parental involvement. The four teachers voiced concerns over educational policy changes such as movement toward the use of rigorous testing and implementation of more rules and regulations over which they did not have control, and changes in their society such as less parental involvement and support. Japanese teachers described the trend in Japan to "relax and enjoy learning" that resulted in fewer instructional days and thinner textbooks. They stated that children weren't learning as much mathematics as they used to learn. Lisa and Ken explained that Japanese parents did not demonstrate respect for schools and teachers as in the past. The U.S. teachers voiced similar concerns about parents.

Of the four teachers, only Lisa showed signs of making changes to mathematics lessons by reflecting on her actions and students' reactions. The grade level meetings provided opportunities for Ken to reflect on his lessons, but he did not seem to use his reflections in planning lessons. He focused on future lessons that were to be taught separately from the lessons already taught. He planned lessons and taught lessons as they were planned, even when students struggled to understand the concepts. This was apparent in one of the lessons when he was teaching the topic of a group of ten. Many students were confused and struggled to grasp this new concept during the lesson, but Ken repeated the same explanation and did not elaborate further. He did not include the concept in the next lesson to check students' understanding of the concept.

The U.S. teachers did not have a similar meeting for any subject except reading. They did not reflect on mathematics lessons to make any changes to the future lessons. They simply followed the prescribed lessons. These differences from the Japanese teachers could be due to

the type of the mathematics programs used to teach, which was scripted. It might also be due to the lack of opportunities to collaborate with colleagues to study and plan lessons that might prompt teachers to reflect on their lessons, teaching, and student learning.

Summary of This Chapter

This chapter presented the data collected from each of the four individual teachers studied. Each teacher's beliefs, the mathematics teaching practice and PCK demonstrated, and a cross-sectional analysis were presented. In the following chapter, a thorough analysis and discussion is provided for each teacher.

CHAPTER 6

Discussion

This chapter is divided into three sections and includes the following: (1) summary of the study, (2) discussion of the research findings in regard to the four teachers, and (3) implications and future research.

Summary of the Study

The current study was guided by the following research questions:

1. What congruent relationships are found between the identities of teachers and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
2. What is the evidence for the existence of congruent relationships between teacher identities and their teaching practices in four primary grade mathematics classrooms in the United States and in Japan?
3. How can the relationships between the identities and mathematics teaching practices of four second grade teachers, two in the United States and two in Japan, be explained locally and globally?
 - a) What is the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community?
 - b) How can the relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community be explained in terms of its relationship to the broader culture in which the mathematics classroom is situated?

Situated learning theory (Lave & Wenger, 1991) provided a theoretical framework for the study. The goal of this study was to identify and make hypotheses about the relationship between teachers' identities and mathematics teaching practices in primary grades classrooms.

Identifying teachers' identities is a key to investigating the relationship between the individuals, communities, and cultures that surround each individual in the current study. Situated learning theory provides tools with which investigate how an individual forms his or her identity within a particular community by participating in activities that are unique to each community (Lave & Wenger, 1991, Wenger, 1998).

One's teaching identity is constructed through various experiences in a certain community and culture as an individual participates in, and negotiates, by learning particular rules that are specific to each community and culture. Wenger (1998, p.163) characterizes identity as follows:

Lived. Identity is not merely a category, a personality trait, a role, or a label; it is more fundamentally an experience that involves both participation and reification.

Negotiated. Identity is a becoming; the work of identity is ongoing and pervasive.

Social. Community membership gives the formation of identity a fundamentally social character.

A learning process. An identity is a trajectory in time that incorporates both past and future into the meaning of the present.

A nexus. An identity combines multiple forms of membership through a process of reconciliation across boundaries of practice.

A local-global interplay. An identity is neither narrowly local to activities nor abstractly global. Like practice, it is an interplay of both.

Because the process of understanding an individual's identity is complex, the language and actions the participants use within a certain context are examined to explore the socioculturally-situated identity being expressed in each case (Gee, 1999). Gee (1999) suggests that a researcher pick data, choose key words or phrases, and identify the context in which these

key words and phrases are used, think about how social activities and socially-situated identities relate to the data, and identify emerging themes when analyzing the data.

The research shared in this study supports the contentions that teachers' beliefs influence classroom practice and student achievement (Boaler, 1998). Although research has been done to examine teachers' beliefs and classroom practice (Boaler, 1998; Nathan & Knuth, 2003; Thompson, 1984), limited research has investigated how one's culture and community affect teacher identity and classroom practice.

The current study was a qualitative case study. Two participants were from the same elementary school in Japan and two participants were from the same elementary school in the United States. These teachers provided the unit of analysis for the study. Data collection methods included observations of mathematics lessons, teacher interviews, and teacher surveys. All data were analyzed to find common themes among the four participants. Data were analyzed first to compare the two teachers from each country and then to compare all teachers from both countries.

Discussion of the Research Findings

The research findings of this study are discussed in five sections organized by the research questions.

Research Question 1

The first research question of this study examined congruities and incongruities found between the identities of the teachers and their teaching practices in four primary grade mathematics classrooms in the United States and Japan. All participants, except Ken, claimed they liked teaching mathematics even though they did not like mathematics when they were students. All teachers, except Ken, recalled their experiences in school mathematics in a negative

way. They, for example, used words such as “struggled,” “didn’t get it [mathematics],” and “too abstract,” when describing what they remembered about school mathematics as a student. Ken stated that he neither disliked nor hated mathematics as a student. But, Ken did not use words such as “like” or “enjoy” when describing his view on teaching mathematics. Lisa, Mary, and Christy commented on how they liked teaching mathematics as a teacher.

All teachers believed that learning to compute accurately was an important mathematics skill for students. This belief was consistent with the teaching practice in each classroom. They used work sheets or a workbook in all classrooms on a daily basis to practice the skill being taught. All teachers, except Lisa, taught mathematics in a traditional manner with a lecture as the main teaching method. They usually introduced a skill and demonstrated how to solve a problem before having students practice similar problems using the method they had just demonstrated.

Lisa used many mathematics questions in her classroom, which supported her expressed belief that students should think critically. Even though Ken claimed he wanted his students to explain and understand mathematics procedures, his teaching practice did not show evidence to confirm his claims. Ken asked more questions that encouraged students to explain the thought process than Mary and Christy did, but his questioning did not happen as frequently as it did in Lisa’s classroom. This finding confirms previous studies’ (Davis & Krajcik, 2005; Stigler & Hiebert, 1999; Yang & Cobb, 1995) findings that U.S. teachers do not ask questions that encourage students to think mathematically. Mason (2000) stressed, “The style and format of the questions used by lectures and tutors profoundly influence students’ conceptions of what mathematics is about and how it is conducted (p. 97).” If the students are to develop positive attitudes toward mathematics, teachers must use higher order questions that encourage students to think critically.

All participating teachers described their identities as non-mathematics learners when asked about their mathematics learning experiences, but they viewed themselves as confident and successful mathematics teachers. There were many congruities between the four teachers' teaching identities and teaching practices. The study found incongruities in teaching practices between the two Japanese teachers and also between the four teachers from both countries. The next research question addresses the relationship between the teaching identities and mathematics teaching practices.

Research Question 2

The second research question investigated evidence that indicated, or did not indicate, the existence of congruent relationships between teachers' identities and their teaching practices in four primary grade mathematics classrooms, two in the United States and two in Japan, compared locally and globally. The findings of this study showed that the two Japanese teachers' memories of the school mathematics they had experienced as a student were similar, but they did not share the same teaching style and teacher identity. Lisa, for example, exhibited a high level of confidence in teaching mathematics by articulating her beliefs about what her students should learn and by describing how she planned to provide an appropriate learning environment to achieve her goals. Lisa's mathematics lessons included class discussions among both whole and small groups and many hands-on activities. She used questions such as "How do you know?" "Can you come up with another way to get the answer?" and "Do you understand what this student is trying to do?" Ken shared a similar view of teaching mathematics as did Lisa in that students should be able to think critically, but he did not elaborate on how he was teaching mathematics in order to achieve this goal. Ken seemed comfortable teaching mathematics, but he did not demonstrate a deep understanding of mathematics concepts. This was apparent during

one of the lessons when several students struggled with making a group of 10 and 100 to count up to 1000. Ken noticed that several students were struggling with this concept during the lesson, but he did not take the time to explain or discuss what he was trying to teach. He simply went over the instruction, and checked for accuracy while circulating around the room. One possible explanation for this difference between Ken and Lisa could be their teaching experiences. Lisa has taught thirty years, whereas this was Ken's sixth year of teaching. Previous studies have found a relationship between the teaching experiences of a teacher and classroom practice (Cuban, 1993; Huberman, 1989).

The two U.S. teachers shared similar memories of school mathematics as a student, and similar beliefs about teaching mathematics. Mary and Christy liked the Saxon Math program (Larson, 2004) and used it as their core teaching material, and did not supplement with other teaching materials. They followed the Saxon Math teaching guide and planned a daily lesson accordingly. They both adjusted and modified lessons, but Mary omitted some independent student activities completely whereas Christy did not. Mary explained that she omitted those activities because she didn't like the noise level when students worked individually or in small groups with manipulatives. Mary's decision contradicted her belief that students learned best when they used concrete materials. Both Mary and Christy commented on the importance of parent involvement as an important factor for student success. They expressed that the students who had parents to help them with homework and studying for the tests did better in class than those who didn't have anyone to help them. Mary and Christy both indicated that the amount of time parents invested in helping their children reflected in their academic achievement. Mathematics lessons in Mary's and Christy's rooms did not include many higher thinking

questions, as it was not a usual part of Saxon Math lessons. Their lessons consisted of fact practice and prescribed learning procedures.

All four teachers commented on the importance of hands-on activities when teaching mathematics, but only Lisa incorporated hands-on activities on regular basis. As noted earlier, this finding was interesting because Lisa, Mary, and Christy all said they felt hands-on activities provided “fun activities” and “concrete activities” that students needed, but only Lisa included these activities in mathematics lessons. Ken also shared a similar belief that learning mathematics should incorporate some fun activities, and he did incorporate some activities into lessons, but not to the extent that Lisa incorporated such activities.

Of the four teachers, Lisa was the only one who consistently asked higher order thinking questions during mathematics lessons. Others asked open-ended questions occasionally, but they did not usually have class or small group discussions to extend student learning.

The findings of this study indicated that teacher identity influences mathematics teaching practice. Locally, Japanese teachers demonstrated a difference in their teaching practices, but the U.S. teachers did not. The difference in teaching practices between Japanese and the U.S. teachers was apparent in the study. The next section discusses how teacher identity influences problem solving instruction in each classroom.

Research Question 3

The third research question of this study explored the relationship between the identities and mathematics teaching practices of four primary grade teachers, two in the United States and two in Japan, locally and globally. The relationship between teacher identity and the problem solving instruction occurring in each mathematics classroom community was examined first.

Lisa approached problem solving instruction with open-ended questions and class discussion. She used questions such as “How did you get your answer?” “Can you explain what you noticed about another student’s answer?” and “Do you think you can come up with another way to solve this problem?” She posed a problem solving question and had students explore various strategies to solve the problem independently and in small groups. She then had students share their solutions and asked the class to debate on each solution before coming to a consensus. A teacher must possess a deep understanding of mathematics content in order to carry out such discussions (Boaler, 2002; Lampert, 1990). Lisa’s problem solving instruction demonstrated that she had pedagogical content knowledge. She knew the mathematics content she was teaching, and the pedagogy related to how to present the content to her students.

Ken’s problem solving instruction included posing a problem followed up by some class discussion based on individual students’ thoughts and beliefs. Ken’s students sat in groups, but they did not work together as a group. The class discussion consisted of some students volunteering explanations of their choice of a certain solution until someone completed the correct method of solving a problem. If two or three students could not come up with the correct explanations, Ken would explain the procedures on the board. His explanation would be a solution suggested in a teacher’s guide. Ken did not demonstrate a strong understanding of mathematics content when it came to problem solving. His pedagogical content knowledge of problem solving instruction was higher than Mary’s and Christy’s, but not at Lisa’s level.

Problem solving instruction in Mary and Christy’s classroom was similar. They both posed a question outlined in the Saxon Math teachers’ guide and had students work for a few minutes on the questions individually. They then called on a student to answer the question. If the answer was correct, they would move to another problem without any explanation either by

themselves or by a student. If the answer was incorrect, they called on another student but did not go back to discuss why the previous answer was incorrect. Mary and Christy both claimed they were confident and enjoyed teaching mathematics at their grade level, but they seemed to focus on how they taught mathematics when I asked them about teaching mathematics. They explained how they liked the Saxon Math program but they didn't discuss what they liked about teaching mathematics. They used phrases such as "easy to follow," "everything is there," "contains a lot of skills," "reviews skills previously taught," and "saves time to plan for a lesson because it is all laid out on the teacher's guide." These responses could result from their lack of knowledge of mathematics content. Mary and Christy both focused on how the mathematics was presented to students not on the mathematics itself. The results of the study suggest that Mary and Christy had pedagogical knowledge through the program they used, but not the content knowledge. Their mathematics pedagogical content knowledge, therefore, seemed very limited.

Next investigated was how the relationship between teacher identity and problem solving instruction occurring in each mathematics classroom community could be explained in terms of its relationship to the broader culture in which the mathematics classroom was situated. Because Lisa's and Ken's mathematics experiences as learners were similar and they were teaching at the same school, the differences in their teaching practices had to do with their identities as mathematics teachers. Lisa viewed herself as a mathematics learner and teacher at the same time as she strove to find ways to improve her teaching. She focused on learning and teaching pedagogy as well as on mathematics content. She said:

I always wanted students to think critically when they were solving problems. I didn't know how to go about it...it's not like now. When I first started to teach, there weren't any workshops or anything for new teachers. We just had to go out there and teach. Now the new teachers have mentors and workshops to learn how to teach. I just had to learn by trial and errors and asking questions about teaching to veteran teachers. At the beginning of my career, I lectured a lot. But I wanted students to explore and find solutions. So I started spending a lot of time planning how to teach it that way. For example, I want students to explain their thinking in front of the class. I want to make them think. Like when we are talking about numbers. By checking their tiles, and be able to say, "10 of 10 sticks make 100." And understand there is one less 0 on 100 compare to 10.

Lisa was the only teacher who used particular examples of mathematics content when discussing teaching mathematics. Other teachers talked about making mathematics learning concrete and having students think, but they did not discuss any particular mathematics content. They focused on how to present mathematics lessons while demonstrating a minimal development of mathematics pedagogical content knowledge.

Because Ken, Mary, and Christy's problem solving instructions were similar, this study indicated that mathematics classroom communities in Japan and the U. S. A. did not have a big influence on teaching practices. The instruction in each classroom depended on a particular teacher. This finding was consistent with a previous study in that the real mathematics going on in a classroom depended heavily on the teacher's understanding of mathematics (Ma, 1999).

Implications and Future Research

The analysis of data from the current study strongly suggests that teacher identity and identity formation in sociocultural perspective are essential components in understanding mathematics teaching practice and the mathematics pedagogical content knowledge expressed in teachers' instruction. Teachers' background experiences, and the communities in which they participate, influence how teachers teach mathematics. The cases of the four teachers described in the current study do not identify good or bad ways in which to teach mathematics, no value judgment is placed. The study's intention is to describe characteristics of teacher identities and

teaching practices, in relation to one's culture and community. To teach mathematics in ways aligned with the Standards (NCTM, 1989), teachers must develop a teacher identity as a mathematics teacher and a learner as a means of developing mathematics pedagogical content knowledge. Gee (2002) proposes two separate identities from two different perspectives in order to explain different attributions of one's identity: institutional identity and affinity identity. Institutional identity refers to a "position sanctioned by authorities within institutions" and affinity identity refers to common practices shared by an affinity group. Members of an affinity group share "*allegiance to, access to, and participation in specific practices* that provide each of the group's members the requisite experiences" (Gee, 2002, p.105). Teachers in the current study shared the same institutional identity as an elementary school teacher. But, their affinity identities differed possibly because of the professional development experiences they have had. Lisa developed a different affinity identity from other teachers in the study possibly because she participated in communities of practices that included formal and informal professional development activities from the beginning of her teaching career. The professional development experiences and her passion to learn the best way to teach mathematics may have formed her teacher identity, which was quite different from the other teachers studied here. On the other hand, Ken experienced only formal professional development activity via lesson study, but he did not have an opportunity to participate in the informal professional development activities that Lisa had described having because Japanese schools had changed in many ways by the time Ken started his teaching career. So, his experiences or lack of them may have formed a different identity. Future research could study such possible causes of affinity.

Lesson study activities provided opportunities for the two Japanese teachers to strengthen their mathematical competence, but the U.S. teachers did not have opportunities to do so if they

hadn't acquired the competence during schooling. This finding is interesting because the U.S. teachers hold at least a Masters of Arts degree whereas the Japanese teachers hold Baccalaureate of Science degrees. The results of this study suggest professional development activities might influence the formation of teacher identities more than the educational background of teachers. It is well documented that U.S. teachers often lack the support and knowledge needed in order to implement a standards based mathematics curriculum (Ma, 1999; Stevenson & Stigler, 1992). The creation of a learning community within a school to support teachers in developing positive and strong mathematics teacher identities and in providing mentors for new teachers to help address some of the issues discussed here should be investigated in future research.

By establishing the relationship between mathematics teachers' identities and teaching practices, as seen in their pedagogical content knowledge, the current study suggests hypotheses that could be investigated in order to enhance the understanding of the formation of teacher identities situated in a culture and a community. In closing, it is clear from this study, and previous studies, that different teachers have different teacher identities.

There are a number of directions for further research. One avenue is to repeat the study in different school settings with similar situations so results can be compared with this study. Different groups of teachers might have been exposed to different teaching methods and different professional development activities.

Another direction for future research is to determine what factors encourage or discourage teachers from implementing mathematics education reform. In other words, what events and circumstances influence teachers to change mathematics instruction in their classrooms?

There is a need to examine school communities and their professional development activities in relation to teacher identities and pedagogical content knowledge. The current study suggests that school communities might have an influence on the formation of teacher identity, and the teacher's identity influences the mathematics instruction. The students in different mathematics classrooms developed different beliefs and views about what mathematics was all about according to a research study by Boaler (2002). The students who learned mathematics in a traditional classroom thought of mathematics as something they "did" in a classroom and that they needed to know a specific formula to solve a problem. Another group of students who learned mathematics developed confidence as a mathematics learner. They were able to think independently and valued the importance of mathematical processes. The notion of situated learning that describes the ways in which individuals interact with problems in different forms and settings (Lave, 1988) becomes apparent in those situations. School communities and professional development activities in which teachers participate might influence the formation of their students' mathematics learner identities and their mathematics achievement.

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APPENDIX A

Survey

APPENDIX A: Survey

1. Which students are good at mathematics in your class?
2. What makes “good” mathematics students?
3. What contributes to students’ success in mathematics?
4. How did you learn mathematics as an elementary student? Please describe briefly usual math lessons experienced during in elementary school, middle school, high school, and college and your thought about them.
5. What does a successful mathematics classroom look like?
6. What is good mathematics teaching?
7. How did you learn to teach mathematics the way you do now?
8. What is it like to teach mathematics in rural Alabama or in Japan?

APPENDIX B

Classroom Observation Protocol

APPENDIX B: Classroom Observation Protocol

Class:

Date:
Descriptive Notes

Length of Mathematics Lesson:
Reflective Notes

Sketch of classroom

Development of learning objectives:

Are objectives for the class given verbally, written, or not at all?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Are specific instructional outcomes used?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Are objectives discussed at the end of class?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Selection and use of instructional materials:

Are films, websites, and other audiovisual materials used?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Are handouts appropriate?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Since the text may be pre-selected, does teacher give help with reading or using the text if necessary?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Educational climate for learning:

Are students and teacher interested and enthusiastic?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Is humor used appropriately?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Does teacher not embarrass or belittle students in any way?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Is the atmosphere of the classroom participative?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Did the teacher have eye contact with students?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Variety of instructional activities:

Does timing of classroom activities consider attention spans?

Not Demonstrated *Needs Improvement* *Satisfactory* *Outstanding* *N/A*

Does teacher involve students in deciding what issues to discuss?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Preparation for class session:

Provide examples that show preparation by teacher:

Instructional methods:

List *teacher* activities:

Did the opening gain the class' attention? Did it establish rapport?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Did the opening outline the topic and purpose of the lecture?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Is the delivery paced to students' needs?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher introduce topic, state goals, present material or activity effectively, summarize, and give assignment or suggest an idea to consider before next class?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Could the teacher be seen and heard?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Were key points emphasized?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Were explanations clear to students?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Were examples, metaphors, and analogies appropriate?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Was the lecture stimulating and thought provoking?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Opportunity for student participation:

List *students'* activities:

Does teacher encourage students to summarize and add to others' summaries?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does teacher help quieter students interact with other?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Individualization of instruction:

Are the emotional, physical, and intellectual needs of students met?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher prompt awareness of students' prior learning and experience?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher offer "real world" applications?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher relate class to course goals, students' personal goals, or societal concerns?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Responsiveness to student feedback:

Is the teacher paying attention to cues of boredom, confusion?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher encourage or discourage questions (dissension)?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher provide students opportunity to mention problems/concerns with the class, either verbally or in writing?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Learning difficulties:

Does a student need assistance for a temporary or permanent disability?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Are one or more students not motivated or unable to follow the class?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does the teacher show favoritism?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Are students able to see visual aids?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

Does one group dominate discussion and hinder others' participation?

Not Demonstrated Needs Improvement Satisfactory Outstanding N/A

APPENDIX C

Interview Protocol

