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Mathematics Student Teaching in Japan: A Multi-Case Study

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MATHEMATICS STUDENT TEACHING IN JAPAN:

A MULTI-CASE STUDY

by

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GRADUATE COMMITTEE APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

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As chair of the candidate's graduate committee, I have read the thesis of Allison Turley Shwalb in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

MATHEMATICS STUDENT TEACHING IN JAPAN: A MULTI-CASE STUDY

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Master of Arts

Nearly all research that seeks to assist in reforming mathematics student teaching in the United States has been limited in that it (1) does not consider student teaching models in non-Western cultures, and (2) has not sufficiently studied the unique context of mathematics in student teacher-cooperating teacher interactions. This multi-case study addresses these issues by analyzing the interactions between three cooperating teachers and two student teachers in the mathematics student teaching setting in Japan. Four conclusions are presented to generate a coherent picture of the principles of teaching and learning to teach that are emphasized during this Japanese student teaching experience.

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I could not have completed this thesis if it weren't for the support of many people. I must first recognize my loving Heavenly Father. He was there for me during the struggles I faced and brought me peace and clarity of mind when I needed it.

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DEDICATION

I dedicate this thesis to my beautiful children, David Joseph Shwalb and Havah Marie Shwalb. They bring me joy, laughter and fun amidst the work of life. They are my heaven on earth. It is a pleasure and honor to be their mother.

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Introduction

It may be said that a healthy system is one that is constantly striving for greater excellence. This notion motivates researchers and practitioners in mathematics education to continually seek for new and more effective teacher training methods in the area of pre-service student teaching (see e.g., Mewborn, 2003). However, during the last ten years, experts have found evidence that the potential of the student teaching experience is frequently unmet. For example, many cooperating teachers neglect to explicitly discuss various teaching decisions with their observing student teachers (Zanting, Verloop, Vermunt & Van Driel, 1998). Some cooperating teachers believe that they do not need to play an active role in the student teaching experience at all (Borko & Mayfield, 1995). In many cases, the student teaching experience even undermines reform-oriented university training of pre-service teachers. Often, school environment factors, including the cooperating teacher, discourage efforts to change current teaching practices (Morrell, Flick & Wainwright, 2004). Many practicing secondary education mathematics teachers feel that theories based on reform are not realistic in practice (Jaworski & Gellert, 2003).

Researchers have focused on the interactions among student teachers and cooperating teachers in an effort to improve the quality of mathematics student teaching in secondary education in the United States (e.g., Borko & Mayfield, 1995; Wilson, Cooney & Stinson, 2005). The mentorship between the student teacher and the cooperating teacher presents great potential for the student teacher's growth. During the student teaching experience, student teachers can thoroughly study the practices of their cooperating teachers. Many student teachers feel that "realistic teaching" is best exhibited by seasoned, practicing teachers (Jaworski & Gellert, 2003). As such, cooperating

teachers can aid the student teachers in considering the theory they have learned during their university training in terms of the actions of teaching (Chalies, Ria, Bertone, Trohel & Durand, 2004). Cooperating teachers can utilize their wealth of teacher knowledge in its various forms to aid student teachers in lesson planning. Furthermore, as student teachers implement and reflect upon their own teaching experiences, cooperating teachers can provide valuable feedback by tapping into their own experiences and allowing student teachers to learn how to gain such a perspective for their own future use.

The potential for learning via the student teacher-cooperating teacher relationship has led many researchers to examine what student teachers and cooperating teachers actually discuss during the student teaching experience. Borko and Mayfield (1995); Caires and Almeida (2005); Fieman-Nemser (1998); Nolder, Smith and Melrose (1994); Peterson (1998); and Van Zoest and Bohl (2002) explained what the conversations and other interactions between student teachers and cooperating teachers indicate about the roles each assumes. These studies have led to valuable insight for establishing new models for the relationship between the student teacher and cooperating teacher.

Western research conducted on the interactions of student teachers and cooperating teachers in mathematics classrooms can be enhanced in at least two ways: first, cross-cultural studies are extremely valuable in generating new perspectives for student teacher-cooperating teacher interactions; second, narrowing research to the unique experiences of student teaching in the mathematics context can provide useful information which may not be applicable or present in other secondary teaching contexts. Research on student teaching cannot be based solely on Western theoretical perspective. Furthermore, mathematics student teaching research should not be only generalized to

secondary education perspectives, minimizing the specific context of mathematics teaching. Addressing these two specifications will supplement the research that seeks to improve student teacher-cooperating teacher interactions in mathematics student teaching.

The Potential in the Japanese Student Teaching System

During the 1980s, American researchers conducted a number of projects to understand the significant international differences between Japanese and American students in mathematics proficiency standardized tests (Chokshi & Fernandez, 2004). These studies led to the identification of marked differences in features of typical teaching practices. However, Stevenson and Stigler (1992) pointed out that these features that differ so strikingly overall are merely elements of two different teaching cultures. Embedded within the teaching culture is the cultural activity of student teaching (Stevenson & Stigler, 1992).

Because student teaching is a cultural activity, dynamically affected and sustained by a wide variety of contextual factors, improving student teaching requires an understanding of the cultural scripts that the players in the student teaching system adhere to (Stigler & Hiebert, 1999). Discovering and understanding these cultural scripts is enhanced when viewed through the perspective of a different culture because differences are more noticeable. Specifically, by analyzing a non-Western student teaching culture from a Western perspective, significant features of non-Western student teaching systems may be more evident. New perspectives derived from the Japanese student teaching system will enhance Western research that is currently limited by its own cultural perspective.

This thesis considers the Japanese student teaching system because the Japanese teaching culture is designed for continual improvement of teaching (Stigler & Hiebert, 1999). Because the system of student teaching is more or less contained within the broader teaching system, the Japanese model of student teaching has potential to exhibit similar qualities. In the last ten years, there have been a few published studies that identify features of the Japanese student teaching system that indicate that the student teaching system in Japan aids in continual improvement of teaching (Christenson, 2003; Peterson, 2005; Shimizu, 1999). However, the few studies that examine student teaching in Japan point to features of student teaching only. The connections between features of the student teaching system in Japan have yet to be synthesized to generate an understanding of the broad nature of student teaching in Japan.

The purpose of this thesis is to clarify the broad nature of a Japanese mathematics teaching system within the context of student teaching. The results will provide a deeper view of a student teaching interaction model in-practice that will greatly enhance the current research efforts for reform in student teaching in the United States.

Mathematics in Student Teaching Research

In addition to the need to engage in cross-cultural research, research on student teacher–cooperating teacher interactions should move beyond general secondary teacher education. The published studies that report findings from the unique perspective of student teaching in the mathematics context are few. Most research on student teaching does not account for mathematics, and most research in mathematics education does not look at student teaching relationships. Since Shulman (1986) introduced the term *pedagogical content knowledge*, researchers have shown that when teachers have a strong

foundation of mathematics understanding for teaching, student learning is more productive (Ma, 1999). However, cooperating teachers do not discuss mathematics or mathematics pedagogy with their student teachers more than superficially (Borko & Mayfield, 1995; Williams & Peterson, in press). Mathematics education research must address the issues involved in student teaching through the context of mathematics.

This thesis seeks to specifically identify how and to what extent mathematics in and for teaching is addressed within the Japanese mathematics student teaching system for six unique student teacher-cooperating teacher pairings at a university affiliated junior high school. The current Western research regarding student teacher-cooperating teacher interactions are used as a lens for analyzing the Japanese data. In addition, the unique teaching system in Japan is carefully considered on its own ground. In this way, new or unexpected results are identified, and these findings are analyzed in light of the current Western teaching system.

The purpose of this study is not to describe a student teaching model in order to replace the current student teaching model. Rather, new ideas that show potential for continual improvement are sought after. Once a broad picture of this Japanese student teaching experience is understood, general principles can be adapted and gradually implemented into the current American teaching culture to promote long-term, continual improvement in the student teaching system.

Literature Review

The Unproductive Trend of Mathematics Teacher Education

The current status of the student teaching system in secondary mathematics education has an unproductive pattern. Student teachers begin their student teaching with some reform-oriented theoretical knowledge; however, frequently, they do not get to utilize this knowledge in the classroom (Morrell et al., 2004). Commonly, student teachers hold to the idea that although their university training has presented the theory for an ideal teaching methodology, most schools cannot live up to the ideal (Furlong, Barton, Miles, Which & Whitty, 2000). As a result, instead of attempting to teach according to the ideals that they have learned prior to student teaching, student teachers tend to mimic their cooperating teachers' actions and even shift toward their cooperating teachers' beliefs (Brown & Borko, 1992; Metcalf, 1991; Zanting et al., 1998). Of course, when cooperating teachers are focused on improving their own practice and student teachers are aware of how their cooperating teachers do so, then teaching can improve overall. Unfortunately, cooperating teachers often perceive their beliefs on effective teaching are incompatible with current reform-oriented research suggestions (Jaworski & Gellert, 2003; Wilson et al., 2005). Furthermore, cooperating teachers generally do not make explicit to their student teachers why they make the teaching decisions that they do (Zanting et al., 1998). All told, the current trend of the student teaching experiences in the mathematics classrooms of the United States reinforces the general lack of improvement in teaching in the mathematics classrooms.

The reality is cooperating teachers have valuable knowledge that student teachers can learn from, and many cooperating teachers hold views compatible with current

research (Wilson et al., 2005). In general, student teachers value the knowledge they receive from their cooperating teachers over their entire undergraduate education (Morrell et al., 2004). Yet, student teachers often find themselves lacking in direction. Student teachers do not receive needed assistance with identifying salient features of lessons, discovering the strengths and weaknesses of lesson plans, anticipating student responses, etc. (Feiman-Nemser, 1998). They also need training in how to be self-reflective (Bischoff, Hatch & Watford, 1999) and in discovering their own assumptions about students (Perks & Prestage, 1994). When cooperating teachers do not provide them with this assistance, student teachers are forced to "reinvent the wheel" (Zanting et al., 1998). Without educational training in context, it is inevitable that student teachers generally will only teach how they were taught (Jaworski & Gellert, 2003; McDiarmid, 1990; Morrell et al., 2004).

In some cases, cooperating teachers do not even see themselves as responsible for the education of their student teachers (Feiman-Nemser, 1998). The widely held belief that teaching is mainly learned from experience causes many cooperating teachers to avoid being actively involved in their student teachers' training (Borko & Mayfield, 1995). The mentality that good teaching is merely learned by unguided practice causes cooperating teachers to neglect challenging their student teachers. This attitude will also only maintain the status quo (Feiman-Nemser & Buchman, 1985). Clearly, the current model for student teacher-cooperating teacher interactions will not promote improvement in mathematics teaching. Overall, the best efforts of reform-oriented university mathematics education programs are not utilized and are even undermined by student teacher-cooperating teacher interactions.

A Call for New Models

The vicious cycle of little to no improvement in the student teaching experience has led to the call to investigate new models for cooperating teacher-student teacher relationships (Feiman-Nemser, 1998). Models worthy of investigation should offer improvement and change and must be grounded in current, valid research (Mewborn, 2003). Both elements are critical. Implementing a model simply because it is different from current models will not necessarily lead to positive results. Furthermore, models that maintain qualities that are recommended by researchers can produce the desirable outcomes needed to improve the student teaching system as a whole. Accordingly, Wang and Lin (2005) specifically called for more grounded, qualitative research to examine aspects of the relationships between student teachers and cooperating teachers that may have been unnoticed because of the limitations of past theoretical perspectives.

Enhancing Past Theoretical Perspectives

The nature of student teaching and the relationships between cooperating teachers and student teachers is highly contextualized (Zanting et al., 1998). The event of student teaching is influenced by expectations, work conditions, preparation, etc. (Zanting et al., 1998; Feiman-Nemser & Parker, 1993). Therefore, research focusing on the interactions between student teachers and cooperating teachers should not ignore contextual factors. The culture and structure of the various levels of social systems within which student teaching takes place has a significant impact on the relationship between the cooperating teacher and student teacher. Culture on the societal level clearly plays a significant role in the interactions of individuals within the culture. On another level, the “teaching culture” has equally important effects on relationships between student teachers and cooperating

teachers (Stigler & Hiebert, 1999). For example, individualism and autonomy may be valued by the societal culture at large; however, a smaller teaching culture of a single school may value collaboration and create a microcosm for the collective generation and sharing of innovative ideas.

Stigler and Hiebert (1999) posited,

> If we took seriously the notion that teaching is a cultural activity, we would begin the improvement process by becoming more aware of the cultural scripts teachers are using. This includes comparing scripts and seeing that other scripts are possible. (p. 101)

"Scripts" refers to the often unspoken assumptions of the individuals in the culture regarding the roles, relationships and objectives of the players interacting within the teaching culture.

It stands to reason that improving student teaching also requires an awareness of the cultural scripts cooperating teachers and student teachers are using because student teaching is also a cultural activity (Fieman-Nemser, 1998; Fieman-Nemser & Parker 1993; Zanting et al., 1998). To this end, cross-cultural studies are extremely valuable because salient features of the student teaching system are more evident when viewed through the lens of a different culture. However, very few cross-cultural studies have investigated the student teaching experience, and the studies that do exist only offer a small compilation of a few features and mentalities and only provide a glimpse of the student teaching culture as a whole. This is a limitation of the current research efforts in mathematics student teaching. Once the broad nature of the student teaching experience from another culture is understood, the new findings will enhance the Western research that is currently limited by its own cultural perspective (Stigler & Perry, 1988).

Analysis of the Japanese system of student teaching shows potential for

enhancing research and development efforts in the United States. Stigler and Hiebert (1999) argued that the teaching system in Japan promotes long-term, continual improvement in teaching. Because the system of student teaching is more or less contained within the broader teaching system, the Japanese model of student teaching has potential to exhibit similar qualities. Recently, a few studies have identified features of the Japanese student teaching system that indicate this is so. For example, Peterson (2005) reported that the greatest emphasis in student teaching in Japan is on lesson development. A parallel finding is evident in the teacher development practice of lesson study in Japan. The purpose of lesson study is to engage practicing teachers in continual improvement of their own teaching to increase student understanding. (For more information on the practice of lesson study, see Fernandez and Yoshida (2004), Lewis (2002), Shimizu (1999), and Stigler and Hiebert (1999).) Although the emphasis on lesson development is only a feature, it points to a broader tenet of the teaching system: improvement is expected to be long-term and continuous, and teachers are focused on student learning (Stigler & Hiebert, 1999). The purpose of this study is to characterize principles that describe the nature of a Japanese mathematics teaching system within the context of student teaching.

A second specification for this study addresses the context of mathematics in analyzing student teacher-cooperating teacher relationships. The explication of pedagogical content knowledge is one of the critical missing elements in student teaching in the United States (Borko & Mayfield, 1995; Williams & Peterson, in press). If there is a need to address pedagogy in terms of mathematics content, research on student teaching should also specifically address the teaching of mathematics to be emphasized during the

student teaching experience. This is particularly needed given the fact that that there is a general lack of emphasis on mathematical pedagogy in student teacher-cooperating teacher interactions (Borko & Mayfield, 1995; Williams & Peterson, in press). Mathematics education research must address the issues involved in student teaching through the context of mathematics, not simply general principles of teaching and learning to teach. Therefore, this thesis seeks to specifically identify how and to what extent mathematics is addressed within the Japanese student teaching system.

Current Findings and Suggestions on Student Teaching in the United States

This thesis investigates a Japanese system of student teaching. However, the perspective from which the analysis is conducted is unavoidably influenced by the culture of the current Western-oriented research. Rather than attempting the impossible task of avoiding such an influence, the intent of this thesis is to enhance Western research by analyzing the Japanese data in terms of the current findings and suggestions from within the Western culture. Doing so has considerable advantages in analysis because facets of the Japanese culture that may have been overlooked by a researcher from that culture can be much more apparent to a researcher outside of that culture. For example, in a separate cross-cultural study conducted by Stigler and Hiebert (1999), a Japanese researcher was analyzing a recording of an American mathematics lesson. During the lesson, the teacher needed to stop because an announcement was made over the intercom system. To the American researchers observing this same segment, the intercom announcement went unnoticed. However, the Japanese researcher was perplexed by the announcement, stating that such an interruption would have not been common in the Japanese culture. The researchers were then able to question why and to what extent such interruptions were

evident. Had the research been conducted solely from within the American culture, this phenomenon would probably have never been addressed. Similarly, a Western researcher studying the Japanese student teacher-cooperating teacher relationships may notice characteristics of that teaching system that may go unnoticed by a Japanese researcher.

An overview of the Western research regarding student teacher-cooperating teacher relationships follows as a perspective I utilized while analyzing the teaching system in Japan. First, the roles cooperating teachers can and do assume are described. The advantages and disadvantages for cooperating teachers assuming these roles are included. Secondly, the significance of collaboration during the student teaching experience is discussed. Finally, the importance and prevalence of explicit reflection during cooperating teacher-student teacher interactions is presented. Conversational topics between cooperating teachers and student teachers that are particularly relevant for this thesis are outlined. These perspectives guided the origination of the analytical process for the Japanese data. Furthermore, the findings and suggestions of the Western orientations were considered in light of the results of the Japanese data to draw conclusions regarding the implications of this research.

Roles of the Cooperating Teacher

How cooperating teachers perceive their roles is largely an effect and a component of the complex contextual nature of teaching and student teaching (Borko & Mayfield, 1995; Zanting et al., 1998). Views on the overall purpose of student teaching are only consistent among cooperating teachers who have similar views of their roles and on how student teachers learn to teach (Feiman-Nemser, 1996; Borko & Mayfield, 1995). There are a variety of roles a cooperating teacher may assume. Although the various roles

described below cover the majority of roles outlined as significant in the current literature (Caires & Almeida, 2005; Fieman-Nemser, 1998; Jaworski & Gellert, 2003; Nolder et al., 1994; Williams & Soares, 2002; Zanting et al., 1998), this list is not exhaustive.

Bear in mind, there is great variability in the roles that cooperating teachers perceive or actually take on, and many cooperating teachers assume multiple roles in different situations. In addition, there is great variability among different pairings of student teachers and cooperating teachers, even within the same school. This variability makes it impossible to generalize exactly what all cooperating teachers do in the United States (Evertson & Smithey, 1999; Franke & Dahlgren, 1996; Gratch, 1998; Hawkey, 1997).

Individual differences are undoubtedly a feature of the contextual nature of student teaching. For example, the personality or needs of one student teacher may require their respective cooperating teacher to take on a specific role that he or she may not have assumed with another student teacher. Because of the variability in roles, the following review of research highlights a few broad findings of current trends concerning cooperating teacher-student teacher relationships. The review also provides an overview of the dominant theories and research findings with regard to what constitutes a quality student teaching experience. Special emphasis is placed on research that specifically focused on the cooperating teacher-student teacher relationship.

No role or responsibility. Some cooperating teachers resent having to be the mentors of student teachers and do not want much responsibility in student teacher education (Williams & Soares, 2002). Although some researchers claim that student learning is not jeopardized by novices (Burn, Hagger, Mutton, & Everton, 2000),

cooperating teachers often view the training of student teachers as harmful to their students' learning because student teachers cannot teach as well as experienced teachers (Williams & Soares, 2002). Williams and Soares (2002) found that some cooperating teachers believe that training pre-service teachers takes away from valuable class time and class preparation time. Cooperating teachers rarely see themselves as teacher educators who are responsible for teaching their student teachers how to teach (Murray & Male, 2005; Jaworski & Gellert, 2003).

Means for experience. The main responsibility of a cooperating teacher who is a means for experience is to provide the student teacher with a place to practice teaching (Zanting et al., 1998). The cooperating teacher will organize a variety of experiences for the student teacher, within which the novice can develop his or her own image and style as a teacher. Student teachers need to be in perplexing situations that challenge their ideas and beliefs on teaching to develop a robust, yet flexible teaching construct (Cooney, Shealy, & Arvold, 1998). However, when this is the only role a cooperating teacher assumes, the cooperating teacher may possess a "sink or swim" mentality (Zanting et al., 1998): either the student teacher is capable and prepared to teach, will develop a teaching method to survive the experience, or will quit.

Many cooperating teachers believe that the objective of the student teaching experience is to simply provide student teachers with a place to practice their hand at teaching (Jaworski & Gellert, 2003; Wilson et al., 2005). Murray and Male (2005) reported that of the several ways a teacher may learn to teach, classroom experience was judged by cooperating teachers to be the most influential. These teachers rated experience as more valuable than reflection, reading resources, interaction with other colleagues, and

education. Feiman-Nemser (1998) suggested that the reason that teachers in the United States feel little responsibility for the education of their student teachers is because teaching is learned through experience; therefore, the cooperating teachers' sole responsibility is to provide their student teachers with that experience. It is the student teachers' responsibility to make sense of their experiences alone.

Coach. As a coach, the cooperating teacher is particularly interested in providing the student teacher with feedback on ideas and lessons. He or she may provide the student teacher with advice on how to present a lesson or handle certain students. A coach will make suggestions on how to improve teaching based on whatever definition of quality teaching he or she holds. However, in order for student teachers to have the adaptable teaching mentality necessary for an environment as dynamic and diverse as an American classroom, student teachers need to learn more than how to teach; they need to learn why certain methods are effective in certain situations (Tomlinson, 1995).

In this role, the cooperating teacher can also be an evaluator, and he or she will largely pass on knowledge in a transmission-oriented style (Murray & Male, 2005). However, many cooperating teachers feel that providing direct feedback and suggestions for improvement is disrespectful and may hamper the growth of a student teacher's budding teacher identity (Zanting et al., 1998). They see evaluation and providing constructive feedback as dichotomous responsibilities (Chalies et al., 2004).

Emotional support. Many cooperating teachers see themselves as the student teachers' friend, someone they can talk to. Clarke and Jarvis-Selinger (2005) reported that the majority of cooperating teachers they observed saw their main role as "nurturers." This type of cooperating teacher will focus on motivating the student teacher and

providing empathy during the struggles of student teaching. Cooney, Sheany, and Arvold (1998) emphasized the need for cooperating teachers to support their student teachers during this time of construct perturbation as the student teachers' notions are being put to the test.

Strictly supporting and motivating student teachers has negative consequences, however. A common belief of cooperating teachers who mainly see themselves as emotional supports is that student teachers need to feel they can develop their own style as teachers (Jaworski & Gellert, 2003). As a result, the coaching role is seen as in conflict with the emotional support role and can be neglected entirely (Zanting et al., 1998). The philosophy of maximizing comfort and minimizing risk may also minimize the growth of the student teacher (Borko & Mayfield, 1995).

Model. When cooperating teachers use themselves as exemplary teachers, they are taking on the role of a model. Such a cooperating teacher may give many examples of what they would do in certain situations. Fieman-Nemser (1998) urged that these examples should not be confined to the actions involved in presenting a lesson. To aid student teachers in learning to become effective teachers, cooperating teachers must also model reflective practices and collaboration with other teachers (Fieman-Nemser, 1998; Schön, 1987). Student teachers often adjust their teaching behavior to be compatible with their cooperating teacher (Metcalf, 1991; Zanting et al., 1998). This tendency can promote improvement in teaching overall. However, when cooperating teachers' beliefs and practices are not in line with reform efforts, the tendency for student teachers to imitate their cooperating teacher works against progress (Brown & Borko, 1992; Jaworski & Gellert, 2003). To help student teachers develop a well-rounded perspective

on how and why certain teaching actions and beliefs are appropriate, Zanting et al. (1998) recommended that several in-service teachers serve as mentors to student teachers throughout their student teaching experience.

Co-Enquirer. A few cooperating teachers have taken on the role of co-enquirer. Cooperating teachers in this role allow their student teachers to be collaborators in the process of reflection and improvement of both parties' teaching (Jaworski & Gellert, 2003). Because student teachers' knowledge about teaching is under construction during the student teaching process, they need to be "partners" in this construction in order to become "reflective practitioners" (Cooney, Sheany, & Arvold, 1998; Schön, 1983; Schön, 1987). Fieman-Nemser (1998) suggested facilitating this partnership by having the student teacher and cooperating teacher engage jointly in the tasks of planning, implementing and reflecting on lessons. This requires the cooperating teacher and student teacher to maintain a mutually supportive relationship (Jaworski & Gellert, 2003) and a positive attitude toward their roles as joint enquirers (Zanting et al., 1998).

For cooperating teachers to become co-enquirers they must see their student teachers as learners of teaching (Zanting et al., 1998). Being a *learner* of teaching is in contrast to being a *performer* of teaching who is to be evaluated (Peterson & Williams, 1998; Zanting et al., 1998). When the student teacher is seen as a performer of teaching, it is difficult to create an environment based on the mutual trust needed for joint enquiry (Jaworski & Gellert, 2003). Many conversations between cooperating teachers and student teachers are evaluative in nature (Ben-Peretz and Rumney, 1991).

Cooperating teachers who are co-enquirers must also view themselves as learners. Student teachers may have difficulty reflecting on their own practice if their cooperating

teachers are not reflective. Similarly, student teachers will not be likely to engage in reform efforts if their cooperating teachers do not also engage in reform practices (Van Zoest & Bohl, 2002). Yet cooperating teachers need not be viewed as merely *learners of teaching*; they may also be viewed as *learners of teaching how to teach*. This role is difficult for cooperating teachers to assume because, currently, there is rarely any training available on how to be a quality mentor or cooperating teacher (Zeichner, 2005). This scarcity is based on the assumption that all the skills needed to educate teachers are attained in the practice of teaching. In other words, it is assumed that if cooperating teachers teach their students well, then they will teach their student teachers well (Zeichner, 2005).

Facilitator of self-inquiry. Cooperating teachers may see their role as one to enable their student teachers to become self-reflective about their teaching. They may do this by actively questioning student teachers about their actions and encouraging the student teachers to become critical of their own teaching. The goal for a cooperating teacher assuming this role is to help student teachers to learn how to think about their own teaching – guiding them along the road toward becoming reflective practitioners.

Collaboration

Collaboration in student teaching is reported as critical for successful student teaching experiences (Fieman-Nemser, 1998). Collaboration in a student teaching situation is often seen as cooperative efforts between the student teacher and the cooperating teacher in lesson planning and in post-lesson reflection activities. Collaboration can also occur between the student teacher and other practicing teachers, other student teachers, or university supervisors. Cooperating teachers may also

collaborate with other practicing teachers or teacher educators from the university to provide quality experiences for their student teachers. It has been shown that the most effective teachers collaborate with other teachers (Fieman-Nemser, 1998; Mewborn, 2003).

Interestingly, many practicing teachers in Western cultures do not collaborate with each other on teaching more than superficially (Fieman-Nemser, 1998). The teaching culture in the United States emphasizes individualism and isolation. This emphasis can work against the existence of collaborative environments (Fieman-Nemser, 1998). It is not surprising that few cooperating teachers assume a collaborative role similar to a co-enquirer with their student teachers when they do not collaborate with their own colleagues.

As student teachers collaborate with their cooperating teachers, student teachers may be more aware of their cooperating teachers' and their own beliefs, a pivotal aspect of developing autonomy. Autonomy is enhanced through the actions underlying collaborative practices (Jaworski & Gellert, 2003). If student teachers have not developed a strong sense of autonomy, they are likely to simply imitate the actions of their cooperating teachers (Metcalf, 1991; Jaworski & Gellert, 2003; Zanting et al., 1998).

Lack of collaborative activities between student teachers and cooperating teachers makes linking theory to practice difficult for student teachers. Currently, many practicing teachers and, thus, cooperating teachers feel that theoretically-based reforms are not realistic in terms of classroom application (Jaworski & Gellert, 2003). This is one reason why cooperating teachers do not explicitly discuss theory with their student teachers via collaboration (Jaworski & Gellert, 2003). If a student teacher is unaware of his or her

cooperating teacher's underlying beliefs, made explicit through collaboration, then the student teacher will have difficulty applying the knowledge they gain about theories from their university courses into the teaching practice. As such, the student teacher will have difficulty forming an identity as a teacher that matches the beliefs they may have developed through their study of current research (Hawkey, 1996). Collaboration should be a key component of student teacher-cooperating teacher interactions.

Explicit Reflection

Current research recommends a student teaching model emphasizing reflection on behalf of the student teacher and cooperating teacher (Jaworski & Gellert, 2003, Feiman-Nemser, 1998; Zanting et al., 1998). In general, this means that student teachers and cooperating teachers should analyze the current patterns and routines related to teaching and student teaching. To be maintained, patterns and routines need to be socially verified, given that routines are socially negotiated in the first place (Jaworski & Gellert, 2003). For example, if a student teacher implements a certain teaching strategy, reflection should occur focusing on the social interactions that occurred as a result of the implementation of the strategy. If there is sufficient evidence that the strategy may have promoted student understanding, the strategy could be retained with allowance for alterations to the strategy based on social indicators. The act of reflection is complicated because there are many social indicators, each of which are influenced by a variety of factors. However, reflection is critical for continual improvement.

During meetings where the student teacher and cooperating teacher reflect on lessons and teaching, cooperating teachers should be explicit with their student teachers regarding the important elements of teaching, learning, and learning to teach. Doing so

will assist the student teachers in gaining clear, connected knowledge on teaching. Zanting et al. (1998) reported that student teachers claimed they learned the most about their cooperating teachers' teaching style during post-lesson reflection meetings. With this knowledge, the student teacher can be a better analyzer of the teaching practice. This understanding can aid student teachers in linking theory to the practice of teaching (Zanting et al., 1998).

In spite of the benefits of clearly explicating practical knowledge, many cooperating teachers do not engage in this practice (Ben-Peretz & Rumney, 1991; Zanting et al., 1998). This may be partly due to the fact that many teachers are unaware of the knowledge they possess that drives their own teaching and because teachers are generally unaccustomed to talking about their teaching (Zanting et al., 1998). Zanting et al. (1998) recommended that student teachers encourage their cooperating teachers to be explicit by regularly asking questions of the cooperating teachers. In this way, student teachers may clarify their mentors' implicit knowledge.

Cooperating teachers have much to offer student teachers because cooperating teachers have gained various forms of knowledge through their own training and experience (Chalies et al., 2004; Borko & Mayfield, 1995; Gates, 1994; Jaworski & Gellert, 2003; Shulman, 1986). However, as Murray and Male (2005) caution, "good teaching cannot be atomized and reduced to a list; rather it is about the inter-twining of many professional and personal factors into a teaching and learning experience, made coherent by the teacher educator" (pp. 136–137). Therefore, researchers that seek to analyze the interactions of cooperating teachers and student teachers need to look at the forms of knowledge the cooperating teacher shares with the student teacher in light of the

contextual factors and culture at play.

Cooperating teachers possess a wealth of knowledge that student teachers can learn from and integrate with their own teaching. This includes but is not limited to: information on content and materials, general pedagogy about teaching, general pedagogy about learning, underlying principles behind actions, knowledge regarding specific students, managerial strategies, the school and broader contexts, pedagogical content knowledge (also referred to as "mathematical knowledge for teaching"), and the purpose and value of education (Ball, 1990; Ball, Lubienski, & Mewborn, 2001; Feiman-Nemser, 1998; Jaworski & Gellert, 2003; Peterson, 1998; Shulman, 1986; Van Zoest & Bohl, 2002). A few of these categories are of particular relevance to this thesis. They are discussed in further detail below.

Underlying principles behind teaching actions. As reflection occurs, Zanting et al. (1998) recommended that cooperating teachers clearly present the underlying principles behind teaching actions (Zanting et al., 1998). This is in contrast to cooperating teachers merely discussing teaching events, unjustified methods for teaching, materials for teaching, etc. (O'Neal & Edwards, 1983). As cooperating teachers clarify the underlying principles behind their teaching actions, student teachers will be better able to discern for themselves what appropriate teaching actions are.

Management and behavior. Previous research has shown that many cooperating teachers spend a large amount of time discussing classroom management and issues related to student behavior during reflection meetings (Borko & Mayfield, 1995; Tabachnick, 1979). Indeed, classroom management is one of the main initial concerns of most student teachers (Kagan, 1992), and cooperating teachers should address the

concerns of their student teachers. However, in the mathematics classroom, poor discipline is most often an element of poor planning and unsuitable mathematics (Perks & Prestage, 1994). If the student teacher and cooperating teacher wish to eliminate poor student behavior, conversations and plans aimed at achieving this goal should be centered on planning appropriate lessons. When controlling the behavior of students is at the forefront of student teachers' attention, the learning of the students is neglected. Classroom management can be handled from a teacher-centered perspective or a student-centered perspective. Wilson and Cameron (2005) claimed that the main difference between theory and the practice of cooperating teachers is that theories from the research emphasize student-centered solutions while actual practice is largely teacher-centered.

Management involves more than student behavior. Student teachers assume many responsibilities under the traditional student teaching model utilized in the United States. For many student teachers, all at once, they are responsible for teaching, paper work, diplomacy, lesson planning and more. The amount of work is often overwhelming. To allow for reflection on any issue, whether managerial or otherwise, the student teacher needs time away from other teaching responsibilities (Jaworski & Gellert, 2003). Morrell et al. (2004) attributed student teachers' difficulties in promoting conceptual understanding and interdisciplinary connections to the fact that the novices have other concerns to handle besides instruction such as behavior, time management and teaching, all while inside another teacher's domain. Burn at al. (2000) found high levels of sophisticated conversation which allowed for greater sense-making on the part of the student teachers who were given regular time away from the managerial aspects of teaching in order to collaboratively reflect of their teaching experiences.

Pedagogical content knowledge. In 1986, Shulman introduced the term pedagogical content knowledge to contrast general knowledge about teaching and knowledge pertaining to the subject, e.g., the domain of mathematics. Since 1986, many researchers have attempted to clarify the definition of pedagogical content knowledge. Ball et al. (2001) described a form of teacher knowledge they termed "mathematical knowledge for teaching:"

> Such knowledge is not something a mathematician would have by virtue of having studied advanced mathematics. Neither would it be part of a high school social studies teacher's knowledge by virtue of having teaching experience. Rather it is knowledge special to the teaching of mathematics. (p. 448)

This form of knowledge includes "using curriculum materials judiciously, choosing and using representations and tools, skillfully interpreting and responding to their students' work, … designing useful homework assignments," (Ball et al., 2001, p. 433) responding to students questions, addressing their confusions, and building on student thinking (Cannon, 2008).

Having a strong foundation of mathematics understanding for teaching makes learning more productive (Ma, 1999). However, cooperating teachers do not discuss mathematics or mathematics pedagogy with their student teachers more than superficially (Borko & Mayfield, 1995; Williams & Peterson, in press). The underlying features of a cooperating teacher's pedagogical content knowledge as manifested in their teaching actions and conversations with student teachers is generally not made explicit by cooperating teachers (Borko & Mayfield, 1995).

The analysis of the student teaching experience for this thesis is influenced by the current research presented above. Furthermore, this study seeks to discern how the current Western research suggestions and findings compare with the student teaching

model under investigation in this thesis.

The Japanese Model of Student Teaching

Two factors were critical in choosing a student teaching model to investigate that would enhance current perspectives on possible models. First, the student teaching model must be accompanied with positive outcomes in terms of student success since student success is the purpose of education in the first place. In addition, models chosen to investigate should be different from the models in current use that are under speculation. The Japanese model maintains these two features.

Differences between Japanese and Western models must not be interpreted as the sole cause of student success but as tools to highlight where research suggestions are successful or perhaps inadequate. Cross-cultural studies cannot identify causal mechanisms for mathematical achievement because learning is extremely complex and experimental control is impossible to gain (Stigler & Perry, 1988). However, cross-cultural studies are particularly useful because they extend the current beliefs of what is possible in another culture. They also highlight assumptions that may have been too implicit to be recognized from within a given culture (Stigler & Perry, 1988).

Mathematical Proficiency Among Japanese Students

The main objective of education is to provide students opportunities to learn. Thus, when one group of individuals shows evidence of greater mathematical understanding than another group, a research investigation follows. This was the case with regard to Japanese students' understanding of mathematics. As early as 1964, international comparisons were made in the field of secondary and elementary mathematics (Stigler & Perry, 1988). As major discrepancies in mathematical

understanding were noticed, further investigations were pursued. In 1989, the National Research Council documented marked differences between Japanese and U.S. students' mathematical competency. This study, titled the Second International Mathematics Study, found that the performance of the top 5 percent of mathematics students in the United States equaled the top 50 percent of students in Japan. Since the 1980s, a number of studies have reported similar findings (LaPointe, Mead, & Phillips, 1989; NCES, 2003).

The intent here is not to report that Western students are relatively poor in mathematics. As Baker (1997) stated, "International studies are most useful scientifically and politically when they are used to shed light on how and why a country produces a particular pattern of achievement" (p. 16). Researchers should focus on the critical question of why the Japanese students perform so much better than their Western counterparts. A number of possible answers to this question have been posited which take a variety of factors into consideration including family and cultural values, school practices, and student attitudes (Stevenson & Stigler, 1992; Wang & Lin, 2005).

Certainly, no single factor alone causes students to succeed or fail. However, what is the purpose of education if it is not assumed to have an effect on student understanding and academic success? Students' attainment of mathematical understanding must be attributed, at least in part, to teaching variables (Stevenson & Stigler, 1992).

Japanese Teaching Practices

The tendency to focus attention on teachers when there are discrepancies in student achievement motivated researchers to document how teaching practices compare between countries. Stigler and Hiebert (1999) described how mathematics lessons in Japan solicited student creation of and collaboration on mathematical concepts. In Japan,

students are responsible to supervise each other during work periods in mathematics classes, and large amounts of student conversation is not only allowed but expected (Sato, 1993). In the United States, by contrast, students are expected to passively receive mathematical knowledge from the teacher and engage in silent, individual practice exercises to reinforce their understanding (Stigler & Hiebert, 1999).

Lesson planning activities also show noticeable differences across cultures. In Japan, many teachers participate in regular reflective, collaborative professional development meetings within schools and in broader arenas (Howe, 2005). Particularly noteworthy is the Japanese practice of lesson study for in-service teachers. Here, practicing teachers carefully prepare and present innovative ways to teach various mathematical concepts to each other. After these lessons, the practitioners discuss the lesson for its quality (Fernandez & Yoshida, 2004; Lewis, 2002; Shimizu, 1999; Stigler & Hiebert, 1999). Such opportunities are typically unavailable for practicing teachers in the United States.

The purpose of this thesis is not to criticize American teachers. “We must get beyond the tendency to assign blame if we are to make maximum use of what can be learned from cross-cultural studies of mathematics teaching and learning” (Stigler & Perry, 1988, p. 36). In fact, the attitudes and beliefs of many American teachers are compatible with Western research recommendations (Morrell et al., 2004). Furthermore, Jacobs and Morita (2002) have shown that American teachers are beginning to show evidence of valuing teaching methods that include student collaboration and frequent episodes of student participation in developing mathematical concepts. However, noticeable differences in teaching styles do exist between nations. Understanding why

differences exist is fundamental to improving teaching.

International differences also exist in how teachers view quality teaching. In reflecting on lessons presented by other teachers, Japanese teachers were more critical of fast-paced lessons and insistent on students discussing and generating the main mathematical ideas (Jacobs & Morita, 2002). American teachers praised lessons that hold reviews and a good deal of teacher guidance (Stigler & Hiebert, 1999). Stevenson and Stigler (1992) summarized their impression of how teachers viewed quality teaching. They claimed teachers in the United States see a highly skilled teacher as an "innovator" who creates new ways to present lessons. In Japan, a quality teacher is seen as a "skilled performer" who can expertly present even standard lessons in ways appropriate for a specific class.

Interestingly, Jacobs and Morita (2002) also described American teachers as willing to accept a variety of teaching strategies as appropriate, but Japanese teachers held to the ideal script described above when introducing new mathematical concepts to students. This may be partially due to the fact that, in Japan, national bodies such as the Ministry of Education and the Council of Teacher Education have more absolute control and have created a more uniform educational system (Jacobs & Morita, 2002; Kobayashi, 1993). In the United States, individual states have much greater autonomy than the individual preferectures of Japan when it comes to decisions about public education. An implication of this cultural difference is that although American teachers might teach in an overwhelmingly similar fashion (Stigler & Hiebert, 1999), they have a flexible view of what constitutes good teaching (Jacobs & Morita, 2002). Japanese teachers have a relatively stable view of how teaching should be done, and they, for the most part, all

teach according to this view (Stigler & Hiebert, 1999).

To understand why teachers in different societies teach as they do is as complex as understanding why different populations have different levels of student achievement. In both cases, the influences of the society and the teaching culture are significant. However, how teachers engage in their practice must be, at least in part, a reflection of the teachers' experiences during the teacher-training process, including the quality of student teacher-cooperating teacher interactions. In a survey of the mathematics teacher training process in Japan, Christenson (2003) suggested that the development of the unique Japanese teaching techniques lies more in the structure and environment of the student teaching experience than in the actual university classes themselves.

Student Teaching in Japan

The structure of student teaching in Japan is quite different from that of the United States. In Japan, student teaching lasts only about four weeks, as opposed to semester-long student teaching common in the United States. During the two weeks prior to student teaching, the student teacher begins preparing lessons to be presented. Typically, several student teachers work with the same cooperating teacher. The student teacher has some homeroom responsibilities but is not expected to take over all of the roles of the teacher, as is very common in schools in the United States. Instead, the student teachers observe their cooperating teachers' and fellow student teachers' lessons, plan and practice lessons, interact with the students, and teach only three to ten lessons. The cooperating teacher meets regularly with the student teachers to discuss the development of their lesson plans (Christenson, 2003; Peterson, 2005). Cooperating teachers are actively involved in post-lesson reflection meetings for their student

teachers' lessons.

Another important aspect of student teaching in Japan is the existence of university- "attached" schools. Many universities that have teacher education programs also have an affiliated school where student teachers perform their student teaching. The teachers of these schools are viewed as faculty of the university. In Japan, attached schools may be seen as model schools or as practice schools. However, they are best thought of as laboratory schools (Hayo, 1993). Affiliated schools are also present in the United States, but they are less common.

In addition to the structural aspects of student teaching in Japan, research on the nature of student teaching, although limited, suggests that there are differences between Japanese and Western student teaching programs. In Japan, as in the United States, student teachers report difficulties in handling student behavior problems and teaching for slower learners (Jaworski & Gellert, 2003). Sugi, Shwalb and Shwalb (2006) reported that there is a growing tendency toward disrespect in Japanese classrooms. However, cooperating teachers do not address student management issues with their student teachers. Peterson (in press) found that the Japanese cooperating teachers he observed and interviewed did not bring up issues regarding student misbehaviors with their student teachers even when such a conversation seemed relevant by Western standards. Management issues of this sort are not the focus of the student teaching experience in Japan.

In Japan, much of the conversation between cooperating teachers and student teachers is geared toward understanding pupils' knowledge and needs and fostering mathematics discovery, with the priority on sharpening instructional skills (Christenson,

2003). Cooperating teachers ask many questions of their student teachers during the lesson planning stage. The lesson is the primary concern of the parties involved (Jaworski & Gelllert, 2003; Peterson, 2005), and student teachers welcome criticism and offer criticism to their peers (Peterson, 2005). Jaworski and Gellert (2003) described teacher training within the Japanese university setting to follow a modeling approach where student teachers and professors present lessons, and the university students and their professors reflect on their lessons.

In Japan, teachers are expected to learn how to improve their practice throughout their careers (Christenson, 2003; Peterson, 2005). Because of this, Christenson (2003) proposed that student teaching is viewed as a time for student teachers to *learn how to learn how to teach*. This is in contrast to the view that student teaching is a time for student teachers to simply *learn how to teach*. Japanese beginning teachers confirmed this notion by expressing that the main thing initial teacher training provided for them was it prepared them to develop skills necessary to teach (San, 1999). They did not say their teacher training prepared them to teach, but to learn.

After student teaching, new teachers have a one-year probationary period during which they receive further initial service training (Kobayashi, 1993). Over the course of this year, the new teacher undergoes intense mentoring from an experienced teacher whose sole job is to mentor first-year teachers (Howe, 2005). It is also during the first year that the event of becoming a teacher with all of the “strings attached” occurs. Stevenson and Stigler (1992) described that in Japan, little formal education in general pedagogy is received prior to graduation because of the expectation that this training occurs during the one-year probationary period. In contrast, regardless of how much

training education students in the United States may or may not receive, rigorous formal training virtually stops when pre-service teachers become in-service teachers.

Some may say that the Japanese first year experience is more like the student teaching experience in the United States. In deed, beginning Japanese mathematics teachers feel that the skills of managing school business, building relationships with the school and home communities, and understanding students are not developed until their first years as full-time teachers (Jaworski & Gellert, 2003; San, 1999). If this is true, it reinforces the need to investigate the nature of the interactions between student teachers and their cooperating teachers during the student teaching experience in Japan. If other responsibilities of teaching are not required of the student teachers, what other messages about teaching are being conveyed about teaching through professional interactions during the unique Japanese student teaching experience? It has been suggested that Japanese student teaching helps prepare novices to be career-long learners, continually striving to improve their practice (Christenson, 2003; San, 1999), yet how this is done has not been fully investigated.

Utilizing a Cross-cultural Model

Understanding the nature of Japanese student teaching will only be useful to Western researchers, practitioners and policy-makers when they are considered in light of Western culture. First of all, the national cultural features of student teacher-cooperating teacher relationships cannot be adopted by a culture in which the features are inherently incompatible. For this reason, educational reforms and changes cannot simply be implemented by “external imposition” (Jaworski & Gellert, 2003). In addition, asking teachers to modify their current mentoring practices needs to done with care so as not to

stretch mentors beyond their zone of proximal development (Cooney, Wilson, Albright, & Chauvot, 1998). When politicians, businesses or even researchers attempt to suddenly implement new standards or rubrics without respect for the current practitioners, morale drops, and teachers feel they are not trusted, respected or appreciated (Bullough, 2002; Stigler & Hiebert, 1999).

Improvement should be expected, however (Mewborn, 2003). Western culture emphasizes progress and quality education for all students. Changes within the smaller system of the teaching culture are possible (Jacobs & Morita, 2002). For example, Evertson and Smithey (2000) found that mentors could be trained to better serve student teachers by engaging in a variety of practices including eliciting more student teacher self-reflection, being specific in their feedback, and not merely cheerleading. When the mentors applied these actions, students were more engaged, and lesson implementation was improved. Furthermore, since American teachers can accept different models of teaching as appropriate (Jacobs & Morita, 2002), cooperating teachers may be able to change their concept of an "ideal script" within the student teaching context. It may take time, but Murray and Male (2005) have shown that teachers can change to form identities as valuable teacher educators in the field.

There is a need to develop a teaching infrastructure that can learn from its own experience (Stigler & Hiebert, 1999). As new models develop, the implementation should be brought about by ongoing reflective practice of the current and incoming practitioners (Mewborn, 2003; Zanting et al., 1998). As Wada (1993) stated, "When a radical reform is born of native thought patterns, it naturally finds support among its people" (p. 83).

Research Questions

The research on current trends in cooperating teacher-student teacher interactions outlines several components of effective practices and various roles of cooperating teachers during student teaching. The challenge remains, however, to understand a model in practice that will address the limitations of the current reform efforts. The Japanese student teaching system offers evidence of a model quite different from the Western perspective. It is likely that this model of student teaching is a contributor to higher levels of student understanding in mathematics. The goal of this thesis is to characterize the nature of the relationship between the cooperating teacher and student teacher in light of the structure of a Japanese student teaching experience. Specifically, the following research questions are posed: What aspects of teaching and learning to teach do the cooperating teachers emphasize during the student teaching experience in Japan? What do these emphases reveal about the principles that define the nature of the Japanese student teaching system?

Methodology

The Case Study Research Tradition

This thesis presents a multi-case study of the interactions between cooperating teachers and student teachers in Japan during the event of student teaching in response to the call for more grounded, qualitative research to examine factors which may have been hidden because of limitations of past theoretical perspectives (Wang & Lin, 2005). Given the scope of the research question and the available data, a multi-case study design is fitting. There is limited available research on the relationships between cooperating teachers and student teachers in Japan. Because the main objective of this research is to characterize these relatively unexplored relationships within the contextualized nature of student teaching in Japan, the research design must allow for new and unexpected findings. A case study design allows researchers to be "explicitly mindful" of the goal of the study and of the related research while being open to and reeducated by new or unexpected findings (Miles & Huberman, 1994). Case studies welcome the variety of instruments necessary to explore such a rich domain, and proper analysis of case study data considers a wealth of variables (Creswell, 1998). Furthermore, multiple cases enable the researchers to more thoroughly understand the Japanese student teaching system than would a single-case study. Comparisons may be drawn where contrasting and comparable findings may be evident, and hypotheses can be tested across cases, resulting in more valid findings (Miles & Huberman, 1994).

Data Collection

Sampling and Participants

In the spring of 2003, Dr. Blake Peterson of Brigham Young University made

inquiries to various Japanese universities with affiliated junior high schools, requesting permission to observe a student-teaching cycle for mathematics. Of the many inquiries, one attached school was able to make arrangements for research visitors and was also available for observations during the desired time–frame. From September 2, 2003, to September 29, 2003, Peterson collected data from Fuzoku Junior High School in a major city on the Japanese island of Shikoku for one four-week cycle of student teaching. (The data for this study is different than the data gathered by Peterson in 2002 and reported in 2005 (Peterson, 2005).)

All three cooperating teachers for mathematics at the junior high school were selected for study. These three teachers are named Kimura Sensei (41 year old male), Ueno Sensei (38 year old male), and Sasaki Sensei (33 year old female). (All participants' names are pseudonyms.) They had been teaching middle school mathematics for 9 to 18 years. Sasaki Sensei had a masters degree and Ueno Sensei and Kimura Sensei had bachelors degrees.

The selection of student teachers targeted for observation was based on the student teachers' schedule for lesson presentation. All of the seven mathematics student teachers attending this student teaching cycle were required to teach one lesson for each of the three cooperating teachers. In addition, all seven of the mathematics student teachers were required to jointly create a "research lesson" that would be taught by one of them near the end of the student teaching. The student teachers were to also assure that they taught once in each of the three junior high grades, first, second and third grade (equivalent to seventh grade, eighth grade, and ninth grade, respectively, in the United States). The student teachers were to consult the cooperating teachers' teaching schedule

for the four weeks that they would be student teaching. This schedule described the classes, dates and periods for each teacher (see Appendix A). The student teachers selected specific dates and times they would teach a lesson for each of the three cooperating teachers. After all of the student teachers had chosen their lesson days, three student teachers did not overlap in their schedule of preparing and presenting lessons. These three student teachers, ST Akihiko, ST Tomoko, and ST Motori, were selected for observation. For this thesis, only ST Akihiko's and ST Tomoko's interactions with the cooperating teachers were analyzed to maintain a manageable and thorough study of the relationships. Each student teacher was in the middle of their junior year of college and both were about 20 years old. ST Akihiko is male and ST Tomoko is female.

The selection of the site for study and the participants was based on willingness and availability. There is no indication that this affiliated school differs greatly from other affiliated schools in Japan. Furthermore, the cooperating teachers and student teachers selected to participate in the study did not appear significantly different from other teachers or student teachers at the school. However, the findings reported in this study should not be considered representative of Japanese student teaching in general. Rather, the research is a multi-case study aimed at understanding the complexity of the student teaching experience for three cooperating teachers and two of their student teachers.

Data Sources and Instruments

The unit of analysis for the study is the interactions between student teachers and cooperating teachers during the student teaching experience. There were fourteen interactions total: five planning meetings, two research lesson practices, six reflection meetings, and one meeting of general instruction. The cases of student teacher-

cooperating teacher interactions were supplemented with records of lesson plans, lesson presentations, and interviews. Specifically, the data utilized for this thesis were the copies of written lesson plans of the student teachers, audio-video of conversations student teachers had with their cooperating teachers during the lesson planning stage, audio-video of the lessons presented by the student teachers to the junior high students, audio-video of the reflection meetings after the student teachers' lessons, and audio-video of interviews of cooperating teachers and student teachers conducted both before and after student teaching. The student teachers met and practiced the research lesson four times. Two of the practice research lessons as well as the presentation and reflection meeting were also analyzed for this study. Because ST Akihiko was chosen to present the research lesson, he was required to only teach lessons for Sasaki Sensei and Kimura Sensei. In addition, a general meeting of the mathematics cooperating teachers with the mathematics student teachers at the beginning of the student teacher session was recorded and analyzed. All documents were transcribed in Japanese then translated into English by undergraduate and graduate student research assistants fluent in both languages.

Researcher Effects

Peterson was physically present during all stages of data collection where audio-video devices were used. Given the fact that he was an outside source, many efforts were made to make his presence as non-disruptive to the normal flow of events as possible. Peterson heeded the advice Miles and Huberman (1994) provided to help the researcher minimize affecting the site and participants of study during data collection. First, Peterson was present for the entire time the student teachers were at the school, from about 7 am to 6:30 p.m., Monday through Saturday. He also attended a variety of school

activities to “fit in” as best as possible. Second, the instruments were relatively unobtrusive. In Japan it is common for lessons to be observed by several individuals who would later participate in post-lesson reflection meetings. For the data collected here, at least three other student teachers and one cooperating teacher observed all student teacher lessons. In many cases, six peers were present. The research lesson was observed by 21 individuals, including peers, cooperating teachers, university professors, and undergraduate education students. Thus, it is likely that Peterson’s presence was simply one more of many. Besides the video recordings, copies of the lesson plans were regularly handed in by the students to various mentors and instructors, so the knowledge that these documents would be reviewed for research were no more invasive than the knowledge that they would be reviewed by peers, cooperating teachers or university professors. Third, participants were informed of the nature of the study in that they were aware that the researcher was interested in the nature of the interactions between cooperating teachers and student teachers. Fourth, data was collected at multiple locations (various classrooms and offices), during different times of the day (from 7 am to 6:30 pm), and during a variety of different activities (school meetings, lesson planning with and without peers and cooperating teachers, lesson presentations, reflection meetings, extra curricular activities at the school, etc.).

Data Analysis

Prior to analyzing any data, a rigorous literature review was conducted. Topics specifically sought after for the sake of analysis were (1) the nature and structure of student teaching in Japan; (2) research on what is currently being emphasized by cooperating teachers to student teachers, including what roles cooperating teachers

assume; and (3) research-based guidelines for beneficial cooperating teacher practices. After an exhaustive literature review, very little information regarding topics (2) and (3) were found from a Japanese perspective. Nearly all of the available research on current practice and best practice guidelines for cooperating teachers in a student teaching situation is written from and about Western cultures. Indeed, it is because of the lack of information regarding the relationship between student teachers and cooperating teachers in Japan that this study is warranted.

The research question of this thesis is, briefly, (1) what aspects of teaching and learning to teach do the cooperating teachers emphasize during the student teaching experience in Japan, and (2) what do these emphases reveal about the principles that define the nature of the Japanese student teaching system? To discern what is emphasized during the student teaching experience in Japan, the following sub-questions were posed:

(1a) What actions do cooperating teachers and student teachers take in preparing, presenting, and reflecting on teaching experiences?

(1b) What do cooperating teachers and student teachers talk about in various stages of the student teaching experience?

To expand the analysis into higher levels of abstraction and generality than mere description, the following additional sub-questions were posed:

(2a) What do the conversations and actions of cooperating teachers and student teachers say about the nature of learning to teach, teaching how to teach, and the nature of teaching?

(2b) What do the answers to the above questions reveal about the Japanese student teaching culture under study?

The answers to these questions were sought using a coding system that originated from the current literature and evolved as needed from the unique set of data. First, an initial framework of descriptive and inferential codes was established based on past research. These codes were used to find answers to questions (1a) and (1b) posed above. With these initial codes, the data for the student teachers were coded. Throughout the initial coding process, however, some codes were slightly modified or split into smaller, more specific codes, and new codes were developed as the data required. Again, at this stage, all codes were at the descriptive and inferential level. However, careful notes were made as more abstract and general patterns and themes emerged, especially with respect to questions (2a) and (2b).

The data were then re-coded due to the fact that the codes changed throughout. Re-coding was performed as many times as necessary until all passages of text were assigned at least one descriptive code. The codes and initial findings were discussed throughout the coding process during collaboration meetings with Peterson. He verified the nature of the coding by reviewing passages of transcribed text and determining if they were accurately represented by the coding scheme described. The codes were continually refined until Peterson verified that all passages he had reviewed were correctly described by their coding scheme.

In addition to checking the reliability of coding schemes, another purpose of the collaboration meetings was to explore the deeper, abstract levels of the data and to ascertain broader representations by identifying themes and patterns. In this way, the analysis progressed to more sophisticated levels.

> The progression is a sort of ladder of abstraction. You begin with a text, trying out coding categories on it, then move to identifying themes and trends, and then to

> testing hunches and findings, aiming first to delineate the deep structure and then to integrate the data into an explanatory framework. (Miles & Huberman, 1994, p. 91).

In the case of this study, the explanatory framework was aimed at integrating the key features and patterns of the student teacher-cooperating teacher interaction into a coherent picture of the student teaching culture expressed in the data. Additional research related to new or unexpected findings was consulted to ground the study with the current state of the field and to provide greater insight and explanations for findings.

These new hypotheses and patterns were also tested with the data, going through the same verification processes as the initial coding scheme. In this way, the data analysis had a spiraling approach, similar to Creswell's (1998) data analysis spiral. The major difference between Creswell's data analysis spiral and the process in this study is the base of Creswell's spiral begins with managing the data. Creswell suggested reading through the data several times before considering descriptive codes. The study reported in this thesis began with an initial set of loose codes based on past research. The purpose for the "start list" was to help cut down on data-overload, due to the large amount of data consulted for this study (Miles & Huberman, 1994).

The data codes and hypotheses were further analyzed using the "replication strategy" (Miles & Huberman, 1994). Miles and Huberman recommended a code-development and analysis process similar to the method used in this study. They term this strategy "stacking comparable cases." They describe the process as follows:

> You write up each of a series of cases, using a more or less standard set of variables (with leeway for uniqueness as it emerges). Then you … analyze each case in depth. After each case is well-understood (the cross-cutting variables may evolve and change during this process), you stack the case-level [findings] into a meta-[finding] which is then further condensed, permitting systematic comparison. (p. 176)

Validity and Reliability

Several safeguards suggested by Miles and Huberman (1994) were set to maintain a high level of reliability and validity. To confirm viable findings, collaboration meetings were held at every stage in code development and analysis. Special attention was paid to the cultural assumptions to be avoided and the cultural implications the study was trying to elucidate. In addition, alternative explanations were specifically explored and tested with the data. Also, evidence of counter-examples to hypothetical findings was diligently sought. Findings were triangulated using a variety of coding strategies on a variety of sources of data. With the various data sources, care was made to weigh data sources appropriately, not relying on one person or theme without sufficient evidence that doing so would be an accurate representation of the teaching system. According to Miles and Huberman (1994), strong data is collected with repeated contact, seen firsthand by a trusted field worker, and collected in an informal setting. These safeguards were maintained in data collection. All outliers, unexpected findings, and extreme cases were specifically considered in light of the other findings, and not disregarded.

Results

The purpose of this study is to describe and analyze the areas of emphasis cooperating teachers portrayed to their student teachers in their interactions during the student teaching experience in Japan. The main sources for understanding these emphases are from the physical and structural attributes of the student teaching system and the nature of the conversational topics. First, a description of the design of the Japanese student teaching system is presented. In addition, reoccurring verbal emphases from the cooperating teachers regarding the structure and expectations for the student teachers are described. Following the structural facets of student teaching, I present three other main areas that were emphasized by the cooperating teachers: lesson production, student reactions and interactions, and mathematics pedagogy. The critical themes in each of these categories are reported.

Structure of Student Teaching

Although Peterson observed the structure of the student teaching, the cooperating teachers also verbally described their expectations regarding this structure. The student teachers received explicit instruction in regards to the quality of work, how lessons were to be prepared, time frames for work, where to receive materials, and other logistical matters. Three general topics regarding the structure of student teaching were identified. They are (1) logistics, (2) the generation and reflection of lessons, and (3) nurturing quality work and improvement.

Logistics

Logistics includes any conversation or instruction regarding specific procedures the student teachers were to follow; descriptions of assignments and expectations; where,

when and how to complete assignments; how to manage time (non-lesson); where to get materials for teaching, and other student teaching activities. Logistics also includes general information about the school and the student teaching schedule.

Out of necessity, this topic was quite ubiquitous during the initial meeting of student teachers and cooperating teachers at the beginning of student teaching. During this meeting, Kimura Sensei described how the student teachers were to go about choosing and preparing lessons to teach to the students. He informed student teachers of the library where they could find resources for lesson planning. He informed them that they were responsible for choosing their lesson topics based on the teaching schedule that they had received. He also encouraged them to be wise in their use of time during the short period they would be interns there.

All three cooperating teachers also discussed logistical issues during the planning phases of lesson development. Almost all conversations to this end were in aiding student teachers in generating appropriate lesson plans that followed the style and requirements of the faculty. Student teachers were to fill out a formal lesson plan for every lesson they taught (See Appendix B). Prior to teaching their lesson, they would meet with their cooperating teachers to discuss their plan. The student teachers would not be permitted to teach unless the cooperating teacher “signed” (literally, “stamped”) the plan indicating it was adequate. In all six cases of student teacher lesson plans, several revisions were required before the lesson received a stamp of approval. One of the reasons revisions were necessary was because the plan was not filled out correctly on the form. All cooperating teachers spent time training their student teachers how fill out a lesson plan correctly.

Generation of and Reflection on Lessons

Because the conversations between student teachers and cooperating teachers were recorded during lesson planning and post-lesson reflection, a great deal of information was received regarding the structure of how student teachers were expected to generate and reflect on lessons. These findings are presented below.

Student teacher collaboration. One expectation was the use of collaboration in lesson generation. A poignant example of the expectation of student teacher collaboration came during a reprimand to ST Akihiko. Sasaki Sensei saw ST Akihiko's lesson as inadequate because of his lack of preparation. She explained that he should have consulted with other student teachers in preparing and reflecting on his lesson. She said to him during his reflection meeting,

> One of the good things that Ms. Kumiko [another mathematics student teacher] said was when she asked, 'what would you (the other student teachers) do? What do you think?' … Just asking the other teachers for their advice or other help I think leads up to the overall instructor's progress.

Collaboration was also built into the structure of post-lesson reflection. Reflection meetings had a specific pattern that was explained in detail to the student teachers prior to teaching their own lessons. To demonstrate how reflection meetings were to run, the student teachers were required to observe a lesson taught by the cooperating teacher Ueno Sensei. Student teachers were instructed to take careful notes that were supplemented with their own views and opinions on every lesson they observed. These notes served as a resource for the student teachers when they attended the mandatory formal reflection meeting after the class. At their first reflection meeting for Ueno Sensei's lesson, they were told how reflection meetings were to run. First, the teacher would give a self-evaluation explaining why he taught the way he did and identify issues

that he noticed. Later, the observers would be permitted to ask questions regarding the lesson. After questions, they were expected to offer opinions and suggestions. Several student teachers were present for each lesson a student teacher gave. When the reflection meeting was for a student teacher's lesson, the student teachers would speak first. After the student teachers were through, the cooperating teacher would express his or her own thoughts. The heavy involvement of the other student teachers and the cooperating teacher during the reflection meetings further demonstrates the importance of collaboration in the structure of the student teaching experience.

Another important component of the format of student teaching that required student teacher collaboration was the development of the research lesson. This lesson was supposed to be innovative, be engaging, and aid students in understanding a mathematical principle. Research lessons were planned over the course of the four-week student teaching experience by all seven mathematics student teachers that were at the school. They met several times so ST Akihiko could practice teaching the lesson to the other student teachers and in front of the three cooperating teachers. These student teachers prepared a lesson that taught the theorem of three squares (a.k.a., the Pythagorean Theorem). When the lesson was finally presented to students, many individuals including university and graduate students, professors, and other teachers from within and outside of school, observed the lesson and participated in a reflection meeting afterward.

The very nature of how these lessons were to be planned shows the important feature of student teacher collaboration in lesson development. One student teacher described his experience by saying,

> The innovation of the theorem of three squares helped each one of us to think about all of the processes by getting ideas from other people and fighting one idea

> against another. I have learned a lot from it, and I think everyone else learned a lot from this too.

Later during the reflection meeting, Sasaki Sensei described the collaborative efforts of the student teachers and her involvement with them during the reflection meeting by saying,

> During the process of planning this lesson, we helped each other come up with questions and what to write on the board. We also thought about the responses students would have… We cooperated with other teachers and tried to come up with good key questions for the lesson. You were thinking about this section for a long time. I think that helped you to improve your skill. I think you cooperated with each other and did a great job.

Notice how Sasaki Sensei included herself in the development of the lesson. The degree to which cooperating teachers were involved in the planning and presenting of lessons is another element of structure and is described in the next section.

Guiding the thinking of student teachers. In the very first meeting of student teachers and cooperating teachers, Kimura Sensei described the manner in which cooperating teachers would assist student teachers in developing quality lessons. He informed the student teachers that they needed to first come up with their own ideas on what to teach. They also needed to have a lesson plan imagined fully. After they had generated their own ideas, they could then discuss these ideas with the cooperating teacher. In other words, cooperating teachers required the student teachers to spend some effort to think independent of the cooperating teacher before receiving guidance from the cooperating teacher.

When the student teachers did have meetings with their cooperating teachers regarding a lesson plan, a common technique cooperating teachers used to assist student teachers in refining their lessons and teaching skills was to ask the student teachers

critical questions regarding their developing lesson. For example, a common topic all three cooperating teachers discussed with their student teachers was anticipating student responses. In order to aid student teachers in doing this, they would ask the student teachers to imagine what they would do if they were in the situation of the students. In this way, the cooperating teacher guided the student teachers' thinking without explicitly stating the "right way" to teach. The cooperating teachers wanted the student teachers to identify the issues and develop their own solutions. Another example of a cooperating teacher utilizing student teacher-questioning occurred during ST Tomoko's reflection meeting in Ueno Sensei's class. After the lesson, several student teachers felt the board was a little bit crowded. Later, Ueno Sensei involved the other student teachers that had observed the lesson by asking them what ST Tomoko could have done to resolve this issue. After letting them discuss the possibility of several options, he put forth a suggestion they had not thought of – the use of an overhead projector.

As in the case with Ueno Sensei suggesting the overhead projector, cooperating teachers did not require student teachers to come up with all ideas on their own. In reflecting on lessons, cooperating teachers readily offered specific advice on how to improve a lesson. A dramatic example of this was during ST Akihiko's reflection meeting in Sasaki Sensei's classroom. Sasaki Sensei was disappointed in how the lesson went. She criticized ST Akihiko for his lack of preparation and for not coming up with a realistic way to improve the lesson even after he admitted to feeling that it was not successful. She then described in some detail how the lesson could have gone and gave reasons for the teaching actions she recommended.

Not all cooperating teacher suggestions were as dramatic as this, yet the

cooperating teachers were very willing to provide a variety of suggestions of ways to teach. However, after putting forth suggestions, they would still allow the student teachers to have some freedom to choose between the options. For example, during a lesson planning meeting, Kimura Sensei gave ST Akihiko several examples of ways his lesson could go and resources that he could use. Kimura Sensei then encouraged ST Akihiko to consider the options and choose a teaching plan that he liked. In the final interview of Kimura Sensei, he described this strategy well:

> I did not tell them to implement everything I told them. I told them my suggestions and asked them to do whatever they felt was good. I will evaluate interns with their own ideas and effort. However, I suggested their lecture would fail when their plan was not good enough. I don't expect interns to do everything I tell them to do. If they do, it is like a robot. I prefer they use their own ideas and feelings for their teaching.

In a separate interview, Ueno Sensei expressed a similar opinion:

> My style [of instructing interns] is more like let interns do whatever they want to do if I determine they can do it within a 50-minute class period. I would like to cherish how interns think, and understand from their lecture and what they learned. I don't like cooperating teachers to instruct everything that interns have to do. Interns have their own ideas, so if they want to try something, I think we should let them try.

Allowing student teachers to think on their own, to develop their own lessons, and to choose the details of a lesson plan demonstrates the freedom student teachers were given during the student teaching experience. In the many processes to be considered in lesson development and implementation, student teachers were expected to be creative in generating original ideas. Imitation was not expected and was, in fact, explicitly discouraged. One of Sasaki Sensei's complaints against ST Akihiko's lesson was that he simply followed her suggestions rather than thinking on his own. She said,

> It shouldn't just be "because this teacher thinks so" or other people's opinions… This may be harsh, too, but you used a lot of the materials I suggested, this time,

> haven't you? And the objectives you listed were mostly what I had written down, too. Putting it simply, you didn't struggle at all to get to this point.

Although imitation was discouraged in creating lesson plans, imitation was expected for certain teaching practices. Specifically, lesson plans had a very rigid format that student teachers were to follow exactly, and reflection meetings had a pre-set style. The student teachers were specifically taught how these meetings and plans were to run.

Nurturing Quality Work and Improvement

A third underlying tenet regarding the structure of the student teaching experience surfaced across all cooperating teachers and both student teachers. There was a clear focus on generating quality work, improving lessons and skills to obtain this high quality, and to encourage this improvement in a serious yet nurturing manner.

Quality work expected. Student teachers were expected to spend considerable time, thought and research in preparing to teach lessons. Prior to creating a lesson plan, the student teachers were required to engage in *kyozai-kenkyu.* This expression is translated as "content analysis." It refers to the "careful analysis of the mathematical connections both among the current and previous topics (and forthcoming ones, in some cases) and within the topic. Also included are the anticipation of students' approaches to the problem and the planning of instructional activities based on the anticipated responses" (Shimizu, 1999, p. 113). Content analysis required the student teachers to consult prior lessons, various textbooks and other materials to understand the important concepts and to glean ideas for questions and problems to utilize in the lesson. Content analysis meant more than following the outline of the students' textbook. The student teachers were expected to reference many sources and generate original ideas. The time allotted for mathematics lessons was only 50 minutes; however, in addition to the time

spent in content analysis, the amount of time spent discussing lesson plans with cooperating teachers was typically an hour. In the case of the research lesson, the student teachers met with the cooperating teachers for approximately four hours. The number of lesson plan revisions required of student teachers also demonstrated the expectation of careful thought and quality preparation.

Every detail of the lesson was required to be thoroughly planned out. After one of the practices the student teachers held for their research lesson, the cooperating teachers began working with the student teachers on the smallest details of the lesson such as what colors to use for triangles and which variables to use to label vertices. After the research lesson was presented, many of the positive comments on the lesson from other teachers, professors and graduate students were regarding the minute details that the student teachers had attended to. Examples of praise for careful consideration of details were evident across all cooperating teachers.

When details of the lesson were not complete, cooperating teachers reiterated the importance of thorough preparation. For example, to assist students in understanding bounds on domains of functions, ST Tomoko gave them a function of x and a pre-made set of Cartesian axes so students could plot coordinates on a Cartesian plane. She chose several x-values and asked students to discover the output values and to plot the coordinates. However, one of the input values she chose could not be represented on the graph because the output value was too large. During the reflection meeting, Ueno Sensei spent some time discussing how important it was for student teachers to have each example chosen beforehand. He also encouraged students to practice displaying their board before teaching the lesson to make sure that everything would fit well and would

look organized.

Student teachers recognized the emphasis on quality work in lesson preparation. Both ST Tomoko and ST Akihiko expressed regret for their lack of preparation, even when they had spent many hours preparing for a single lesson. When interviewed at the end of the student teaching experience, ST Akihiko said, “The most important thing I learned was to do my best at everything with students, with content analysis, everything.”

Improvement. Striving for quality lesson plans was a continual process. Improvement was expected and requested as student teachers developed their lesson plans. A clear example of the cooperating teachers’ expectation for excellence was in the requirement of lesson plan revision. For instanced, when ST Tomoko met with Sasaki Sensei, she pointed out many areas in her lesson plan where she expected a clearer description of the lesson goal and correct usage of the Japanese language. Furthermore, the cooperating teachers acknowledged when something had been improved. Ueno complimented ST Tomoko on her lesson plan for his class, saying it was very good because it was her second draft.

Even after a lesson was presented, the cooperating teachers continued to push the student teachers to discern how the lesson could have been even better. Ueno Sensei said the following to ST Tomoko:

> What you feel after class is something you need to pay attention to. You make your best efforts before the lesson, but you also need to realize your plan still has some holes. You never know how children respond until you teach them.

During reflection meetings, cooperating teachers utilized the “holes” of a lesson as a springboard for student teachers to consider when improving lessons. In many cases, the cooperating teachers and even the student teachers posed the questions, ‘What would you

have done to improve this issue?' or "Acknowledging there was a problem here, how would you have done things differently?" The cooperating teachers expected the student teachers to thoughtfully determine changes they should have made that would have resolved issues that occurred during their lesson. One of Sasaki Sensei's criticisms of ST Akihiko's attitude was that he did not care to take the time to consider a realistic way to resolve the problems that occurred using his teaching plan. On the other hand, Ueno Sensei sincerely complimented ST Tomoko during her reflection meeting for her careful consideration on how she could have improved her lesson after she had taught. He said, "I am amazed at your ability to reflect on your work as shown by your own evaluation." Granted, Sasaki Sensei was referring to ST Akihiko's first lesson, and Ueno Sensei mentored ST Tomoko's third lesson; however, whether in praise or criticism, the cooperating teachers showed the value they placed on student teachers being willing to improve upon their lesson.

Beyond improving the lessons, cooperating teachers also spent some time emphasizing how a student teacher could improve overall. Because of Sasaki Sensei's poor opinion of ST Akihiko's lesson in her class, she spent much time focusing on improvement. She told him that it was okay if he made mistakes as long as he used his experience to learn and improve. She emphasized the characteristics ST Akihiko needed to develop as a teacher and individual to become a better teacher overall. Specifically, she stressed the importance of teachers having humility in their teaching. She explained that without this characteristic, teachers cannot improve their teaching. She further elaborated by saying that asking other student teachers for their advice would improve his teaching.

On a few occasions, the cooperating teachers expressed the idea that the student

teachers would improve as they gained more experience in teaching. For example, Sasaki Sensei told the student teachers that time and experience would help student teachers discern if students were bored or confused. However, the use of experience to teach principles of teaching and to create good lessons was not emphasized nearly to the extent as was the notion that improvement comes with careful preparation and an active effort on the part of the student teachers to generate quality work. During Ueno Sensei's final interview he expressed, "the biggest improvement in these interns was them realizing that they needed to improve and prepare well for the content of their lesson."

Nurturing student teachers. Cooperating teachers clearly emphasized the importance of quality work, the seriousness of the student teaching experience, and the continual effort for improvement; however, this was not at the expense of the cooperating teachers' emotional support and nurturing attitude toward their student teachers. As reported above, the harshest criticism toward a student teacher was during ST Akihiko's reflection meeting for Sasaki Sensei's class. Yet, she also tried to help him realize that even experienced teachers struggle with many of the same issues he had to face. For example, after spending over ten minutes going over the many problems she saw in the lesson, she saw that he was discouraged, so she added,

> I can't talk big either. Teaching students, you get nervous and start panicking. But if you think that way, it becomes harder to evaluate others' work. So, I felt, more than anything else, that we need to prepare really well for our lessons, which makes us less nervous. And if in doing the lesson, you mess up badly, it's okay as long as we improve upon that experience and benefit the students in the future.

Both Ueno Sensei and Kimura Sensei also expressed their own faults and the general difficulty of teaching in front of students in an effort to buoy up the student teachers during the demanding experience of student teaching.

The nurturing attitude of cooperating teachers also came across as they expressed belief in the student teachers' ability to improve and teach well. Sasaki Sensei tried to encourage ST Akihiko by telling him that she believed that he could pull off a great lesson if he fixed a few things. At the end of this meeting, she stated, "You will be better. Keep trying." After ST Tomoko's lesson for Ueno Sensei's class he expressed support for her by saying "I'm sure you will be a wonderful teacher." Later, during the final interview of ST Tomoko, she described how much that short expression of confidence helped her morale.

Cooperating teachers further supported the student teachers by identifying areas of the lessons or lesson plans that were impressive to them. They made a point to compliment the student teachers both in general terms (e.g. "very nice work") and specifically (e.g. "you were dealing with the students with composure"). The reflection meetings were business oriented, yet respectful and cordial. During the reflection meetings for every student teacher, almost all individuals began their comments regarding the lesson by first thanking the student teacher for allowing them to observe the lesson. In fact, although this was never explicitly stated during the observations for this study, there seemed to be an unspoken expectation that the participants in the reflection meeting were to thank the teacher for their lesson prior to expressing their opinions about the lesson.

Lesson Production

In addition to the underlying structural elements, cooperating teachers emphasized topics specifically related to the production of a lesson. Five areas of lesson production were prominent in discussions between cooperating teachers and student teachers. They

were 1) classroom display, 2) oral presentation and teacher presence, 3) interesting lesson material, 4) lesson organization, and 5) the questions and instructions given during the lesson. These topics are described below.

Classroom Display

A striking topic that was repeatedly emphasized by cooperating teachers was the importance of clear and organized materials for display during the lesson. Most often these conversation were in regards to the blackboard. The legibility of writing, the layout and spacing of items on the board, even the straight alignment of characters were addressed by all cooperating teachers. There was a specific place on the lesson plan form for students to sketch how they would display items on the board (See Appendix B). Classroom display also includes the layout and organization of materials for students to use during class. ST Akihiko utilized several worksheets in his lesson in Kimura Sensei's class. As he organized these worksheets, the clarity and layout of the worksheets were discussed quite thoroughly. The necessity for an organized board was understood by both student teachers and cooperating teachers. That is, both groups brought up the importance of an organized board and clear teaching materials in all interactions.

The reasons for a well-planned classroom display were also discussed. One reason for having good materials to display in the classroom was to allow the students to have more time to think about mathematics. For example, during the initial meeting with the student teachers, Kimura Sensei suggested that the student teachers use "flash cards" (large posters with writing already on them). He said, "It is more effective to write down questions on paper rather than writing long sentence questions on the black board. This gives students more time to think about questions." In another situation, ST Tomoko

asked students to hand-draw pictures of fruit and a balance in her lesson on solving equations. Several student teachers suggested she should have provided them with a worksheet with the pictures instead because the students spent so much time drawing careful pictures of fruit that they didn't have as much time to think about the mathematics.

Another reason for a clear, organized board was to clearly show the important points of the lesson and to reduce confusion. Sasaki Sensei emphasized the importance of a high-quality board display and said, "Basically, the best way of writing on the blackboard is if you can still see what has been taught that day after the class." When Ueno Sensei helped ST Tomoko plan her lesson, he spent time discussing how she should draw graphs on the board to show which parts of the graph were outside the bounds of the domain. During the reflection meeting on this lesson, they returned to the topic of clear writing on the board and the use of the overhead projector to keep the mathematics organized.

Oral Presentation and Teacher Presence

In addition to the attention paid to the physical features of the classroom, cooperating teachers also emphasized the importance of the oral presentation and teacher presence. Specific topics that were mentioned by cooperating teachers that are classified as oral presentation include the dialect of the student teacher, the speed of speech, and the volume of voice. For example, ST Akihiko received many positive comments in all of his lessons for his clear voice. Teacher presence incorporates the appearance and mannerisms of the teacher. This refers to the level of confidence a teacher portrays, the appearance of nervousness, and how natural the student teacher appeared in interacting with the

students. Both student teachers admitted to feeling quite nervous about teaching, yet they also both received compliments on their confidence and naturalness. A student teacher observing ST Akihiko's lesson for Sasaki Sensei's class commented that his manner of speech had a desirable calming effect on the students. ST Tomoko was complimented on her choice to chat with the students about their recent field day prior to class because it created a comfortable atmosphere for the students. At another meeting, Ueno Sensei cautioned student teachers not be too jovial with the students until they were used to their particular sense of humor. The general point cooperating teachers made regarding the importance of teacher presence and oral presentation was that student teachers were responsible for conducting themselves in the classroom with the purpose of keeping the classroom environment positive for students.

Interesting Material

The content of the lesson itself was also a prominent element in terms of lesson production. The cooperating teachers repeatedly emphasized that creating an interesting and engaging lesson for the students was an important responsibility of the student teachers. They complimented the interest that student teachers generated by bringing in outside materials or knowledge, such as when ST Tomoko would bring up mathematics history in her classes.

The value put on generating interesting mathematics lessons was apparent in the many comments made regarding "interesting lessons." For example, in the research lesson on the Pythagorean Theorem, ST Akihiko asked the students to use pre-cut geometric shapes to form a square, like solving a jig-saw puzzle. Those observing the lesson were impressed with the interest this generated in the students. One graduate

student observer said,

> I thought the flow of the lecture was really interesting for the students. It was like a quiz show. From now on, when students think about the Pythagorean Theorem, they will remember that it is fun like a quiz show... . When I was a student, there were not activities like using partitioning of squares. There wasn't any sensibility of teachers. Therefore, when I heard about the Pythagorean Theorem, I could not understand it. Just looking at the outside shape didn't help me to know what is going on inside of the square. However, your lecture had activities to help them understand those kind of things, so I thought it was a really interesting lecture.

This comment also highlights that creating an interesting lesson was about generating the interest via the mathematics. Stigler and Hiebert (1999) claimed that one of the key differences in attitudes on mathematics between the U.S. and Japan is that in Japan there is a belief held by the teachers and passed on to the students that mathematics is intrinsically interesting, while in the U.S. mathematics is seen as a boring field that is only fun to learn if it is supplemented with outside resources, stories, or applications.

Although putting in gimmicks to make the lessons more interesting for students was certainly not observed, there was one case where the idea that the teacher needed to keep the students interested in an otherwise tedious topic was addressed. ST Akihiko was expected to teach the students about "transposition." Transposition, in this case, refers to a short cut in the steps to solve simple equations. Rather than having students perform an operation on both sides of an equation to isolate a variable, the lesson was to show that doing so results in switching a term or number to the other side of the equal sign and performing the opposite operation. For example, instead of putting in all of the details in the solution presented in Figure 1a, transposition refers to skipping row 2 and only attending to the details in Figure 1b. The $5x$ "moved" to the left and "became" negative.

Detailed solution		Solution using transposition	
7X = 5X - 12	(1)	7X = 5X - 12	(1)
7X - 5X = 5X – 12 - 5X	(2)	7X - 5X = - 12	(2)
7X - 5X = -12	(3)	2X = -12	(3)
2X = -12	(4)	X = -6	(4)
X = -6	(5)		
(a)		(b)	

Figure 1. Solving equations with and without transposition.

> Commenting on the topic of transposition, Kimura Sensei said,
>
> This part is not interesting. It's very orthodox and normal, but usually lessons are like this. Lessons are not always interesting. Interns usually teach an interesting part and what we regularly do is really normal lessons. But, if you become creative, isn't this possible? For example, create small groups, make them come up with their own questions, and solve those questions as groups.

Kimura Sensei explained that the reason transposition worked was a critical point of the lesson, so it needed to be well understood by the students. The lesson plan also needed to allow time for students to practice the principle. However, he also stressed to ST Akihiko that even monotonous parts of lessons are important, and he needed to think of creative ways to keep the students interested by how he ran the classroom. He put the responsibility on ST Akihiko to keep the students engaged in what was seemingly a boring topic for students.

Lesson Organization

As the cooperating teacher and student teacher discussed the content and activities of a lesson, a critical issue the cooperating teachers brought up was the "flow" of the

lesson. Cooperating teachers expected the student teachers to create lessons that seamlessly moved from one segment to another in a natural way. In Ueno Sensei's final interview he said, "The thing I paid most attention to was the flow of the lecture. Like if they taught this, and then taught that, the transition needed to be very smooth." All cooperating teachers and student teachers focused on the flow of specific ideas as they generated their lessons. The lesson flow was complimented and/or discussed during all six post-lesson reflection meetings.

The key in determining whether the sequence of the lesson was appropriate was whether the students would be comfortable with the current discussion and if it would feel natural to them to move on to the next idea of the lesson. For example, in ST Akihiko's self-evaluation of his lesson for Sasaki Sensei's class, he expressed regret in how the lesson went because he tried to push through the topics unnaturally, forcing ideas upon students in an "intrusive" manner. ST Akihiko's lesson was on simultaneous linear questions. He posed a problem of having two of the same unknown whole numbers in one box and a different whole number in another box. Then he told the students what the sum of the three numbers were. He then asked the students, "What numbers could be in the boxes?" After the students provided a few of the possible combinations of numbers, he gave them a second condition that narrowed the solution set to one. However, as the lesson continued, he was the only person providing explanations for why using simultaneous solutions was better than other methods for solving these types of problems. Sasaki Sensei offered the following alternative lesson sequence:

> If I were you, I think I would have started with the boxes. I wouldn't put up a problem. Just put down the boxes, and tell them these are boxes. Say you're putting in cards [with unknown whole numbers written on them], and put them in. … Instead of putting up a problem, you could just have them guess what's in each

> box. They could start asking for hints. Then, you could tell them that the sum would be 13. With that, the students would seriously start thinking.
>
> Weren't the students raising their hands, offering answers in your class, too? You can praise them, but they'll say there's too many ways that could happen and that it's impossible to determine. And here, you can't say that you'll give them conditions that would help yet. They haven't really noticed how many different solutions there will be. And they don't realize that they need those conditions to solve. I felt like making them realize this was probably the most important part of the lesson.
>
> I think the children would prefer that sequence, too. Being asked how many is in each, realizing that there are many answers, being asked how many there are, and noticing that there were a lot, and they'd realize that there needs to be more—some necessary conditions. Then, you can tell them good job and give them the condition. They'd be happy to receive it. That seems like a real conversation with the children. And I think they'd be impressed that with two conditions, the problem becomes solvable.

Sasaki Sensei recommended that a more natural flow for the lesson focused on phrasing questions and ordering ideas so that students would understand the necessity of certain conditions and would appreciate the mathematical principle under discussion.

All lessons that were observed for this study required the students to be active in the lesson. In all cases, the students were expected to engage in a conversation with the teacher and with each other about the mathematics under discussion. The students were given time to work on tasks designed to clarify key mathematical concepts. Because the students were asked to think and participate, student teachers needed to think carefully about how students would respond and the amount of time they would take doing a particular activity. However, student teachers were often surprised at the pacing or responses of the students. Because of this, the cooperating teachers recommended that the student teachers be flexible in their lesson. As Sasaki Sensei said,

> A teacher sometimes has to change the lesson plan according to the flow of the lesson or students' response. It also differs from class to class. Ueno Sensei mentioned that he would wait for the answer he wants. If you want to stick to

> something, giving students some hints and helping them express with their own words is very beneficial. They will remember the things they gained by themselves.

Questioning and Instructions

As mentioned previously, the cooperating teachers showed meticulous attention to the details of lessons and lesson plans. One of the areas that received special attention was in the careful wording of questions and instructions given to students. Because it was so prominent, and because it was also a critical component of lesson production, it receives its own section here.

The importance of asking clear questions was noticed from the very first meeting of cooperating teachers and student teachers. During this meeting, Kimura Sensei explained that a formal post-lesson reflection meeting would follow all lessons by student teachers. In his brief description of the meeting, the only purpose he gave for having the meeting was to discuss whether the questions that were posed to the students were easy to understand. This, of course, was not all that was discussed during the reflection meetings, but the fact that this was the only purpose initially presented shows the significance quality questions played in teaching.

The Japanese word *hatsumon* refers to “a key question that provokes students’ thinking at a particular point in the lesson ” (Shimizu, 1999, p. 109). During the interactions of the student teachers and cooperating teachers, they focused on the clarity of the *hatsumon* and whether the students would be able to understand the mathematics based on their engagement in response to the *hatsumon*. Cooperating teachers emphasized that the questions the student teachers asked should engage the class in a conversation about mathematics. Sasaki Sensei referred to the need for questions

generating a dialog between students and the teacher several times in the reflection meeting for ST Akihiko. She said, “Imagine having a conversation with your students. Don’t turn your back on them.” A great deal of attention was given to creating good *hatsumon* by all student teachers and cooperating teachers.

Student Reactions and Interactions During Lesson Implementation

The previous two sections discussed the structural components of teaching and the components of lesson production that were emphasized during the Japanese student teaching experience. A third topic that received particular focus in all the conversations between cooperating teachers and student teachers was the student reactions and interactions during lesson implementation.

One of the most important players in the presentation of a lesson is the student. Discussions on how the students interacted with each other, the teacher, and the lesson were emphasized in all conversations between cooperating teachers and student teachers. In their discussions with student teachers, cooperating teachers emphasized four main areas pertaining to student interactions and reactions. They were 1) guided thinking of students, 2) collaboration of students, 3) the importance of individual students, and 4) impressions of students. These are discussed below. A brief discussion on the lack of emphasis on management follows this.

Guided Thinking of Students

Cooperating teachers reiterated the importance of students generating and using their own mathematical ideas as they participated in the lessons. The reasons for allowing students to think on their own, rather than having the teacher do and explain everything, were explained by the cooperating teachers. For example, Sasaki explained to both

student teachers that having students use their own words helps them remember better. Ueno described that if a concept was not well understood by students, they needed to spend time working on it to clear up any misunderstandings. He said to ST Tomoko,

> Drawing coordinate axes was okay, but the problem occurred because you also drew the graph, and that's why you had a difficult time later on. You should pick someone to do it or ask for a volunteer. If you had someone draw, he/she would have drawn with the broken line. If he/she didn't use the broken line, you could give instructions to do so. Because students didn't understand the concept of domain quite well, if you did everything for them, they could never learn.

Allowing the students the time necessary to think on their own was an element of teaching that all three cooperating teachers tried to teach their student teachers. Recall that the reason Kimura Sensei gave for using flash cards with main points written on them was to give the students more time to think on their own. Sasaki Sensei acknowledged the uneasiness a student teacher may feel as he or she waited in silence for the students to think on their own, but stressed that it was important nonetheless.

The student teachers attempted to give the students the time and freedom to think on their own; however, they questioned how they were to get across the main points of their lesson if the students did not generate these points on their own or as groups. In response to this, Ueno Sensei first pointed out that it is appropriate for a teacher to help students organize their own ideas if they are on the right track. He also gave other specific advice when a student teacher asked about this issue:

> Student Teacher: I have one more question. You mentioned that it was quite hard to use the figure B with the demonstration of plan B [see Appendix C]. If none of the groups came up with the idea that you wanted, what should you do?
>
> Ueno Sensei: I think that the lesson plan shows what I want in my lesson. There should be some parts that I have to stick to an idea and some parts that I don't care too much. I usually have a lot of things I don't care about in my lesson. I tend to think that would be good if an idea comes up. So even though one idea does not come up, it still would be okay. But I would pay extra attention to this part. I

> might wait until I got the answer I wanted, or I might give students some hints. For example, Yuki wrote down an idea, using figure B. Then I would tell all the students about what Yuki was doing. This is somehow giving others a hint for what they have to do. I have to do this kind of thing in order to get what I want.

Another way that cooperating teachers suggested they guide student thinking while also allowing the students to think on their own was by redirecting the authority on clear and correct solutions. The student teachers were told that they should not answer whether or not a solution or explanation was sufficient. Rather, the students should determine if the explanation was sufficient based on whether or not other students in the class could understand it. Ueno Sensei explained to his students,

> There are many ways of expressing ideas and explanations. Well, I will put you into a group of four people and let you work as a group. Please make sure to listen to other people's ideas and explanations and make sure to get the reasons. If you can explain the reasons clearly, then the idea should be okay. I mean the answer should be right.

Collaboration of Students

One of the suggestions the cooperating teachers gave in helping students to think on their own, rather than having the teacher explain everything, was to have students explain principles to each other. The use of student collaboration in the mathematics classrooms was evident in all observations. Thus, much of the conversation regarding student reactions and interactions during the lesson was centered on features of collaboration.

The ubiquitous use of student group work was built into the everyday teaching of the students in this study. Prior to the student teachers arriving, the students had been trained how to form groups by rearranging their desks. They had been frequently asked to prepare group presentations on mathematics tasks. This being the case, there was little discussion regarding the logistical details of how to form groups because all the student

teachers had to do was say “form groups,” and the students would quickly do so. The only example of student teachers receiving this kind of instruction was when they observed Ueno Sensei’s lesson. He asked his students to work in groups and later explained that his only motivation for doing so was to “introduce student teachers to this kind of learning style.” Besides their observation of the method, there was no other instruction on how to get students to form and work as groups during the student teaching experience.

The conversations that did occur regarding student collaboration were centered on when group work was appropriate and the advantages of student collaboration. Two main purposes for collaboration were explicitly taught to the student teachers. They were to have students assist other students in understanding and clarifying concepts and to allow students to quickly see a variety of methods to solve problems. Ueno Sensei identified these two purposes during the reflection meeting on his lesson. Later, Sasaki Sensei quizzed ST Tomoko on these purposes:

> Sasaki Sensei: The advantage of using a group activity is students who understand better can teach students who understand less. We have another advantage, don’t we?
>
> ST Tomoko: Get to know each classmate’s idea?
>
> Sasaki Sensei: If they have classmates to work with, then they will have more….
>
> ST Tomoko: I know. Two heads are better than one.
>
> Sasaki Sensei: That is right. They will know new methods by working with friends. So there are two advantages for group activity. If you use the group activity, it will work very well based on understanding the advantages of using groups.

Kimura Sensei alluded to a few other advantages or purposes for student collaboration. He suggested to ST Akihiko that allowing students to work in groups

makes lessons more interesting to students. On a managerial side, Kimura Sensei also suggested that student collaboration allows many students to receive individual attention and eases the task and the time it takes for the teacher to visit each student during class to check for understanding. He taught ST Akihiko a style of teaching that he termed "small teacher," where students who do understand a concept teach students who do not. Kimura Sensei told ST Tomoko,

> It is hard if you try to explain everything students ask, so recently I try to ask them to explain. After one student operates a balance, you can ask others why he/she did so. If they don't see why, you can then turn the table to the student who did the operations and ask him/her what he/she did.

During a meeting to plan the research lesson, the cooperating teachers suggested the possibility of having other students assist groups who could not form a square using the puzzle shapes. Thus, collaboration eases the task of the teacher to assure all students receive enough attention.

Importance of Individual Students

Cooperating teachers had a clear focus on assisting all students to understand the mathematics. In analyzing the conversations and emphases of the cooperating teachers, it is clear that the students were the most important factor to consider in all lesson planning and presentation. Ueno Sensei explained to the student teachers that although group work may bring out mathematical ideas, the individual's understanding of the mathematics is the most important. Sasaki Sensei also emphasized this idea in ST Akihiko's reflection meeting by saying the students' thinking was more important than ST Akihiko's momentum or tone during the lesson. She encouraged him to put the students first as he presented lessons. Ueno Sensei taught the importance of the student by saying:

> A plan is just a plan. Don't get me wrong. I'm not saying that the plan is not

> important. I don't mean that you can do whatever you like, but it is still a plan. Your main focus is students. The lesson is contingent on students' ideas or reactions.

The student teachers understood the importance of the students as evidenced by their own comments. ST Akihiko said, "It seems like I was the only one talking, and students were only listening. The lecture should be putting students at the center of attention always, but I talked too much." Even more poignant is ST Tomoko's comment in her final interview: "After this internship was over, I was at home thinking students were the most important thing in teaching. If students don't follow a teacher, the teacher is powerless. So I understood the importance of students."

Impressions of Students

All conversations between cooperating teachers and student teachers had discussions on the impressions the students had on the lesson presentation and on the instructor. Cooperating teachers tried to teach the student teachers that it was a teacher's responsibility to create a classroom environment that was enjoyable for students to participate in.

ST Tomoko paid special attention to the more emotive needs of students. For example, she took a considerable amount of time to construct colorful paper fruits to use during her lesson in Kimura Sensei's class. Kimura Sensei gave her much praise for this and added that students appreciate the extra efforts teachers make to be friendly with their students. He said,

> Students ask me why I come to class early for a special class, why I wear a nice tie, and so forth. In this kind of conversation, it is extremely important to have a friendly conversation with them while encouraging them to study hard. That's why I feel it is necessary for you to arrive early for class and talk to students before class. And, it might be different for each grade, but students see teacher's efforts. When they saw your drawings of melons and bananas, they said, 'You

must have put in a lot of effort to make those.' It is apparent when teachers try to do their best. Children can sense that.

Later, ST Tomoko taught a lesson in Ueno Sensei's class. To discuss a misconception that many students held, she asked a male student to present an answer at the front that was incorrect. Later, during the reflection meeting, she demonstrated her sensitivity for the feelings of her students by saying, "He said something like he was hurt. Although, I'm not sure if he was serious or not. Looking back on this, I think that even a small little thing that teachers do to make fun of students might hurt them."

Management

Peterson (in press) reported that management was not discussed between cooperating teachers and student teachers in his observations of the Japanese student teaching experience. This study specifically looked for evidence of discipline-related issues. With one exception, the cooperating teachers did not discuss any issues on this topic.

The one case where classroom management was mentioned was during a reflection meeting for ST Akihiko's lesson in Kimura Sensei's class. They were discussing the incident when the students were working in their groups and talking about the task. ST Akihiko had to give them further instructions, but because the students were paying attention to each other, ST Akihiko was required to "use a loud voice" to get their attention. During the reflection meeting, Kimura Sensei recommended that when student teachers put students in groups to work on a task, that they give them all of the instructions before hand. Otherwise, they should ask the students to "stop moving their hands" before trying to explain anything to them.

In an interview after the student teaching session was over, Peterson asked the

cooperating teachers regarding student management. Ueno Sensei's response was that students are likely to chat if the class is boring. He said,

> If the problem is solved when it is small, I can handle it. Every student has a possibility to chat in a class even though they are not especially bad students if a lecture is boring. So if a class is boring and it caused chatting, then I have to do something during this class period. Otherwise there will be many other fires coming out from other places.

In other words, Ueno Sensei suggested that management problems can be avoided by having interesting lessons. Kimura Sensei explained that if serious behavior issues were to occur during a student teacher's lesson, it is the responsibility of the cooperating teacher or homeroom teacher to handle the problem. He said it was inappropriate for a student teacher to handle a large behavior problem. Sasaki Sensei informed Peterson that teachers learn how to handle behavior problems after they begin their teaching career by observing other teachers, receiving assistance from their mentor teacher, and through the experience of teaching. Although the cooperating teachers did have the above opinions regarding management in terms of student behavior and discipline, this topic was not explicitly discussed nor emphasized to the student teachers.

Mathematics Pedagogy

One of the specific intentions of this study is to identify how mathematics was discussed in the student teaching interactions in Japan. Nearly all discussion on mathematics was in terms of the teaching of mathematics. Mathematics pedagogy accounted for over 90% of conversation that was related to mathematics. The other conversations pertaining to mathematics involved either the student teachers' subject matter knowledge or was an exploration of mathematics that was not related to the lesson under discussion.

The dominant themes discussed in terms of mathematics pedagogy were 1) lesson goals, 2) key mathematical concepts, 3) generating appreciation for mathematics and mathematics teaching, 4) scaffolding of content, 5) student understanding of proof and reason, and 6) tendencies of students with mathematics. These themes are discussed below.

Lesson Goals

As student teachers developed their lesson plans, they were required to clarify specific goals for the lesson. The activities of the lesson were only considered appropriate if they helped achieve the goals. This being the case, the cooperating teachers focused attention on the wording and meaning of the student teachers' lesson goals in lesson planning. ST Tomoko and Sasaki Sensei spent considerable time in their conversations prior to ST Tomoko's lesson discussing the need to clarify the phrasing of the goal of the lesson. Below is a small segment from their conversation on this subject:

> Sasaki: Do you need this part? (reading) 'Being interested in the content of *Sonzu* by thinking of his question. Also realizing the advantage of simultaneous equation.' Okay, let's use this part. How about this? (reading) 'Help students be interested in the content by thinking of various questions and also apply to future activities by realizing the merit of simultaneous equation.' Well, let's take away the words 'simultaneous equation.' (writing) 'Nurture the attitude of learning affectionately.' You can use words like 'attitude' or 'nurture attitude.' Probably you can say 'nurture attitude.'
>
> ST Tomoko: I would like to post the question of *Sonzu* that students have never heard of before at the beginning of the lesson for the purpose of getting their interest. Then in the process of solving it, I want to let them learn many different ways to solve it. Also let them hear other people's opinion, and finally let them realize using the simultaneous equation is the best way to solve.
>
> Sasaki: So the problem is your goal. Your first goal is to nurture an attitude of interest and then you wrote 'find other people's strength.' What do you mean 'other people's strength?'
>
> Later, Sasaki Sensei said:

> The problem is here and goal. What is the goal? (She reads the lesson plan again). You don't have to write down this goal; instead, you have to write down 'desire for interest.' … You should write down your goal on desire for interest and attitude.

Earlier they also identified another goal of the lesson:

> Sasaki: This is making students only to be interested in the topic. Then what do you want them to learn?
>
> ST Tomoko: What you mean is what the final goal for this lesson is?
>
> Sasaki: What do you want them to do?
>
> ST Tomoko: I want them to know there are many ways to solve it, but using simultaneous equation is the easiest way to do it.

Cooperating teachers also discussed how different activities in the lesson were related to the stated goal or objective for the lesson. During ST Akihiko's planning meetings for his lesson in Kimura Sensei's class, Kimura Sensei discussed several different ways ST Akihiko could encourage students to think about transposition. Later they compared two different activities that students could do regarding transposition. Kimura pointed out that the activities served two different purposes.

> ST Akihiko: I'll think about those two ideas.
>
> Kimura: In that case, the aim of this lesson will slightly be changed.
>
> ST Akihiko: Oh…
>
> Kimura: Slightly different. This one is to implant a basic idea in them. In order to do so, you will make different kinds of handouts for different courses. The other one is not questions that a teacher will give for students. It is to encourage students to actively create their own problems. They are two different aims.
>
> ST Akihiko: That's right. In that case, students will not actively…
>
> Kimura: Yes, the aim is for students to actively involve…
>
> ST Akihiko: Right. If I want to raise students' positive attitude, I should pick this

one.

The goals of the lessons observed came in two forms. One of the goals was to aid students in understanding a key mathematical principle. A second goal that was frequently cited was to help students be interested and to appreciate a mathematical principle. Because all lesson activities were expected to achieve the lesson goals, these two topics were common in conversations on mathematics pedagogy. They receive their own headings below.

Key Mathematical Concepts

Both during lesson preparation and during post-lesson reflection, cooperating teachers accentuated the importance of identifying and teaching toward the key mathematical concepts. The tools used in teaching were only appropriate if they aided students in understanding key mathematical principles. When ST Akihiko began to generate his lesson on transposition, he wanted the students to work on an application problem using a variety of solving methods. He planned to focus on the variety of methods students would utilize to solve the problem to highlight the efficiency of transposition. However, Kimura thought the problem he chose did not emphasize the key mathematical principle of the lesson - why transposition works in the first place. He stated,

> Being creative out of the textbook during content analysis is not enough. What we are being asked is to help students understand the meaning of transposition and how efficiently students can solve equation. Even though lessons are interesting, if students do not fully understand, it would be worthless.

Teaching for student understanding of the fundamental mathematical principles was a motivator for all cooperating teachers. In Ueno Sensei's final interview, he demonstrated the importance of students understanding the mathematical concepts when

he said,

> I emphasized to them that lectures were for students... Interns may understand the concepts easily, but not students. … So how they listen to students is very important as a teacher… I often talked to student teachers about the gap between teachers and students. Teachers need to think from a student's point of view because there are things teachers easily understand but not students.

Cooperating teachers tried to teach the student teachers the importance of students understanding the main mathematical principles. For example, when Sasaki Sensei described in some detail how ST Akihiko's lesson could have been improved, she justified her alternative lesson flow on the grounds that the students would understand the necessity of two conditions when trying to solve for two unknowns. She held this was the key mathematical principle when she said,

> But they'll say there are too many ways that could happen and that it's impossible to determine. And here, you can't say that you'll give them conditions that would help yet. They haven't really noticed how many different solutions there will be. And they don't realize that they need those conditions to solve. I felt like making them realize this was probably the most important part of the lesson.

Sasaki Sensei explained later that ST Akihiko was so concerned with a few special cases of undetermined solutions that he neglected to help the students understand what the most important mathematical principle was for the lesson.

Generating Appreciation for Mathematics and Mathematics Teaching

The cooperating teachers taught the student teachers that teaching is more than getting students to perform mathematical tasks well. They often remarked on the difference between their mathematics classrooms and a cram school. Cram schools are after-school or weekend classes that many Japanese students attended. The purpose of these schools is to help the students perform well on entrance exams and other standardized tests. Sasaki Sensei explained that in this school the teachers had a different

purpose. She stated,

> Our purpose is not to help students get 100% on the math test. Some students get good scores on math tests, but some don't. Although some don't get good scores on math, it is still meaningful for us to teach them math. But if the role of a school is only to help students understand the characteristics of math or check something by using a graph, I feel so empty. So if I can feel your enthusiasm in your lesson plan, it is even better.

It was important to the cooperating teachers for the lessons to generate appreciation and respect for mathematical principles. The cooperating teachers did not simply want the students to enjoy a class; they wanted the students to appreciate doing the mathematics. Kimura Sensei told ST Akihiko, "What you should do is … help them notice the greatness of being able to solve equations. It would be excellent if students notice it." In the initial interviews with cooperating teachers, all cooperating teachers said they want their students to believe that math is fun so they will like the subject. Generating student interest in mathematics was a clear goal of the cooperating teachers.

The cooperating teachers also expressed that creating lessons that interested the students was very rewarding as a teacher. When asked what he felt was the most important thing he could teach his student teachers, Ueno said,

> Well, it is difficult to say what is most important, but I hope that they will feel teaching is fun. It is actually hard. I think being a Japanese teacher is a very hard job. We have so many things to do, but I hope they will feel being a teacher is a hard job, but it is worth it.

Kimura Sensei explained,

> It is hard for freshman to plan a lecture; however, you feel your hard work wasn't a waste after you see students involved in activities. I think all students worked on the activities really well.

In his final interview, Kimura explained,

> Teachers can study as much as they want. They will want to study more if they desire to help students understand. So my role is to help interns see how

> wonderful and difficult it is to teach. If they are thanked by students and see their eyes glitter, they will have a strong feeling for being a teacher.

These quotes show that cooperating teachers felt it was important for student teachers to value and enjoy the teaching experience of mathematics. Similarly, they wanted the student teachers to understand the importance of generating appreciation for mathematics in the students.

Tendencies of Students with Mathematics

Because of the emphasis on the student, a reoccurring topic that was a focus of the student teaching experience was the students' tendencies in engaging with the mathematics. Anticipating student responses and misconceptions and addressing the variety of student responses were common issues during meetings.

Student misconceptions. It was clear that cooperating teachers felt the need to assist student teachers in considering students' misconceptions. The cooperating teachers assisted student teachers in identifying specific ways students may think about problems or have misconceptions. For example, as ST Akihiko and Kimura Sensei were refining the lesson on transposition, Kimura Sensei pointed out that many students have problems solving first-order equations when the linear coefficient on the left of the equal sign is a smaller number than the linear coefficient on the right. For example, if a student was asked to solve $2x = 3x + 2$, students may end with the statement $-x = 2$ and believe their solution is complete. He also pointed out that when students do transposition with division, they often confuse the divisor and the quotient. He wanted ST Akihiko to be aware of potential misconceptions so he could address them with the students. Cooperating teachers urged the student teachers to be thorough in their planning so that they could be prepared for the misconceptions students would have.

After a lesson was presented, the teachers would discuss the misconceptions the students had during the lesson. Importance was placed on addressing all misconceptions of all students. In the case of ST Akihiko's lesson on transposition, ST Akihiko did not address the misconception regarding the division of coefficients. He was told that he needed to build time in his lesson plan to discuss this tendency since many students did not even realize they were making mistakes. Sasaki Sensei told ST Akihiko that if he did not understand why students had a misconception, he should have asked them directly why they believed as they did. As the students clarified the reasons behind their own actions, both the teacher and the students could clear up misconceptions. At the end of the reflection meeting, Sasaki Sensei asked ST Akihiko to teach the lesson again to clarify the many misconceptions the students had as a result of him not addressing them during the lesson.

Variety in student tendencies. A common teaching strategy observed was to have students first work on a task individually then as a group. As they did so, they would be encouraged to think of several different methods to accomplish the task. The teacher would then select students to present different methods for solving the problem to the rest of the class. There were a variety of motivations for having different solution methods presented. For example, in ST Tomoko's lesson in Kimura Sensei's class, she wanted the students to compare various methods for solving word problems for unknown values, either using a picture or an equation, to show the efficiency of systems of equations. In ST Akihiko's lesson on transposition, he wanted different methods presented because he assumed that some students already knew the topic he planned to teach, and he wanted to have a student present the method that other students may have not learned in the

classroom yet. ST Tomoko utilized a student's incorrect solution method to try to draw the students' attention to a common misconception in order to clear up any misunderstandings. The cooperating teachers highlighted these purposes or advantages explicitly. The cooperating teachers showed that generating a variety of solution methods was desirable in the classroom if it served the goal of the lesson.

Students also showed diversity in their speed and level of understanding. The student teachers regularly brought up the difficulty they had accounting for the diversity in the classroom. The cooperating teachers spent time trying to help the student teachers prepare and accommodate for varying work speeds and levels of understanding. For example, Kimura Sensei acknowledged that the students in this school were highly motivated and, in his particular class, all at a relatively high level of mathematical understanding. However, he warned ST Akihiko that in many classes, especially in the public schools, students would have varying levels of mathematical ability. He asked, "Suppose you teach at a public school, and you want students to understand how to solve equations. What would you do if you have students whose [math] ability is low?" Later he suggested that having other students assist the low-end students is a creative way to help those that struggle.

Because the students had a tendency to respond to the mathematics using a variety of methods and at varying speeds and levels of understanding, the task of teaching for all students was difficult for the student teachers. However, teaching so that every single student was involved and understanding the material was an important component of teaching that the student teachers were taught. For example, when ST Tomoko taught her lesson in Sasaki Sensei's class, she received much praise for the positive classroom

environment she had established. Yet, there was one student that did not want to work at all. She was told that she should have done something to motivate this student. Similarly, at one point in ST Tomoko's lesson in Kimura Sensei's class, a few students had questions regarding the division of a coefficient. She tried to engage in a conversation regarding the topic, but the cooperating teacher later said that in doing so, the rest of the class was neglected. He said,

> Another thing was, though I often make the same mistake, when you tried to explain the concept of dividing by two, you had a one-on-one discussion with one student. You asked one question. Then the student answered. Then you asked another question to the same student, and so on and so forth. When you continue this style of teaching, the lesson becomes tedious. … This process takes time, and the lesson was boring at that time. Children were more into the lesson when they were asked to use the balance and moved apples and stuff. So you needed the idea of not having one-on-one question and answer time.

Kimura Sensei explained that when ST Tomoko addressed the questions of one student, she should include the entire class. The variety of needs and concerns of students should be addressed in a manner that was engaging for all students.

Scaffolding of Content

Another important mathematics pedagogy topic that was emphasized by the cooperating teachers was the need to utilize past mathematical understanding and to build toward future mathematical concepts. The student teachers were required to carefully design their lessons to fit naturally with the rest of the curriculum for the year and beyond. This requirement was made evident in the set form for the lesson plan. The student teachers were required to describe how their lesson was related to previous lessons and how the principles they were teaching would aid in the future mathematics the students would encounter (See Appendix B). Sasaki Sensei described this well by saying,

> It is very important that student teachers don't just focus on content analysis, but that they look at the yearly teaching plan. That is the purpose of the section in the lesson plan called "mathematical point of view or thinking…." If they understand the true essence then they can write a better teaching plan.

Because the student teachers had to carefully describe how their lesson fit with the rest of the year's content, the cooperating teachers focused on assisting the student teachers in planning for this. Kimura Sensei described to ST Akihiko how his lesson should fit naturally in the unit when he said,

> Because of that, we learned that equations are convenient at first, in the introduction part. We did the introduction, interpretation of value, characteristics of equality, and worked on solutions. At the end, we teach that equations are really convenient when students solve these kinds of problems. It's a flow of study.

During ST Akihiko's reflection meeting for his transposition lesson, a student teacher asked him why he taught as he did. ST Akihiko explained that because the characteristics of equality (i.e. If $A = B$, then $A + C = B + C$) were taught previously, he wanted to utilize those characteristics as he helped the students understand why transposition worked. The student teacher was satisfied with this answer, showing that the scaffolding of content was sufficient motivation for lesson organization. More examples of the need to connect lessons into a coherent unit were evident throughout all conversations as the student teachers clarified these ideas in their lesson plans.

Student Understanding of Reason

A critical component of mathematics pedagogy that all cooperating teachers focused on was the need for students to understand the justification for mathematical actions. It was not enough for students to be able to merely solve problems and imitate procedures. When Ueno Sensei taught his lesson for the student teachers to observe, the goal of his lesson was for students to understand why multiplying numbers of opposite

sign results in a negative number. He explained that students need to understand why rules work in order to raise students' thinking ability. Sasaki Sensei told ST Tomoko,

> Math can be very easy like riding a bicycle. When you master it, it is easier to ride without training wheels, but it is important to know the reasons for using simultaneous equations so they will think to use it.

All cooperating teachers explained that having students perform well on tests and compute answers like a "machine" or "robot" was not as desirable as helping the students to understand why the principles of mathematics work.

Cooperating teachers showed the importance they placed on students thinking about the reasons behind mathematical actions by frequently suggesting to the student teachers that the students should rely on the sensibility of the formation of ideas as the authority for correctness. In other words, the students should consider whether a rule or method is correct based on the reasonableness of the mathematics and not simply if the teacher confirms it. The student teachers also were shown the importance of students personally verifying their mathematical claims. During the research lesson reflection meeting, an observing teacher complimented the student teachers for allowing the students to first make a mistake by forming a rectangle instead of square. She held that by doing so, the students were motivated to carefully verify their future constructions based on the definition of a square.

Mathematics pedagogy was discussed in a variety of ways. Granted, there are other ways mathematics may be discussed in a student teaching setting. However, in order for any one of these themes to be mentioned in this study, it had to have been so pervasive in the data that neglecting to mention it would not accurately portray the full array of emphases in the Japanese student teaching experience. Furthermore, these topics

account for all major facets of mathematics pedagogy conversation in the data. It is grouped according to the dominant themes that were generated during the analysis of these conversations.

Summary of Dominant Topics

As may be expected, a wide variety of topics were emphasized during the student teaching experience. Regarding the structure of student teaching, logistical components were addressed, especially as it pertained to filling out lesson plans appropriately. Also, the use of collaboration, the guided thinking of the cooperating teacher, and avoiding imitation were highlighted in the nature by which lessons were to be generated and reflected. The structure of student teaching was based upon nurturing quality work and improvement in the student teachers' progression in the mathematics teaching field.

In terms of lesson production, the cooperating teachers emphasized the importance of the details of the classroom display and the oral presentation and teacher presence during the lesson. They taught the student teachers it was their responsibility to utilize interesting material in lessons and to organize the flow of lessons so students could connect mathematical concepts. The student teachers were also required to spend considerable thought in determining how they would ask questions and give instructions which were clear and how they assisted students in understanding the key mathematical concepts of the lesson.

The observations in this study had a clear emphasis on the students' reactions and interactions during lesson implementation. The student teachers received advice on how to guide the thinking of the students without forcing ideas upon them intrusively. The cooperating teachers counseled the student teachers on when and why student

collaboration in the mathematics classroom was useful. Furthermore, the student teachers learned that the students' interactions and reactions with the lesson should be the motivating factor in all teaching decisions. Thus, a key topic in conversations between cooperating teachers and student teachers was on the students' impressions of the lesson.

The fourth topic that was emphasized during the interactions of student teachers and cooperating teachers was mathematics pedagogy. Identifying and teaching toward lesson goals was stressed as fundamental in teaching mathematics. The two main goals that received particular emphasis were to help students understand key mathematical concepts and to generate appreciation or interest in a mathematical principle. Because of the focus on students, another emphasis in mathematics pedagogy was in the tendencies of the students with the mathematics. Cooperating teachers identified potential student misconceptions to aid student teachers in anticipating their responses. Variety in student responses was valued, and student teachers were taught how to accommodate for differences in students' speed, level of understanding, motivation, and method for problem solving. Furthermore, cooperating teachers encouraged the student teachers to situate their lessons properly with respect to the rest of the curriculum. Finally, cooperating teachers repeatedly emphasized the importance of students understanding the reasons behind mathematical procedures.

Discussion and Conclusions

This chapter uses the themes and emphases of the student teaching experience in Japan to generate a coherent picture of a Japanese student teaching system. The many topics that were emphasized were analyzed to establish a general understanding of the system as a whole. Metaphors and abstractions were generated and tested with the data.

The goal in analyzing the data was to portray accurate and descriptive conclusions regarding the nature of mathematics student teaching for the 14 cases of interactions between the three cooperating teachers and two student teachers in this study. This chapter organizes the findings reported in the results chapter into a cohesive and inclusive unit that describes the nature of the student teaching observed. This was done by weaving together the strands of information the data presented together with the strands of relevant suggestions of current research regarding the relationships of student teachers and cooperating teachers. This 'tapestry' of Japanese mathematics student teaching is described through four fundamental descriptions.

Teaching as a Student-driven Performance Paradigm

According to Stevenson and Stigler (1992), the Japanese view a superior teacher as a "skilled performer" who can expertly present even standard lessons in ways appropriate for a specific class. They presented the idea that mathematics teaching in Japan is comparable to a careful stage performance. The performance paradigm alluded to by Stevenson and Stigler was evident in the teaching of mathematics in this study. Furthermore, this paradigm was taught to the student teachers during their student teaching experience. However, the type of stage performance is slightly different than a traditional play or symphonic concert. It is more similar to participative theater. Below is a breakdown of elements of performance and how they are related to the classroom as manifested through the interactions of student teachers and cooperating teachers. Connections between the current research on quality teaching and the performance paradigm are drawn.

The Set

The physical display of the stage and the props that are utilized receive careful consideration in a stage performance. Similarly, in the Japanese student teaching experience in this study, a very strong emphasis was made in regards to the classroom display. The cooperating teachers taught the student teachers to carefully consider the board display, legibility of writing, the layout of student worksheets, and other objects for viewing. The importance placed on the "set" utilized in teaching is comparable to the thought that goes into the physical features of a stage performance.

The Plot

The plot, or the story line, in a stage production is usually planned for months before a stage performance. In most cases, a plot for a play has a moral or message that the creators and presenters of the play wish for the audience to understand. All of the elements that go into the plot are designed to help the audience to understand the message. In the case of the Japanese teaching, the message of the plot was a mathematical concept. The emphasis placed on *hatsumon* was to aid students in understanding the plot of day. Cooperating teachers emphasized that all of the other elements going into the lesson should help the students understand or appreciate the mathematics at hand.

The other aspects of the plot line and how they are ordered are considered in the same manner the cooperating teachers discussed lesson flow with their student teachers. It was important that the flow of the lesson did not cause the students to become lost or confused. If this happened, the students could not understand how other parts of the lesson made sense. The same can be said for an audience of a play.

Although the plot may have an important moral, a stage production is not considered worth viewing if it is not interesting or engaging for the audience. In a similar manner, the cooperating teachers did not hold their message as more important than the students to whom they were presenting. The lessons had to be interesting for the students. In some cases, the lessons were made more interesting by use of "the set and props;" however, as is the case in a stage production, these elements could not compensate for an uninteresting message. The mathematics was viewed as the interesting topic in the same way a thought-provoking message makes a particular play timeless.

The Actors

Among the many responsibilities of actors in a stage performance is the expectation that they speak and present themselves in a manner that allows their message to be heard. For example, their diction, the speed of speech, and voice projection are all specific topics they are trained in. These same elements were repeatedly highlighted to the student teachers as elements of oral presentation. Even the concept of teacher presence is similar to the responsibility of an actor to overcome their nervousness and present the message they have rehearsed.

The teacher was not the only actor in the stage production that was witnessed in this study. The students also played important roles in presenting the mathematical production. This striking characteristic is discussed in detail below.

The Audience

In a stage production, the most important element that allows the play to be performed in the first place is the audience. The students are the motivation for the opening night of a production in the first place. As such, all of the other elements of

performance are negotiated to include and inform the audience. Their impression of the performance is what determines whether or not the play is of worth. Furthermore, the notion of the performers doing a half-rate job because they were tired or too busy to prepare is considered extremely unprofessional and not tolerated by the performance community. In other words, a stage performance is audience-centered, not actor-centered.

A similar attitude is clearly taught to the student teachers during their student teaching experience. They learned that the students are the most important when planning and presenting their lessons. All of the work that they put into teaching was only considered of high quality if the students enjoyed and learned from the lesson. The difficulty a teacher may encounter while preparing and presenting a lesson is second to the enjoyment and learning of the student. In other words, the student teachers are taught that teaching is student-centered, not teacher-centered.

A notable finding from this study is that the audience in the Japanese mathematics classrooms played a slightly different role than the audience of a typical play or other performance. In most cases, when one thinks of an excellent play, one imagines the audience as captivated, yet passive, viewers of the actions of the individuals on the stage. In the Japanese classroom, the audience actually became the actors because the students were expected to play a part in the development of the lesson. This is a striking and important component that enriches the performance paradigm.

The general teaching style observed required the students to be actively involved in the generation of the mathematical concepts. The students were responsible to bring up main points and to participate in discussing and developing issues pertaining to the mathematics. The cooperating teachers frequently commented on the need for the

students to think about the mathematical principles and be engaged in explaining concepts to the teacher and others. Because of this, the student teachers were concerned with how to guide the students in the generation of the important mathematical ideas.

Viewing the lesson presentation as a performance in a traditional sense does not allow for this sort of active involvement. Rather than the actors or script-writers preparing a definitive manuscript to be rehearsed and performed, they utilized a carefully thought-out plot outline with which they guided the audience through. It is rather like an improvisational performance. Teachers were responsible to provide materials and ask just the right questions or utilize the appropriate student response that would lead the plot along the course they had prepared. A skilled teacher who had prepared a quality lesson would be able to anticipate student reactions to the lesson and be able to focus on key mathematical principles. As participants in the production, the students' role was to fill in the details of the plot outline and to think deeply about the "moral" of the lesson.

Student involvement in presenting the mathematical ideas of the lesson was the reason the cooperating teachers told their student teachers that they needed to have a flexible "story line" yet a clear flow of the lesson. The cooperating teachers tried to teach the student teachers to recognize the important role the students played as "co-actors" with the teacher. This created some unpredictability in lesson presentation, yet the cooperating teachers taught that a good lesson followed the flow of the students' thinking as they engaged with the mathematics, or plot of the play. It was the teacher's responsibility to guide the students toward the desired goal.

Another interesting element pertaining to the audience is the notion of discipline. As noted in the results chapter, the cooperating teachers did not discuss management

except on one occasion by one cooperating teacher. This is striking considering the strong emphasis on management issues in the U.S. (Borko & Mayfield, 1995; Tabachnik, 1979). The single mention of a management-related issue was when Kimura Sensei told ST Akihiko to wait until he had the students' attention before giving more instructions. In a similar manner, the actors on a stage expect the audience to react to the performance. In doing so, they may laugh or clap or even remark on a bit of the performance to the person next to them. In these situations, the actors are trained to "pause for laughs," just as ST Akihiko was trained to wait for the students' attention before moving on. Furthermore, it was desirable to have a classroom that was filled with the noises of student engaging in mathematical tasks, just as it is desirable for the audience to react, even verbally, to a riveting stage production.

Although other issues of management were not discussed with the student teachers, the cooperating teachers did provide some insight into how they viewed discipline problems. They prevented discipline problems by presenting an interesting lesson in the first place. They held a similar opinion to that of Perks and Prestage (1994), that management problems were usually an issue of unsuitable mathematics. In a similar way, a performing troupe does not expect the audience to cause a disturbance during their production. If the audience was restless, the cause would usually be attributed to the performance not matching the needs or expectations of the audience. If a performance is engaging and accessible to the audience, then the audience will respond well. The idea of the performers disciplining the audience in order to get through the performance is almost comical.

Rehearsal

In most stage productions, months of rehearsal and refinement are necessary before the production is deemed worthy for public performance. The highest quality of work is expected of all participants during the rehearsal phase and the actual performances. Improvement is demanded at every step in performance development. Similarly, in the Japanese student teaching experience, planning sessions were intensive, and the smallest details went through revisions for improvement. The student teachers literally rehearsed the production of their lessons. The expectation for rehearsals and practice are built into the structure of student teaching.

The performance paradigm goes beyond a single play or production. The Japanese student teaching experience does not focus on a single lesson or story line. Although the conversations between student teachers and cooperating teachers were typically lesson-focused, the cooperating teachers took advantage of the student teaching experience to aid the student teachers in learning principles that would aid them in developing and presenting lessons. Thus, the cooperating teachers were assisting them in developing skills that would last their entire career. In other words, they focused on the underlying principles behind mathematics teaching, just as Zanting et al. (1998) recommended. The very act of post-lesson reflection meetings shows the long-term commitment to improvement and quality teaching. The stage performance paradigm describes the development of a performer's or a teacher's career, and not just a single play or lesson.

The parallel made between Japanese teaching and the presentation of an excellent stage production is not only accurate, but it is taught to the student teachers during the student teaching experience. By explicitly emphasizing the importance of the set, the oral

presentation and presence of the actors, the careful planning of an interesting message and organization of the story line, the pivotal role of the audience, and the need for rehearsal, the analogy is at least implicitly taught to the student teachers. Furthermore, the deep and thorough discussion of these varied topics show how various features of Japanese student teaching in mathematics are related to form a coherent teaching system. In the observations in this study, cooperating teachers did not explicitly draw the connection between teaching and preparing and performing a stage production; however, the elements of performance were explicitly taught. Thus, the stage performance paradigm was perpetuated via the interactions of the cooperating teachers and student teachers.

Mathematics Teaching as a Cohesive and Goal-oriented Field

The second conclusion that was drawn from the results of this study is that the student teachers were trained to maintain a unified, goal-oriented mathematics teaching system. Specifically, the interactions of the cooperating teachers and student teachers showed that the underlying motivation for all discussions pertaining to the student teaching experience was to generate student interest and understanding of mathematical principles. Because of the focus on these over-arching goals, the topics relating students and mathematics were the guiding reasons for nearly all interactions between cooperating teachers and student teachers.

During the student teaching experience, student teachers were trained to teach according to a system of goals that allowed for coherent connections across and within mathematical topics. Ball (1990) described a form of teacher knowledge she termed “mathematical content knowledge.” Included in Ball’s description of “mathematical

content knowledge" was the understanding of the network of connections relating different concepts and how each concept contributed to the whole of mathematics. The cooperating teachers utilized their understanding of the network of concepts as they assisted student teachers in generating lessons. Shimizu's (1999) description of *kyozai-kenkyu,* translated as "content analysis," referred to the notion that cooperating teachers train the student teachers to connect their lesson to the other mathematical topics within the lesson and in past and future lessons. They expected the student teachers to focus on the connections across concepts.

Peterson (2005) found that the focus in the student teaching experience in Japan is on the lesson. The emphasis on the development and implementation of the lesson was also evident in this study. The student teachers were required to spend hours revising lessons and attending to the smallest details of the lesson, from the color of figures, to the exact wording of questions. The sequencing of activities within a single lesson had to flow naturally, and all activities within the lesson had to achieve the specific objective written in the lesson plan. Indeed, the generation and presentation of a single lesson was the base from which all conversation stemmed. Yet, the discussions pertaining to lesson generation and presentation were, by no means, restricted to an isolated event in a 50-minute period of time. The cooperating teachers and student teachers emphasized the need to clarify and teach toward key mathematical principles. In fact, topics pertaining to mathematics pedagogy were so prevalent that attempting to discuss pedagogical content knowledge apart from other aspects of emphases was unrealistic. This is a particularly significant finding given the lack of discussion on mathematics pedagogy in the U.S. (Borko & Mayfield, 1995).

All areas of emphasis in interactions between student teachers and cooperating teachers were motivated by the students' interactions with the mathematics in the lesson. One of the most prominent areas of emphasis was the importance of student teachers teaching toward the key mathematical principles outlined in their lesson plan. The cooperating teachers taught the student teachers to focus on the development of the key mathematical principles by addressing misconceptions as they occurred, sequencing lessons to utilize the key principles of past lessons, and generating lessons that would aid students in further exploration of key mathematical principles in subsequent classes. The lessons were expected to fit within the unit and yearly objectives in a logical sequence.

In a larger arena, the student teachers were taught to teach toward two other objectives that went beyond the yearly curriculum. First of all, mathematics teaching in the Japanese classroom needed to, as Ueno Sensei phrased it, "raise the students' thinking ability." Increasing students understanding of mathematical principles was the motivation behind having students understand the reasons for why mathematical procedures worked. The cooperating teachers encouraged the student teachers to create lessons that allowed students to develop their own ideas, justify their thinking, and consider and assess the usefulness of a variety of methods as they solved problems. Student teachers were also taught to enjoy teaching and to share the joy of mathematics with their students by creating interesting lessons and focusing on the needs of the students.

The Japanese cooperating teachers observed in this study had a clear sense of the long-term objectives of mathematics teaching. They utilized their understanding of the unified and goal-oriented nature of teaching to assist student teachers in focusing on the underlying principles and goals of teaching. The interactions of student teachers and

cooperating teachers showed that the student teaching system was designed to focus on a coherent lesson flow utilizing specific features of lessons. The focus on the lesson, in turn, was utilized to teach general principles of teaching. These general principles were all guided by the underlying focus on the students' interest and understanding of connections across mathematical concepts.

Student-centered Teacher Training

The most noticeable characteristic underlying the conversations and discussions regarding teaching mathematics in the Japanese student teaching setting was the focus on the student. Wilson and Cameron (2005) claimed that the main difference between theory on teaching and the practice of teaching in the U.S. is that theory is student-centered, while the practice of teaching is largely teacher-centered. In the case of the Japanese student teaching experience, the student was valued and respected as the creator of and motivation for mathematical understanding. The students' responses to the ideas presented in a lesson were the standards by which quality was determined. The student teachers were held responsible for creating lessons that were engaging and that met the needs of all students. The prime emphasis in the student teaching context was in helping student teachers generate lessons that focused on the students as they engaged with mathematics.

Student Response as an Indicator of Quality

Jaworski and Gellert (2003) promoted lesson reflection that focused on the social indicators that ensued as a result of teaching actions. The social interactions of the students in this study were the focus of discussions in lesson planning and reflection meetings as Jaworski and Gellert recommended. The cooperating teachers emphasized

that the students' understanding of the concepts was critical in determining if particular classroom practices were appropriate and sufficient. The social verification of ideas was not only emphasized to the student teachers but also the students themselves as they struggled to create and defend mathematical assumptions.

The emotive impressions of students were also critical in determining the quality of lesson activities. It was clear that generating interest or fun for the students was critical in lesson development. Even "standard lessons" were expected to be interesting for the students. Furthermore, if students responded negatively by show of disruptive behavior, the students were not necessarily blamed or punished. The cooperating teachers expressed that student disruptions were indicators that the teacher needed to create a more engaging lesson that would keep the students interested in the mathematics. In other words, the reaction of the students toward the lesson was not so much an indicator of the quality of the students; it was an indicator of the quality of the lesson.

Teacher is Responsible for Student Enjoyment and Understanding

One of the prominent messages that cooperating teachers conveyed to the student teachers was that the teacher was responsible to help the students enjoy and understand mathematics. The cooperating teachers would not blame the mathematics students if there were parts of a lesson that did not go well. They held the student teacher responsible for creating a lesson that was enjoyable and accessible for the students. From minor attributes such as the teacher speaking clearly, to the general organization and flow of the lesson, the cooperating teachers explained throughout the student teaching experience that the student teachers needed to plan for and play upon the students' reactions with the lesson. They needed to address the needs of all students. The student teachers were

required to pay attention to the students who were not participating and find ways to make the class engaging for even a single student who did not participate.

The Lesson as the Mediator Between Mathematics and Students

Student teachers enter their student teaching experience with, assumedly, a good deal of mathematical understanding of the concepts they are expected to teach. On the other hand, mathematics students expect and are expected to learn mathematical concepts. The emphasis on the lesson in Japanese student teaching (Peterson, 2005) is sensible considering that it is the lesson that connects students with the mathematics. The relationship of the lesson, the mathematics, and the students is pivotal. If one of the three elements in this triad does not receive sufficient emphasis in student teacher training, novice teachers may find themselves neglecting a critical component for the purpose of education in the first place. Stigler and Hiebert (1999) recorded one researcher's opinion of how the Japanese style of teaching compares with the U.S.:

> In Japanese lessons, there is the mathematics on one hand, and the students on the other. The students engage with the mathematics, and the teacher mediates the relationship between the two. ... In U.S. lessons, there are the students and there is the teacher. I have trouble finding the mathematics; I just see the interactions between students and teachers. (pp. 25–26)

Stigler and Hiebert (1999) admitted that this observation may be a little too harsh of U.S. lessons; however, the stark contrast is useful in understanding how the Japanese lessons compare with other mentalities of teaching.

In the observations for this study, the lesson was used as the mediator between students and the mathematics. The teachers were responsible for generating lessons that allowed the students and the mathematics to connect. This is different than students dealing solely with teachers or the notion that students passively bend to the system of

mathematics. Rather, the lesson is the playing field where students directly dealt with mathematical issues and generated healthy mathematical constructs for future understanding.

The student teachers witnessed that the teaching culture first put a priority on the students and what caused them to be enthusiastic about learning. The cooperating teachers used the focus on students to help the student teachers generate lessons that clarified the mathematics in ways students could understand and appreciate. The Japanese student teaching culture observed in this study centered on the student and focused on building lessons that would assist the students in engaging with the mathematics.

A Parallel Between Mathematics Student Teaching and Mathematics Teaching

Several important observations regarding the underlying tenets of learning to teach have been suggested above. Specifically, student teachers were taught to consider the field of mathematics teaching in the same manner one would consider the art of a stage performance. Student teachers were taught to situate their teaching within a system of clear goals to create a unified teaching experience. Student teachers were also trained to be student-focused in their profession. However, the usefulness of this study comes from clarifying how these principles were taught to the student teachers. The answer to this question came by considering the various emphases presented to the student teachers in light of the structure and roles observed. Doing so revealed that the manner in which in-service Japanese mathematics teachers taught their mathematics students is like unto the manner the Japanese cooperating teachers taught their mathematics student teachers. This claim is supported below via 1) the structure of learning and teaching, 2) the focus on underlying principles, 3) the emphasis of long-term continual growth, and 4) the roles

the cooperating teachers play.

Structure

How students of mathematics and students of teaching mathematics were expected to learn their field was very similar in structure. The emphasis on individual learning and understanding, the use of collaboration in generating and refining ideas, and the method of guided thinking from the teacher or cooperating teacher were specific components of structure that were remarkably similar in the case of student teachers and mathematics students.

Individual learning. The experience of individual students was valued more than all other components of teaching. Even when group work was recommended, the advantages of group work were focused on aiding individual students to understand. There were many instances where the students were expected to first think on their own before receiving assistance from peers or the teacher. For example, the purpose of having students use their own words in presenting ideas was to help the students remember the ideas and be able to use them in the future. In other words, the teachers wanted the mathematics students to think on their own so they could gain autonomy in their mathematical experiences. Similarly, student teachers were expected to think on their own regarding their lesson plans prior to asking for assistance from their cooperating teacher. They were provided with ample resources to aid them, yet they were encouraged to develop their own ideas. This was done so the teachers could have experience in becoming autonomous teachers. The teaching style of having students first work and struggle on their own before going to others for help was evident in both teaching student teachers and in teaching mathematics students.

Collaboration. After thinking on their own about a mathematical concept, mathematics students were frequently put into groups to discuss their thinking. The purpose of group work was to help the group members to organize and refine their own thinking and to consider a variety of options for solving problems. In the classroom setting, the students were asked to have a member of a group present an idea for the class to discuss and compare with other options. A very similar style of teaching was utilized by the cooperating teachers. Student teachers were expected to work with each other in refining lessons. After each lesson, the student teachers and at least one cooperating teacher engaged in a reflection meeting to discuss various aspects of the lesson and general principles of mathematics teaching. For the research lesson, one student was selected to present the lesson to students. Afterward, many other student teachers, teachers, professors, and graduate students were invited to comment on the lesson, ask questions to the presenter, discuss the good qualities of the lesson, and suggest ways the lesson could have been improved. By requiring the student teachers to collaborate after lessons, the student teachers would be better able to be reflective practitioners (Jaworski & Gellert, 2003; Feiman-Nemser, 1998). Furthermore, by training the pre-service teachers in the processes of collaboration, the student teachers were being prepared to engage in in-service teacher collaboration which has been shown to improve teaching overall (Mewborn, 2003). In the case of reflecting on ideas, the use of collaboration was built into the structure of the reflection meetings. In both the case of the student teachers and the mathematics students, the teacher (or cooperating teacher) was included in the collaborative efforts.

Guided thinking. Much discussion went into how student teachers were to guide

the thinking of mathematics students toward the goals of the lesson. In many cases, guided thinking was done by posing questions or instructions that would encourage the students to think about problems that required the use of the key mathematical concept of interest. The student teachers were expected to have a dialog with the students regarding the important issues and not intrusively tell the students the main mathematical principles. The mathematics students were supposed to decide and discover on their own the important points of mathematics when they were ready to receive it. In addition, the teachers did not want the students to merely imitate a set of procedures. They wanted the students to develop the procedures on their own. More importantly, they wanted the students to understand why the principles worked.

Cooperating teachers also guided the thinking of the student teachers. They asked questions to help the student teachers consider how their lessons would be received by the students. They engaged the students in brainstorming conversations to solve problems with lessons. They used examples of other student teachers' lessons to help the student teachers consider multiple options for lesson content. Furthermore, just as mathematics students were not to be imitators of the teacher, the student teachers were expected to generate their own ideas for lesson planning. They were only encouraged to use ideas that they could justify on their own. The cooperating teachers expected the student teachers to understand why they made the teaching decisions they did as Tomlinson (1995) recommended. The cooperating teachers did not try to teach in the "transmission-oriented" manner Murray and Male (2005) cautioned against. The cooperating teachers' style of gently guiding students and student teachers to focus on important issues are remarkably alike.

Emphasis on Underlying Principles

As the teachers led the students through the lesson, they always had a clear goal for the lesson. The goal was set and clarified well before the teachers began to teach the lesson. Key mathematical principles were emphasized, and all activities in the lesson were centered on helping students understand and appreciate those principles. Recall, the student teachers were taught within a goal-oriented system that was explicit and thorough. In an analogous fashion, the cooperating teachers emphasized the reasons behind their own teaching actions, thereby teaching the underlying principles of mathematics pedagogy as recommended by Zanting et al. (1998). The cooperating teachers explained to the student teachers the importance of teaching for the underlying principles of teaching. The most evident reason given for all recommendations was to help the students understand and appreciate key mathematical concepts in a coherent manner.

Quality Work and Long-term Continual Improvement

Both students of mathematics and students of teaching mathematics were taught the importance of quality work and building upon past knowledge to achieve greater understanding. In the case of the mathematics students, they were given ample opportunities to think and refine ideas. They were taught to create quality work as they were encouraged to record and present their ideas with clarity and organization. Furthermore, the teaching of students was centered around long-term mathematical objectives. The lessons presented to students were carefully situated with past and future lessons to help the students improve their mathematics understanding. The teaching of mathematics students was aimed at aiding students in synthesizing content in a connected

manner to allow for long-term improvement of students' mathematical thinking ability.

The student teachers were also taught to prepare and present lessons that were of the highest quality. They were taught to pay special attention to the details of the lesson. After the lesson, they were encouraged to reflect upon their teaching in order to improve as teachers. The Japanese teaching culture witnessed in this study emphasized quality work and continual improvement in both the mathematics students and the student teachers of mathematics.

The emphasis on long-term, continual improvement in the teaching system in Japan was noted by Stigler and Hiebert (1999). They claimed that the Japanese teaching system perpetuates growth and improvement:

> What is most impressive about Japan is that the culture genuinely values what teachers know, learn, and invent, and has developed a system to take advantage of teachers' ideas: evaluating them, adapting them, accumulating them in the professional knowledge base, and sharing them. The Japanese have created a national research-and-development system, based on teachers' experiences, that ensures the gradual improvement of teaching over time. (p. 130)

The results of this study add to the claim that the teaching culture ensures improvement of teaching by showing that quality and improvement are also an integral part of the student teaching system.

Roles of Teachers and Cooperating Teachers

The roles the cooperating teachers play in mentoring student teachers is similar to the role these teachers play as teachers of mathematics. Before discussing the relationship between the roles of Japanese mathematics teachers and the roles of the cooperating teachers in this study, a brief description of the roles the cooperating teacher assumed is provided.

Describing the roles of the Japanese cooperating teachers. First of all,

cooperating teachers demonstrated that they recognized their position as teacher educators. They did not appear to share the disdain for the responsibility of mentoring student teachers described by Williams and Soares (2002). Instead, they made clear efforts to explicate their practical knowledge they had gained through their teaching experience. Moreover, they did not see their sole responsibility as evaluating or merely providing the student teachers with a classroom in which to practice their teaching as Wilson, Cooney and Stinson (2005) described. The post-lesson comments were not evaluative in nature, as a coaching role might assume. Rather, they were suggestive for future use. From the extra time the cooperating teachers put toward assisting the student teachers in planning and reflecting on lessons, to their careful and directive comments, they demonstrated a vested interest in the professional growth of the student teachers.

Jaworski and Gellert (2003) recommended that cooperating teachers take on the role of co-enquirer. In many ways, the Japanese cooperating teachers in this study acted as co-enquirers of the teaching of mathematics. The most notable example of the co-enquirer role was during the sample lesson reflection meeting the student teachers witnessed and participated in for Ueno Sensei. After Ueno Sensei gave his self-evaluation of his lesson, he expressed that he had not taught the particular topic in his lesson before and that he would like to learn from the questions asked by the student teachers. He saw himself and the student teachers as part of a team of learners with the joint purpose of improving lessons and resolving teaching issues. In many instances, the cooperating teachers encouraged the student teachers to collaborate with each other, and they also demonstrated that they, as current teachers, served as co-enquirers with other in-service teachers. For example, Sasaki Sensei explained that humility is an important

characteristic teachers need so they can learn from the opinions of other teachers.

Although the cooperating teachers encouraged collaboration with other student teachers and spent much time reviewing lessons during planning meetings and post-lesson reflection meetings, the exact definition of the co-enquirer role was not made evident through the interactions of the student teachers and cooperating teachers. For example, cooperating teachers and student teachers never jointly taught lessons. Furthermore, in the interactions and discussions of student teachers and cooperating teachers, the cooperating teachers did not allow total freedom and inquiry into any style of teaching the student teachers may have suggested; they guided the thinking of the student teachers. In this regard, they were similar to the coaching role; however, they also emphasized the reasons behind their suggestions which is not characteristic of the coaching role described above.

The cooperating teachers had recommendations for their student teachers, and looked for opportunities to teach them the reasons behind their recommended teaching actions. They did not require their student teachers to "reinvent the wheel" as Zanting et al. (1998) described. They took advantage of the student teaching experience to give sound advice based on the knowledge they gained through their years of teaching. They allowed the student teachers to teach their own way, but the impression that the cooperating teachers were also learning about teaching through a joint and equal investigation of teaching was not necessarily given. The student teaching culture showed it valued and utilized the knowledge the cooperating teacher had.

In many ways, the cooperating teacher took on the role of a model teacher. The student teachers were expected to observe practicing teachers and take careful notes on

their teaching. The cooperating teachers explicitly modeled and taught the student teachers how to plan and reflect on their lessons. They modeled, rather than merely facilitated, self-inquiry. In this way, they trained the student teachers how to be self-reflective, a skill student teachers need to develop during the student teaching experience (Bischoff et al., 1999). However, the student teachers were also discouraged from mimicking the cooperating teachers without understanding the reasons for their teaching actions. For example, Sasaki Sensei did not point out every problem she saw in ST Akihiko's lesson plan because she did not want him to imitate her in every regard. She wanted him to teach according to his plan and then discover on his own that some of his ideas would not be sufficient in meeting his teaching goals. Thus, the cooperating teachers only played the role of a model teacher insomuch as the student teachers learned how to be critical of why the observed teaching styles or suggestions were successful. Furthermore, if a student teacher did implement a suggestion or method recommended by the cooperating teachers, the student teachers were expected to do so in an original and creative manner.

Parallel role of mathematics teachers and cooperating teachers. The parallel between cooperating teachers and teachers of mathematics students is quite strong when considering the roles that each plays. In teaching mathematics, the teachers had, presumably, more mathematical understanding. Therefore, it was the teachers' responsibility to engage the students in an exploration of the mathematical principles so they could come to defensible conclusions. Similarly, the cooperating teachers had, presumably, more understanding of successful ways to teach mathematics - more practical knowledge. Therefore, they assisted student teachers as they went through the

processes of teaching by helping them learn for themselves some of the underlying principles of teaching. Both cooperating teachers and mathematics teachers focused on teaching their pupils the “whys” and not just the “whats” and the “hows” as Tomlinson (1995) suggested.

There was one isolated instance that seemed to provide a counter-example to the parallel role the cooperating teacher and a mathematics teacher assume. During the reflection meeting for ST Akihiko’s lesson in Sasaki Sensei’s class, Sasaki Sensei was very critical of ST Akihiko’s lack of preparation, effort and humility. After allowing the student teachers to discuss their thoughts on the lesson, Sasaki Sensei described in detail how the lesson should have gone. She qualified her sequencing with clear justification. A Japanese teacher of mathematics would avoid such a direct act because the notion of students learning principles on their own or from other students was highly valued (Stigler & Hiebert, 1999).

This example can be explained by recognizing the prominence of the mathematics student in both the student teaching and mathematics teaching settings. If the parallel between teaching student teachers and teaching mathematics students also included a focus on the “student,” then it would be reasonable to assume that, because teachers of mathematics are focused on the needs of the mathematics students, the cooperating teachers should be focused on the needs of the student teachers. This was not the case. The cooperating teachers were, after all, teachers of mathematics students first and foremost. Therefore, the needs of the mathematics students were put above the needs of the student teachers when necessary.

The emphasis on the mathematics students provides an explanation for why

Sasaki Sensei was very directive in her suggestions to ST Akihiko. Because she was focused on the needs of the mathematics students, she provided very detailed descriptions for how his lesson plan ought to have gone in order to aid ST Akihiko in providing quality instruction to the students. Furthermore, while the cooperating teachers did make efforts to nurture and uplift their student teachers, they did not make the comfort of the student teachers their priority the way a cooperating teacher who solely assumed the emotional supporter role might. The student teachers' comfort was never at the expense of the mathematics students' experience in the mathematics classroom. Had Sasaki Sensei been student teacher-focused, she would have been more sensitive to ST Akihiko's creative processes in learning to be a teacher instead of sharply reprimanding his lack of humility and preparation. It may be said, that when the mathematics was at stake, the cooperating teachers were willing to let the students struggle with concepts and gradually generate ideas. However, if the students' mathematical experience was at stake, the cooperating teachers did not avoid being specific and directive in their instructions to the student teachers. They allowed less room for personal exploration of ideas that may put the students' learning or enjoyment in jeopardy.

The analogy which compares the manner in which mathematics students are trained in mathematics and student teachers are trained in teaching, proves accurate when considering structure, underlying emphases, the focus on improvement, and the roles of the teacher. However, the analogy must account for the constant focus on the mathematical understanding and enjoyment of the students in the mathematics teaching culture.

Summary of Conclusions

The four conclusions presented in this thesis are presented below as a summary.

1) Cooperating teachers perpetuate the paradigm that compares mathematics teaching to a stage performance by their emphasis on the elements of performance. This paradigm includes the audience as performers and focuses on the entire career of the actors.
2) Cooperating teachers perpetuate the cohesive and goal-oriented nature of mathematics teaching. The unit of study was at the level of the lesson; however, small features of the lesson needed to be centered on lesson goals, and the lesson goals had to be connected with past and future mathematical topics. The over-arching focus for all of mathematics teaching was for students to understand and appreciate the key mathematical principles.
3) Mathematics student teaching is centered on the mathematics students. All motivations for teaching actions hinge upon the reactions of students with the mathematics in lessons. The teachers were responsible to generate lessons that allowed students to engage with key mathematical principles.
4) The manner in which underlying principles of mathematics teaching are taught to student teachers parallels the manner in which underlying principles of mathematics are taught to mathematics students. Both contexts have similar structures based on individual learning, collaboration, and guided thinking. Both contexts focus on quality work and underlying principles, and the teachers' roles are similar. However, the needs of mathematics students supercedes the needs of student teachers.

Implications

Each of the four conclusions listed above serve as explanatory frameworks for how student teaching was conducted in Japan. These analogies, parallels, and fundamental principles provide useful explanations for the various features and events evident within the Japanese setting. For example, Peterson (in press) found that cooperating teachers did not discuss management and student discipline in his separate study of student teacher-cooperating teacher interactions in Japan. This finding is particularly logical and poignant when considered in light of the performance paradigm. Since cooperating teachers present to the student teachers the notion that teaching is similar to a stage performance, they naturally will not tend to focus on controlling the students' behavior through rules and discipline. Rather, the novice teachers are taught to focus on developing an engaging lesson that will captivate their audience and inspire the students to enjoy the investigation of mathematical topics.

Understanding these frameworks also adds rich dimensions to consider when analyzing the student teaching interactions in the United States. In the beginning of this thesis, I showed that the current model for student teaching interactions in the United States should be enhanced by gaining new perspectives from a Japanese system. Below, I describe several ways the student teaching system of the mathematics classrooms in the United States can be modified utilizing these four frameworks. These suggestions are intended to augment the current efforts in the quest for long-term improvement in mathematics student teaching.

Student-driven Performance Paradigm

I suggest two specific recommendations for student teacher-cooperating teacher

interactions based on the student-driven performance paradigm. First of all, student teachers need to view their mathematics students as the performers and the audience of a mathematical production. The student teacher should understand that he or she is responsible for creating a positive learning environment; however, he or she should also allow the students to be joint-creators in the mathematical experience in the classroom. Cooperating teachers should assume responsibility for teaching their student teachers how this may be done. Second, student teachers should be required to make a concerted effort in preparing and reflecting on lessons in much the same manner a professional actor may rehearse and study to prepare for a performance. All of the details of the lesson, including the physical layout of the classroom, should be carefully planned and later discussed in light of the students' response. Furthermore, student teachers must learn that the improvement process extends beyond single lessons to include their long-term professional development in mathematics teaching. During the student teaching experience, student teachers need to learn effective processes for how to continually seek for teaching methods that will generate the highest possible levels of student understanding and enjoyment of mathematics. Cooperating teachers need to demand quality effort and improvement on the part of the student teachers.

A Coherent, Goal-oriented Field

Cooperating teachers in the United States should assist student teachers in utilizing or developing curricula that is goal-focused and cohesive in order to allow mathematics students to understand the necessity and logic behind their mathematical experiences. In this study, the cooperating teachers assisted the student teachers in clarifying the connections across mathematical contexts. They stressed the importance of

creating an integrated and cohesive experience for the mathematics students. Student teaching in United States is an ideal setting for aiding student teachers in developing lessons that connect mathematical concepts across units. Cooperating teachers in the United States should utilize their knowledge of the curriculum and students to train student teachers in creating lessons that build upon past lessons and prepare students for future concepts.

Student-centered Teacher Training

The interactions between student teachers and cooperating teachers in the United States should remain focused on the needs of the mathematics students. Specifically, cooperating teachers should encourage the student teachers to make the mathematics students' learning and enjoyment of the learning process the priority in all teaching activities. In pre-lesson planning sessions, the cooperating teachers should help the student teachers anticipate how the students may respond to the lesson plan. The student teachers should be required to refine their lesson plan until they are prepared to meet these responses. In their post-lesson discussions, the success of the lesson should be determined by the students' responses. However, the mathematics students should not be held accountable for the level of success of the lesson. The student teachers should understand that they are responsible for planning and presenting a lesson that will keep the students engaged and that will increase their understanding of mathematics.

Mathematics Teaching and Mathematics Student Teaching Parallel

In this study, the manner in which mathematics teachers taught mathematics students was similar to the manner in which mathematics teachers taught their student teachers how to teach mathematics. If an analogous statement can be made in the United

States, then the first step in implementing reform in student teaching interactions is for cooperating teachers to recognize their critical role as teacher educators. Once cooperating teachers understand their position as teachers of student teachers, they can utilize their knowledge of good pedagogy in training the student teachers. This study offers specific recommendations which would allow for increased utilization of the pedagogical knowledge of the cooperating teacher. For example, cooperating teachers should guide the direction for student teacher thinking while still allowing for and valuing individual learning and exploration. Student teachers should be given ample opportunities to work jointly with their peers and other practitioners in the field. Cooperating teachers should articulate what they believe the underlying principles of mathematics teaching are. In general, the valuable pedagogical knowledge cooperating teachers have gained should be not only taught to student teachers but should be used by cooperating teachers as they train them.

Limitations

The purpose of this study was to thoroughly describe and analyze multiple cases of a mathematics student teaching cycle in a Japanese junior high school. This was done to develop and present a unique perspective to be used to improve the current mathematics student teaching system in the United States. In order to develop the cases as thoroughly as possible, the sample selection and size were deliberate and small. Because of this, the results of this study cannot be used to generalize how student teaching is performed in every case in Japan. In order to draw such conclusions, a much larger random sample would be necessary.

In addition, while Peterson conducted two interviews for each cooperating teacher

and student teacher regarding their beliefs, expectations, and after-thoughts on the student teaching experience, the interactions of the student teachers and cooperating teachers were the unit of analysis. Therefore, conclusions were largely generated by these interactions. Had this study been focused more on the presented beliefs of the individuals, as opposed to documenting and analyzing the array of interactions, more focus should have been placed on what these individuals expressed in interviews or in private journal entries.

Finally, this study was not a cross-cultural comparative analysis. No data was collected from a Western perspective. Any cross-cultural comparisons made were based on past research conducted independent of and with different purposes than this study. The findings of this study must only be interpreted as a comprehensive analysis of a Japanese mathematics student teaching system. However, the findings will be helpful in implementing new possibilities for improvement of the current mathematics student teaching system in the United States. The next section provides several suggestions for future research in order to answer how this may be done.

Suggestions for Future Research

In the implications section, I suggested a variety of ways cooperating teachers can enhance the student teaching experience in the United States. The next step for future research is to answer how these recommendations may be implemented. Specifically, to what degree do these recommendations generate long-term improvement in the student teaching system? Which recommendations or combination of recommendations are the most productive in terms of implementation and student success? Many of the recommendations require a change in perspective for both student teachers and

cooperating teachers. How can student teachers be motivated to produce their highest quality work in the student teaching setting? How can cooperating teachers begin to see themselves as teacher educators? A major finding of the research is that student teachers are taught in the same manner that mathematics students are taught. If so, how should changes be implemented if the entire teaching system is so deeply rooted in cultural traditions?

I believe that the mathematics teachers in the United States have the experience and knowledge necessary to enhance the effort to improve mathematics student teaching. Cooperating teachers can be motivated to utilize the principles described in this thesis. As they encourage their student teachers to address the needs of the mathematics students, emphasize the expectation for quality effort, assist their student teachers in generating and teaching toward coherent curriculum goals, and teach them to identify and focus on key mathematical principles, they can guide their student teachers toward a path that will encourage a commitment to long-term improvement.

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Appendix A: Cooperating Teachers' Class Schedule

FUZOKU CHUGAKKO Math Teachers Schedule (Sept. 2003)

Date / day	CT	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
9/2 (Tues)	Kimura	2C	2A			Elective	Elective
	Ueno	Moral Ed	3D			1A	1C
	Sasaki	3B			3C	2B	2D
9/3 (Wed)	Kimura	1B		1D		School Practice	jikyou
	Ueno	3D	3A			School Practice	jikyou
	Sasaki		2B	3B		School Practice	jikyou
9/4 (Thurs)	Kimura	1B	1D			World Citizen 9	World Citizen 9
	Ueno	1A				1C	
	Sasaki	2D	2B		Moral Ed		
9/5 (Fri)	Kimura	2A	2C			School Practice	jikyou
	Ueno		3A		1A (sample)	School Practice	jikyou
	Sasaki	3C	3B	2D		School Practice	jikyou
9/6 (Sat)							
9/7 (Sun)							
9/8 (Mon)	Kimura		2A	2C		1B	1D
	Ueno	BBB	3A			1C	
	Sasaki	BBB	3C				
9/9 (Tues)	Kimura	2C	2A			Elective	Elective
	Ueno		3D			1A	1C
	Sasaki	3B			3C	2B	2D
9/10 (Wed)	Kimura	Field Day Practice (Undokai Renshu)				jikyou	
	Ueno					jikyou	
	Sasaki					jikyou	
9/11 (Thurs)	Kimura	1B	1D			World Citizen 9	World Citizen 9
	Ueno	1A					
	Sasaki	2D	2B		Moral Ed		
9/12 (Fri)	Kimura	2A	2C			jikyou	
	Ueno		3A	1A		jikyou	
	Sasaki	3C	3B			jikyou	

9/13 (Sat)	Kimura Ueno Sasaki	 BBB BBB	2A 3A 3C	2C	jikyou jikyou jikyou	Field Day Practice	
9/14 (Sun)	Kimura Ueno Sasaki	Field Day (Undokai)					
9/15 (Mon)							
9/16 (Tues)							
9/17 (Wed)	Kimura Ueno Sasaki	1B 3D	 2B	1D	 3A	jikyou jikyou jikyou	
9/18 (Thurs)	Kimura Ueno Sasaki	1B 1A 2D	1D 3D 2B		 Moral Ed	World Citizen 9 1C	World Citizen 9
9/19 (Fri)	Kimura Ueno Sasaki	2A 3C	2C 3A 3B	 1A 2D		jikyou jikyou jikyou	
9/20 (Sat)							
9/21 (Sun)							
9/22 (Mon)	Kimura Ueno Sasaki	 BBB BBB	2A 3A 3C	2C		3D ??	
9/23 (Tues)		Holiday					
9/24 (Wed)	Kimura Ueno Sasaki	1B 3D	 3A 2B	1D 3B		jikyou jikyou jikyou	
9/25 (Thurs)	Kimura Ueno Sasaki	1B 1A 2D	1D 3D 2B		 Moral Ed	World Citizen 9 1C	World Citizen 9
9/26 (Fri)	Kimura Ueno Sasaki	2A 3C	2C 3A 3B	 1A 2D		 ST Research Lesson	Debriefing
9/27 (Sat)							
9/28 (Sun)							
9/29 (Mon)	Kimura Ueno Sasaki	 BBB BBB	2A 3A 3C	2C		1B 1C	1D

Akihiko

Tomoko

Motori

Appendix B: Lesson Plan Form

Mathematics Educational Guidance Proposal

Student Teacher Name:_____Date:_____Class Period:_____
Class: _____Cooperating Teacher:_____

Date		Room	
Unit		Semester	
Unit Goal			
View of Instruction			

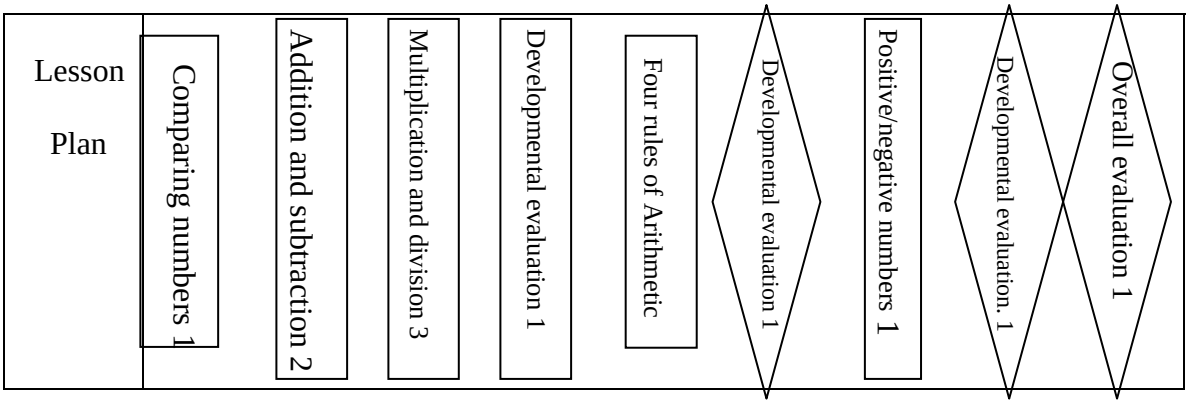
Instruction of the lecture				
Topic				
Purpose				
Activity	Time	Content	Purpose of Teaching	Evaluation

Blackboard Demonstration Plan				

Appendix C: Ueno Sensei's Sample Lesson Plan

The 7th grade class A Lesson plan for Math class
Teacher: Ueno Sensei

Date	05 Sep, 2003 (Fri) The fourth period 11:45 ~ 12:35	Room	Classroom A
Unit	Positive and Negative Numbers	Semester	mid Jun ~ end of Sep
Unit Goal	‣ Help students be interested in negative numbers that are used in various scenes in our daily lives and try to understand its meaning. Also help them try to solve the problems but using four operations of arithmetic. ‣ Help students have broader view of numbers in their daily lives by introducing how to organized and the numerical concept by using positive and negative numbers. ‣ Help them understand the numerical relationship between positive and negative numbers and learn how to use the four operations of arithmetic. Also help them to be able to express numerical values by using positive and negative numbers ‣ Help them feel the necessity of expanding the numerical field from positive numbers to negative numbers and firmly understand the meaning of negative numbers.		
View of instruction	(about materials) In order to think about the real world in a mathematical setting, the numerical range they have learned in elementary school is not sufficient. Therefore, one of the main concepts they need to learn in junior high school math is, "concept of numbers and its expansion." The specific context of the 8th grade math is understand the idea of expanding their numerical world from positive numbers to negative numbers, deepening their understanding of numbers, expanding the possibility of numerical operation, and to learn how to unify the numerical values by using these ideas. One important aspect is to help students sense the flexibility of math through the structural process as well as spontaneous discovery as they go through various activities independently from the logical understanding process. I consider this unit to be an important foundation for their future training of algebra. (about students) Nearly six months have passed since they entered junior high school. There are many students who have strong interest in math in this class. Since most of the students go to private school, it seems that almost everyone might have learned this subject already. Therefore, some students might be ready for the advanced level, however, few students have real understanding of the process of the solving procedures and the reasoning of the concept. There are some students do not go to private school, so it is necessary to teach a lesson that is focused on the basic point of view and the core idea of the problem solving. (about teaching) In this lesson, it is important to enhance students' problem solving ability, however, it is not appropriate to focus only on this. I would like to help them so that they can enjoy solving problems. I also would like to focus on groups so that the students can work together in order to exchange their ideas. I want to keep a broad perspective of this unit as I teach this lesson.		



Lesson of this period	
Topic	Multiplication of positive and negative numbers
Purpose	Consider the fact that the multiplication of opposite signs becomes negative. Help them understand the process of problem solving and learn how to corporate with other students.

Procedure

Activity	Time	Content	O Purpose of teaching △ Evaluation
1. confirm today's topic (Class)	5		○ Introduce a new method of multiplication table to help students being interested
2. Consider the answer of the multiplications of both positive/negative numbers (1) (pos.) x (pos.) (class)	35	・A method to use fingers how to figure out multiplication (+7)×(+6)= +42 (+7)×(+7)= +49	

<table>
<tr>
<td>(2) (neg.) x (pos.)
(pos.) x (neg.)

(individual)
↓
(small group)
↓
(class)</td>
<td></td>
<td>(-2)×(+6)=-12

Why is the answer negative number?

A. (-2)+(-2)+…….(-2)

B.
<table>
<tr><td></td><td></td><td>answer</td></tr>
<tr><td>⋮
(+6)</td><td>⋮
(+6)</td><td>⋮
(+6)</td></tr>
<tr><td>(+6)</td><td>0</td><td>0</td></tr>
<tr><td>(+6)</td><td>(-1)</td><td>-6</td></tr>
<tr><td>(+6)
⋮</td><td>(-2)
⋮</td><td>-12
⋮</td></tr>
</table>
</td>
<td>○ Help them understand the process of problem solving by focusing “why is that?”

△ Did they try to grasp the concept and make an attempt to solve it?
○ Help them to develop functional view by introducing chart

○ Prepare a white board in case of a group presentation and have students write their ideas on the board to share with others.</td>
</tr>
<tr>
<td>(3) (neg.) x (neg)</td>
<td></td>
<td></td>
<td>○ (negative)×(negative) concept will be covered in the next lesson</td>
</tr>
<tr>
<td>3. Review the lesson
(small group)</td>
<td>10</td>
<td>・Review the lesson and help students to solidify their basic understanding</td>
<td>△ Make sure that they can do “opposite-sign-multiplication”</td>
</tr>
</table>