UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

DIFFERENCES IN BELIEFS AND TEACHING PRACTICES BETWEEN INTERNATIONAL AND U.S. DOMESTIC MATHEMATICS TEACHING ASSISTANTS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

DOCTOR OF PHILOSOPHY

By

MINSU KIM
Norman, Oklahoma
2011

Downloaded from SHAREOK. Persistent Handle URL: https://hdl.handle.net/11244/318799

DIFFERENCES IN BELIEFS AND TEACHING PRACTICES BETWEEN INTERNATIONAL AND U.S. DOMESTIC MATHEMATICS TEACHING ASSISTANTS

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF MATHEMATICS

BY

Dr. Curtis McKnight, Chair

Dr. Jorge L Mendoza

Dr. Marilyn Breen

Dr. Shihshu Walter Wei

Dr. John Albert

© Copyright by MINSU KIM 2011
All Rights Reserved.

ACKNOWLEDEGMENTS

I would like to thank Dr. Curtis McKnight, my advisor and committee chair, for his guidance and inspiration. He has always supported me throughout my program. I also would like to pass my appreciation to my committee members, Dr. Jorge L Mendoza, Dr. Marilyn Breen, Dr. Shihshu Walter Wei, and Dr. John Albert.

My special thanks goes to Dr. Ji Y Hong, Dr. Stacy L. Reeder, and Dr. Lee Kyung-Bai for all their help, direction, and for generously sharing their expertise.

I thank my parents, Kim Changyun and Jang Okryun, my wife, Lee Jaewon, and my son, Kim Jaehyun, for cheering me on, giving trust and warm love, listening to my difficulties and supporting me in order to succeed at my Ph.D. program. Without them, I would not have succeeded in my life in the United States and the Ph.D. program at the University of Oklahoma.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION ……. 1

1.1 Problem Statement …… . 1

1.2 Significance of the Study ……. 4

1.3 Research Purpose and Questions …….. 5

CHAPTER 2: REVIEW OF LITERATURE ……. 6

2.1 Definitions of Beliefs …….. 6

2.2 Organizations and Systems of Beliefs ……. 8

2.3 Categorization of Teachers' Mathematics Beliefs ……... 9

2.4 Relationships between Beliefs and Practices …….. 11

2.5 Mathematics Teaching Assistants ……..…… 14

2.5.1 Roles of Mathematics Teaching Assistants ……. 14

2.5.2 Mathematics Departments' Support for and

Limitations for MTAs' teaching ……. 17

2.5.3 The Current Research of MTAs ….……. 19

2.5.4 International Mathematics Teaching Assistants ….. 20

CHAPTER 3: METHODS …… 23

3.1 Theoretical Framework …….. 23

3.2 Research Design ……. 26

3.3 Participants ……. 26

3.4 Data Collection …….. 31

3.5 Data Analysis ……. 35

3.6 Trustworthiness …….. 36

3.7 Ethical Issues …….. 37

CHAPTER 4: RESULTS …….. 37

4.1 Beliefs …… 38

4.1.1 Beliefs about Teaching ……...… 39

4.1.2 Beliefs about Student Learning …….. 52

4.1.3 Beliefs about Mathematics ……. 62

4.2 Teaching Practices ……. 68

4.3 Relationships between Beliefs and Teaching Practices ……. 79

CHAPTER 5: CONCLUSION ……. 85

REFERENCES ……. 92

APPENDIX A …….. 99

Interview Protocol

APPENDIX B …….…… 102

Questionnaire

APPENDIX C …….… 111

Code Book

APPENDIX D ……. 117

Subjectively Statement

LIST OF TABLES

TABLE 3.1: The number of U.S. domestics MTAs vs. IMTAs …… 28

TABLE 3.2: The six U.S. domestic MTAs ……..... 29

TABLE 3.3: The six IMTAs …….. 31

TABLE 5.1: Teaching …… 86

TABLE 5.2: Motivation ……. 88

LIST OF FIGURES

Figure 2.1: Green's quasi-logical structure of beliefs ……. 8

Figure 4.1: U.S. domestic MTAs' Important Aspects

of Teaching Mathematics…….. 40

Figure 4.2: IMTAs' important aspects of teaching mathematics ..…… 40

Figure 4.3: U.S. domestic MTAs' roles ……. 46

Figure 4.4: IMTAs' Roles …….. 47

Figure 4.5: IMTAs' most efficient teaching practices …… 48

Figure 4.6: U.S. domestic MTAs' most efficient teaching practices ……. 50

Figure 4.7: Instructional Goal ……. 52

Figure 4.8: Important abilities for students to learn mathematics …….. 54

Figure 4.9: All students can learn mathematics ……. 56

Figure 4.10: Students' attitudes about mathematics (IMTAs) …….. 58

Figure 4.11: Students' attitudes toward mathematics

(U.S. domestic MTAs) ……. 61

Figure 4.12: Calculus …… 65

Figure 4.13: Advanced Mathematics …… 67

Figure 4.14: Teaching organization …….. 70

Figure 4.15: Definitions, rules, and formulas ……...…… 72

Figure 4.16: Before problem solving …… 73

Figure 4.17: Question Form ……. 74

Figure 4.18: Responses to students' questions ……. 75

Figure 4.19: Methods of summary …… 77

Figure 4.20: Methods for teaching material …….……. 78

Figure 5.1: Relationships between beliefs and teaching practices …… 90

ABSTRACT

Pedagogical methods and beliefs of International and U.S. domestic mathematics teaching assistants (MTAs) influence different students' perspective on mathematics and achievement in mathematics education. The purpose of this study is to help understand international and U.S. domestic MTAs' different approaches to education. This study examined the contrast between international and U.S. domestic MTAs' beliefs and pedagogical methods and a relationship between the MTAs' beliefs and pedagogical methods. As a case study in a qualitative research project, I collected three different data sources, which were semi-structured interviews, questionnaires, and observations, with 12 participants that consisted of 6 international and 6 U.S. domestic MTAs at the University of Oklahoma. The results indicate significant differences in beliefs about teaching and learning and pedagogical methods between the two groups centered on how they taught students to understand definitions and problems and how they motivated students to learn mathematics. In addition, the findings describe that there is consistency between MTAs' beliefs about teaching and learning and their pedagogical methods. This research will contribute to MTAs' teaching and knowledge and will encourage faculty to be interested in the professional development of MTAs.

Keywords: U.S. domestic mathematics teaching assistants (MTAs), international mathematics teaching assistants (MTAs), beliefs and teaching practices

CHAPTER 1: INTRODUCTION

1.1 Problem Statement

After the graduate assistantship program was made in the late 1800s, the mathematics teaching assistants (MTAs) who are either in master's or in doctoral program roles have increased in universities (Belnap, & Allred, 2006; McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Latulippe 2007; Speer, Gutmann & Murphy, 2005). Their assignments are usually grading and proctoring exams, providing tutoring services, and teaching one or more classes from lower-level or basic courses in mathematics departments. For example, I as a MTA, have graded for three semesters, taught a discuss section for two semesters, taught a lower-level class for three semesters, and served as a tutor for over six semesters at the University of Oklahoma. MTAs spend much time interacting with or teaching undergraduate calculus students (Lutzer et al., 2005, Lutzer, Rodi, Kirkman & Maxwell, 2007). Most MTAs interact with undergraduate students at least ten hours every week through teaching classes, office hours, or tutoring service hours in the help center, except for MTAs who are assigned grading at the University of Oklahoma. Because a number of undergraduate students are taught by MTAs, MTAs' teaching practices are major potential factors that directly influence the students' perspective on mathematics and achievement in quality mathematics education (Commander, Hart & Singer, 2000; Speer, Gutmann &

Murphy, 2005). International mathematics teaching assistants also have become an indispensable part of mathematics departments. In the last two decades, international mathematics teaching assistants (IMTAs) have been a high ratio of the teaching assistants' population in mathematics departments in the U.S. (Hill, 1996). For example, IMTAs' population has been approximately 50% of the total MTAs' population from 2004 to 2010 at the University of Oklahoma.

MTAs' first priority is to study their field instead of focusing on their instructional practices. Because the results of their studies are strongly related to their future job, MTAs have struggled with keeping an appropriate balance between studying their fields and doing their assignments. A teaching assignment would often be a burden to MTAs because of their lack of pedagogical knowledge and teaching experiences (McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Monaghan, 1989). In addition, MTAs undergo a transition period from a student to a teacher and do not have as much teaching experience as beginner teachers in K-12, who have at least completed classroom training or a degree in education. Therefore, MTAs teach their class based on their own methods, even though their instructions are rough. McGivney-Burelle, DeFranco, Vinsonhaler & Santucci (2001) and Monaghan (1989) interpret this phenomenon as many MTAs using models of teaching that they have experienced as students. Even though most universities and mathematics departments provide training programs such as short-or long-term orientations, MTAs believe that support is limited to help them

teach their classes (Baiocco & De Waters,1998; McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001).

Despite the limitations of MTAs' circumstances for teaching, MTAs have improved their teaching practices simply through teaching their classes. I have become interested in MTAs' teaching practices regarding MTAs' potential influence on undergraduate education. As I am an IMTA, when I teach a class, I often wonder what kinds of practices other MTAs do in the same lesson, and what efficient practices are for this lesson. I studied the literature related to MTAs' instructional practices to have professional answers to my questions. I found from the literature that researchers have contended that a variety of factors influence teachers' practices. In particular, some researchers assert that teaching assistants' beliefs strongly influence their teaching practices (Speer, 1999, 2005, 2008; Thompson 1984, 1992). DeFranco and McGivney-Burelle (2001) suggest that MTAs' beliefs and teaching practices are influenced by the culture of years of school experiences. In addition, Twale, Shannon, and Moore (1997) indicate that IMTAs have been different from U.S. domestic TAs in terms of teaching because of a different philosophy of education, which differs from that of American education. According to the literature, if I make two groups such as international and U.S. domestic mathematics teaching assistants, I believe that I will find significant differences in their teaching practices and beliefs.

1.2 Significance of the Study

It is noteworthy to investigate how similar MTAs' instructional practices are and how different their practices are under the same circumstances because MTAs' instructional practices significantly influence the quality of undergraduate education. As compared to research involving K-12 beginning teachers, researchers have not seemed to focus on MTAs' studies. In the past two decades, researchers have raised their concerns for MTAs, regarding MTAs' knowledge and beliefs, aspects of their experience, curriculum development for MTA professional development, use of technology, and assessment (Speer, Gutmann & Murphy, 2005). However, research on MTAs' teaching practices has had less progress. Although researchers have recently become interested in IMTAs' experiences, challenges, and characteristics because IMTAs' roles are also significant in mathematics departments, there are few studies on IMTAs' teaching practices. In particular, there is little literature that provides insight into IMTAs' pedagogical knowledge, cross-cultural issues, and different instructional practices, and beliefs. This case study will help us understand the beliefs and teaching practices of these twelve MTAs. Also, I believe that this study will contribute essential resources for the body of knowledge about MTAs and the creation or adaptation of professional development programs for MTAs. In addition, mathematics departments will be able to have insight into the proper support for MTAs by acknowledging IMTAs' and U.S. domestics MTAs' different instructional practices and beliefs. In particular, my research explains the

differences in beliefs and teaching practices of international and domestic MTAs and what factors strongly influence the differences. This information provides a good opportunity for readers to understand the differences, to contribute toward MTAs' teaching and knowledge of MTAs, and to encourage faculty to be interested in professional development of mathematics teaching assistants.

1.3 Research Purpose and Questions

This study is to understand differences in beliefs and practices between international and U.S. domestic mathematics teaching assistants. As a case study, this study has two cases, which are international and U.S. domestic MTAs within a bounded system (Creswell, 2007). In addition, it describes relationships between beliefs and teaching practices. I conducted this study with the intent to contribute to knowledge and professional development of IMTAs' and U.S. domestic MTAs' teaching practices from the experiences of twelve MTAs that consist of six international and six U.S. domestic MTAs at the University of Oklahoma. The aim of this research is to answer the following two research questions: First, "What are the differences in beliefs and teaching practices between international and U.S. domestic mathematics teaching assistants?" and second, "How are mathematics teaching assistants' different teaching practices shaped by their beliefs?" From the findings of the first question, people who are related to MTAs' teaching and research areas and faculty members will increase their attention to

not only U.S domestic MTAs' but also IMTAs' teaching practices. In particular, the findings contribute to the knowledge of MTAs' practices and beliefs. The findings of the second question provide opportunities to understand the relationships between MTAs' practices and beliefs, and support other researchers' assertions that beliefs have a noteworthy influence of MTAs' practices. The next chapter introduces literature related to the study of beliefs, teaching practices, MTAs, and IMTAs as an overview.

CHAPTER 2: REVIEW OF LITERATURE

2.1 Definitions of Beliefs

Over several decades, the definitions of beliefs have been vague even though many researchers have studied them. Researchers have expressed concern because though there are many factors for teachers to consider in making instructional decisions, the factors could not adequately explain the nature of teachers' instruction (Ball et all., 2001). In addition, only considering knowledge could not describe the various factors of teachers' instructional decisions. However, there is still a bitter controversy about the distinction between beliefs and knowledge. Thus, Pajares (1992) described beliefs as a "Messy construct" (p.308) because of a variety of meanings and interpretations. In addition,

Calderhead (1996), Nespor (1987), Pajares (1992), and Thompson (1984,1985,1992) have made distinctions between beliefs and knowledge from features which beliefs possess, the source of beliefs, and how beliefs are organized in memory. In mathematics education, some researchers defined beliefs as personal philosophical conceptions, ideologies, worldviews and values that shape practice and orient knowledge (Aguirre & Speer, 1999; Ernest, 1989; Speer, 2005). According to their definitions, beliefs have been classified based on the teachers' nature of mathematics, teaching, and student learning (Speer, 2005). Researchers contend that "A unique feature of beliefs is their evaluative and affective nature" and that "Beliefs are episodic in nature and tied to people's particular experiences" (Speer, 2005, p365). In addition, Pajares (1992) contends that beliefs significantly influence the definitions of behavior and organizing knowledge, inform the definitions of tasks, and select the cognitive tools to make decisions. Recently, many researchers have still tried to define beliefs and study the characteristics of beliefs. Furinghetti and Pehkonen (2002) and McLeod and McLeod (2002) assert that there is not a certain definition of beliefs yet. In addition, some researchers claim there is no single and general purpose definition (Furinghetti & Pehkonen, 2002; Torner 2002). In addition, Cross (2009) defines beliefs as embodied conscious and unconscious ideas and thoughts about oneself, the world, and one's position in it.

2.2 Organizations and Systems of Beliefs

Researchers have proposed different organizational representations of beliefs. Because a characteristic of beliefs is resistance to change, the organizational representations as "Belief systems" (Green, 1971) are in multidimensional systems (Cross, 2009). The organization of belief systems consists of relationships between various beliefs and between beliefs and behavior from simple sorted lists to more complex hierarchies (Cross, 2009; Green, 1971).



Figure 2.1 Green's quasi-logical structure of beliefs

First of all, Green proposes a "Quasi-logical" representation (Cross, 2009, p. 327) (Figure 2.1). It describes how individual beliefs are well organized in hierarchies, and how these beliefs are held. It is a simple tool to carry information without the content of the belief (Cross, 2009; Green, 1971). Secondly, he refers to a "psychologically central" belief which is not based on the content of beliefs. A psychologically central belief is considered as a core belief which is the most important belief in the belief system. "Peripheral beliefs" are the remaining beliefs

(Cross, 2009; Green, 1971). In contrast to the quasi-logical representation, the relationships between psychologically central beliefs and peripheral beliefs are not inherently logical in the psychologically central belief organization. Third, Cross (2009) proposes that beliefs are clustered. The clusters bring protection and support for their incompatibility and inconsistencies. In addition, he explains the third dimension as "due to the 'protective shield' that the individual provides these clusters, it is possible to hold conflicting core beliefs. This segregation of beliefs is often upheld by another belief" (p. 327).

2.3 Categorization of Teachers' Mathematics Beliefs

Researchers have proposed different categorizations of beliefs (Ernest, 1988, 1989; Kuhs and Ball, 1986; Lerman, 1990; Speer, 2005, 2008; Prawat, 1992). Each categorization has different characteristics of a variety of beliefs based on the content of beliefs. Researchers have taken comprehensive classifications of teachers' beliefs or a single category to center their studies (Speer, 2005, 2008).

Currently, appropriated classifications of beliefs in mathematics education are about the nature of mathematics, beliefs about teaching, and beliefs about student learning (Cooney 2003; Cooney et al. 1998; Cross, 2009; Ernest 1989; Speer 2005, 2008; Thompson 1992). Ernest (1989) introduced the categorization of beliefs about mathematics based on three views such as the problem-solving

view, the Platonist view, and instrumentalist view. In addition, Dionne (1984) proposed three perspectives: the traditional, formalist, and constructivist perspectives. The problem-solving and constructivist views conceptualize mathematics as a "continually expanding field of human inquiry" (Cross 2009; Speer, 2005). These views focus on individual sense-making and students' learning environment (Cobb and Steffe, 1983). The Platonist and formalist views take mathematics as a unified, static body of knowledge that is discovered, not created. The instrumentalist and traditional views of mathematics are that mathematics is a collection of useful facts, procedures, and skills to be used in the process of the solution to a problem. This view focuses not on student's constructed knowledge, but the teacher explaining concepts with students following the procedures. Lerman (1990) suggested two categories about the nature of mathematics: "absolutist" and "fallibilist" views. In the "absolutist" view, mathematics is an abstract, value-free, and independent subject. In the "fallibilist" view, mathematics is a dynamic activity and a problem-solving process (Speer 2005).

Kuhs and Ball (1986) proposed the classification of "dominant views of how mathematics should be taught" (p.2) based on beliefs about teaching and learning: learner-focused, content-focused with emphasis on conceptual understanding, content-focused with emphasis on performance, and classroom-focused. The "learner-focused" view centers on the learner's personal interpretation of mathematical knowledge. In contrast, the teacher is a helper for

learners in mathematics. The "content-focused with emphasis on conceptual understanding" view centers on the mathematical content and ideas in logical relations. The third view, "content-focused with emphasis on performance", emphasizes not only acquiring mathematical rules, processes, and skills but also the content and the logical relations of mathematical ideas. The "classroom-focused" view focuses not on the content or learning among mathematical ideas but on the efficient organization of classroom activities and procedures. Teachers prepare the lessons well with clear teaching materials and provide a student's individual problem-solving activity.

There are more categorizations of beliefs from other researchers. Calderhead and Robson (1991) proposed beliefs about self and beliefs about self as a teacher. Bullough, Knowles & Crow (1991) suggested "beliefs about purposes of school and processes of learning to teach". Skott (2001a) proposed "School Mathematics Images" based on the unit of analysis for research. "School Mathematics Images" is a construct to explain teachers' beliefs of teaching and learning.

2.4 Relationships between Beliefs and Practices

Researchers have been interested in the relationships between teachers' beliefs and their practices. They have contended that beliefs significantly

influence teachers' practices (Speer, 2005, 2008; Pajares, 1992). Some researchers found that teachers' beliefs related to mathematics, teaching, learning, and students were consistent with what the researchers found from the teachers' practices in classrooms (Speer, 2005). Thompson (1985) found consistencies between teachers' beliefs and their practices in class. For example, Kay was Thompson's participant as a mathematics teacher. Kay's beliefs of mathematics were "subject of ideas and mental processes rather than a subject of facts" (p. 288). In addition, her beliefs of learning mathematics were "discovery and verification of ideas" (p. 288). It is here that Thompson's observations were consistent with Kay's beliefs about mathematics and learning mathematics: "She frequently encouraged the students, in a rather persuasive tone, to guess, conjecture, and reason on their own, explaining to them the importance of these processes in the acquisition of mathematical knowledge" (p. 289).

In contrast, researchers also found inconsistencies between beliefs and practices. For example, Lynn was one of Thompson's participants as a mathematics teacher (Thompson, 1984). Although Lynn's beliefs of teaching mathematics were to encourage students to ask questions and participate in class, Thompson observed inconsistencies between Lynn's beliefs and practices because a great part of Lynn's practices was a lecture, which limited student participation and interaction. In addition, Cohen (1990) supported inconsistencies between teachers' beliefs and practices. Ms. Ooublier, a mathematics teacher who was a participant in Cohen's study, thought that she did cooperative learning during her

class as reform mathematics practices. However, Oublier had not changed her teaching practices such as traditional teaching practices when Cohen observed her class, even though she was following reform mathematics practices. A number of researchers found consistencies and inconsistencies between beliefs and observations of practices (Cohen, 1990; Speer, 2005; Thompson, 1984). Thompson (1992) also suggested a complex relationship between them as "teachers' conceptions of teaching and learning mathematics are not related in a simple cause-and-effect way to their instructional practices" (p. 137).

Although researchers often found inconsistencies between beliefs and practices, researchers contended that studies of teachers' beliefs and their practices from investigators' observations are still valuable because of other potential explanations for these findings and complex relationships between them (Speer, 2005, 2008; Thompson, 1992). In addition, researchers have not had clear explanations for particular findings in shaping practices and changes to those practices without examining the relationships between beliefs and practices (Speer, 2008). Thus, many researchers have described that the relationships between beliefs and practices are more complex than they had thought, and have left their studies so that the future focus of the studies would be the relationships (Speer, 2008).

2.5 Mathematics Teaching Assistants

During the late 1800s, graduate assistantships appeared in universities to encourage students to take graduate studies (McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001). Even though universities offered and considered the assistantships early, few researchers in mathematics education have studied about the characteristics of mathematics teaching assistants (MTAs), including teaching, beliefs, challenges, needs, and understandings of mathematics and teaching after the time compared to the characteristics about K-12 teachers (Speer, Gutmann & Murphy, 2005). Over the past two decades, researchers have increased their attentions to undergraduate mathematics education. Although MTAs have the vital responsibilities teaching on undergraduate mathematics education, the attentions of researchers have focused not on instructional practices, but other aspects of education such as curriculum development, use of technology, and assessment (Speer, Gutmann & Murphy, 2005).

2.5.1 Roles of Mathematics Teaching Assistants

Assignments of MTAs

Even though many professors in mathematics departments teach undergraduate students, mathematics teaching assistants play a significant role in undergraduate education of students in two- and four-year colleges and

universities (Belnap, & Allred, 2006; McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Latulippe 2007; Speer, Gutmann & Murphy, 2005) . In general, mathematics teaching assistants are assigned to grade exams and homework assignments, proctor examinations, provide tutoring services to students, and teach one or more sections of a lower-level or basic course in mathematics departments (Belnap & Allred, 2006; Hendrix, 1995; Speer, Gutmann & Murphy, 2005). Recently, MTAs have increased a portion of credit hours of low-level or basic courses. For example, the National Center for Educational Statistics (1998) showed that approximately 29% of first-time college freshmen enrolled in at least one remedial reading, writing, or mathematics course with the highest percentage (24%) in mathematics. In addition, Lutzer et al. (2005) indicated that MTAs teach 8%-13% of students in undergraduate mathematics classes in the U.S.A. In another example, Lutzer, Rodi, Kirkman, and Maxwell (2007) designated that MTAs teach 21% of mathematics and 17% of statistics undergraduate students at doctoral granting institutions. Undergraduate calculus students in their college mathematics careers, and in courses that serve as prerequisites to majors or program distribution requirements have plenty of opportunities to be taught by MTAs. In addition, MTAs significantly affect those students' perspectives on mathematics. Commander, Hart & Singer (2000) suggested that "quality education for undergraduate students is strongly linked to the instruction provided by Graduate Teaching Assistants" (p. 93). Furthermore, "the potential influence that TAs have on undergraduate students' experiences with mathematics is

tremendous" (Speer, Gutmann & Murphy, 2005, p 76). Thus, MTAs are in a critical position influencing undergraduate students' experiences with mathematics.

Potential Sources of Mathematics Faculty

Many researchers suggest that MTAs are the potential sources of mathematics faculty of the future (Belnap, Withers, Proceedings; McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Latulippe, 2007; Speer, Gutmann & Murphy, 2005). Nyquist, Abbott & Wulff, (1989) mentioned that "Although not all TAs are going to be professors, virtually all professors were once TAs" (p. 9). Baiocco & De Waters (1998) indicated that half a million new professors will be needed by the year 2014, increasing the likelihood that MTAs will retain their conditions as an important part in colleges and universities in the future. The National Science Foundation (1992) indicated that faculty members will have limited opportunities to have any guidance regarding their teaching. Therefore, Speer, Gutmann, and Murphy (2005) suggested most MTAs have an opportunity to have the first teaching experiences and these experiences influence their beliefs of teaching and learning mathematics that they will have until becoming faculty members. As the potential sources of mathematics faculty members, the periods of MTAs are important to develop their competencies for teaching in mathematics education. Researchers have suggested that the

significance of early experiences in solidifying beliefs, developing practices, and setting patterns of social learning for new teachers (Brown 1985; Eisenhart 1995; Speer, Gutmann, & Murphy, 2005; Zeichner and Tabachnick 1985). Barrington (2001) and Graff (1994) have suggested that the supports to improve the quality of teaching provided by graduate teaching assistants may have the long term benefits of improving undergraduate education and contributing professional development in the next generation of faculty.

2.5.2 Mathematics Departments' Support for and Limitations for MTAs' Teaching

Many universities and mathematics departments have offered general training programs to prepare TAs to teach their class. According to Buerkel-Rothfuss and Gray (1989), over 25% of schools provide the common training program which is a one-day session prior to the start of the fall semester. 12% of schools offer a one-week or longer training session. In addition, Baiocco & De Waters (1998) explained that 50% of all academic departments conducted training programs for TAs during one-day or week-long orientation session. Latulippe (2007) asserts that half of GTAs are still not involved in training programs for their role as a university instructor. Despite of universities and mathematics departments' efforts to support MTAs to teach class, researchers have found that the training programs have not been enough to satisfy MTAs' demands for

teaching. Travers (1989) describes that over 600 TAs believed their training was inadequate to prepare them for their class. In addition, Moore (1996) indicates that graduate teaching assistants surveyed "felt the need for more training and experience before being allowed independent classroom responsibility" (p. 87).

In addition to the limited supports from universities and departments, research has found that MTAs have several reasons not to be focused on teaching. Even though most MTAs agree that teaching is important, they focus on their research instead of their teaching. Faculty members and the culture of mathematics departments also makes them concentrate on their research, not teaching. For example, Smith (2001) describes that mathematics departments encourage MTAs to dedicate more time to their research than their teaching. 21.8% of department heads reported that faculty members believe that a GTAs' priority is to perform their research, not teaching (Buerkel-Rothfuss & Gray, 1989). Etkina (2000), McGivney-Burelle, DeFranco, Vinsonhaler & Santucci (2001), and Chae, Lim & Fisher (2009) indicate that few MTAs intend to change their practices because of institutional constraints and their reluctance to new pedagogical ideas and practices. In addition, the goals of MTAs are to have their degrees and find jobs based on their excellent research. Therefore, MTAs often have less motivation to consider their teaching in mathematics departments. Despite the circumstances of MTAs, mathematics departments assign MTAs to teach lower-level or remedial courses in general. Even though most MTAs deeply understand content knowledge of their class, they depend on models of teaching

they have experienced as students because they have minimal or no prior instruction in pedagogical theory or experience in teaching (Chae, Lim & Fisher, 2009; Monaghan, 1989). In addition, MTAs' teaching improves with practice during their assignments (Buerkel-Rothfuss & Gray, 1989).

2.5.3 The Current Research of MTAs

Being a MTA is crucial to learn pedagogical knowledge and various practices for teaching. Researchers also have been highly interested in studies related to MTAs because of not only critical MTAs' responsibilities on undergraduate education but also appropriate time to develop MTAs' teaching and pedagogical knowledge. Smith (2001) contends that faculty members who were a graduate student attribute their success to diverse teaching experiences and practices for class as GTAs. In addition, he indicates that a GTA has many opportunities to develop their knowledge of teaching and student learning from a first experience for teaching as a university instructor. Some researchers have studied MTA professional development for teaching (for example, Latulippe, 2007; McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Shannon, Twale & Moore, 1998; Speer, 2005). Johnson (2001), Prieto (1999), and Thornburg, Wood & Davis (2000) suggest workshops, supervising, and mentoring in professional development for teaching assistants' effective teaching in classrooms respectively.

2.5.4 International Mathematics Teaching Assistants

IMTAs have been an enormous portion of undergraduate education because of large numbers of IMTAs in research universities. According to the globalization of universities in U.S., the number of international graduate students has been increasing in mathematics and science departments (Twale, Shannon & Moore, 1997). Through the increased number of IMTAs, researchers expect that IMTAs teach more undergraduate students than U.S. domestic MTAs teach (Kulik, 1985; Vom Saal, Miles & McGraw, 1988). Barber & Morgan (1988) and Dick & Robinson (1993) assert that many undergraduate students at research institutions will meet IMTAs at least once as their instructors during their coursework. In addition, Hill (1996) reported that 40% of non-U.S. citizens'' doctoral students were in science and engineering departments at research universities in 1995 and nearly 75% of them were Asian.

IMTAs have faced more challenges of teaching comparing to U.S. domestics MTAs. IMTAs have been often assigned to teach undergraduate students with lack of pedagogical knowledge and experience of teaching, and little advanced notice as the same as U.S. domestic MTAs (Barber & Morgan, 1988; Boyd, 1989; Byrd & Constantinides, 1992; Chae, Lim & Fisher, 2009; Crittenden, 1994; Ferris, 1991; Smith, 1989; Stevens, 1989; Stevenson & Jenkins, 1994; Torkelson, 1992; Yule & Hoffman, 1993). Unlike U.S. domestic MTAs, IMTAs have difficulties of teaching coming from cultural differences and poor English

proficiency as well (Jenkins, 1997; Luo, Bellows & Grady, 2000). IMTAs also have challenges from lack of understanding and knowledge of American education contexts (Barber & Morgan, 1988; Chae, Lim & Fisher, 2009; Tang & Sandell, 2000; Torkelson, 1992). For example, they have recognized that undergraduate students are able to enroll in introductory level mathematics courses at the university from their assignments. IMTAs have often different teaching practices compared to U.S. domestic MTAs and difficulty interpreting American academic normative standards because of IMTA's internal philosophy of education, which differs from U.S. domestic MTAs' philosophy (Barber & Morgan, 1988; Torkelson, 1992).

IMTAs' lack of English proficiency has become the common issue in research institutions as the number of complaints from students has risen (Bailey, 1984). Most undergraduate students often have complained about the difficulty to understand IMTAs' lessons because of IMTAs' teaching styles, foreign accents and language (Gokcora, 1989; McCone, 1993; Ranney, 1994; Rao, 1993, 1995; Smith et all, 1992; Yule & Hoffman, 1990). These complaints cause many states to enact legislation to mandate IMTAs' English proficiency before teaching undergraduate students (Brown, Fishman, & Jones, 1991; Crittenden, 1994; Dick & Robinson, 1993; Thomas & Monoson, 1993). Although many complaints from undergraduate students focus on IMTAs' English fluency, Nelson (1990) and Smith et al. (1991) suggest that IMTAs' English proficiency is not a primary cause of undergraduate students' complaints. Other researchers contend that

various factors influence undergraduate students' complaints such as ethnicity and cultural differences, and student attitudes toward the course (Boyd, 1989; Rubin, 1992; Rubin & Smith, 1990; Orth, 1982).

The common training programs of IMTAs include class management, communication issues, and general teaching skills (Bloemhof, and Zorn, 1999; Brilleslyper, 2002; Franke, Carpenter, Fenneman, Ansell & Behrend, 1998). Most universities' training programs focus on acquisition of information (Bhagat & Prien, 1996) and the communication issues of the three topics for IMTAs such as fluency in spoken English for non-native speakers (Rubin, 1993). Research has reported that the common training programs for IMTAs are often limited to improve their teaching practices. Etkina (2000), McGivney-Burelle, DeFranco, Vinsonhaler & Santucci (2001) have found no significant change in IMTAs' teaching practices on the common training programs. In the last several years, some researchers have increased their attention toward the pedagogical aspects of IMTAs' training. Bauer (1996) suggests that IMTAs' cultural understanding of American college contexts is as important as their language proficiency in international TAs' professional development. Bhagat and Prien (1996) suggest that the training programs for IMTAs concentrate on cultural issues, communication, and pedagogical skills. In addition, Tang and Sandell (2000) point out that "improved English language proficiency and communication skills do not necessarily improve international teaching assistants' teaching unless they are adequately exposed to cross-cultural issues and receive appropriate

pedagogical training deemed pertinent to their disciplinary areas" (p. 171). Next chapter, I will discuss details of the research methods including research design, participants, data collection, and data analysis.

CHAPTER 3: METHODS

3.1 Theoretical Framework

I believe that human experiences have certain meanings. Even if my experience, at a certain moment, seems without meaning, the experience has varied meanings which I do not recognize merely because material and immaterial qualities of human experiences have a coexistent relationship, according to Plato. In addition, both material and immaterial qualities of human experiences come from an origin. In other words, whether any human experiences have important meanings or not, I believe that we could find its cause because these experiences stem from the origin.

Based on Crotty's description, I have the objectivism view in epistemology. Since phenomena have meaningful entities, respectively, of consciousness and experience, researchers find the objective truth and meaning of the certain phenomena (Crotty, 1998, p.6). If we do not discover or state things, we cannot deal with these as knowledge. Thus, when certain phenomena are verified, the statement becomes meaningful and truthful. Even though research is able to attain

the cause of the origin by being verified, I believe it is impossible to be only verified by experience based on Crotty's explanation about post-positivism. Researchers are able to uncover approximate truth of phenomena instead of not finding the accurate truth with certainty of phenomena in the human experiences (Crotty, 1998, p29). Therefore, as a post-positivist, I believe that knowledge is created by the approximate cause or truth of phenomena through uncovering.

Although phenomena cannot be verified by accurate truths or meanings, the research of the phenomena is important for the post-positivism perspective because researchers will discover approximate meanings and truths. Thus, the research is able to explain well the phenomena well and provide opportunities for readers to understand and accept these as knowledge. In addition, the research helps readers to predict the phenomena based on the post-positivism perspective.

I am interested in phenomena of differences between mathematics teaching assistants. My research topic is "Differences in Beliefs and Teaching practices between International and U.S. domestic Mathematics Teaching Assistants." I assume international and U.S. domestic mathematics teaching assistants have different beliefs and teaching practices. To find these differences, my research questions are: What are the differences in beliefs and teaching practices between international and U.S. domestic mathematics teaching assistants? How are mathematics teaching assistants' different teaching practices shaped by their beliefs? It is hard to determine the truths of the differences even though I discover

regular patterns of the differences between mathematics teaching assistants' beliefs and teaching practices. For example, it is impossible to determine mathematics teaching assistants' beliefs with any accurate equipment. In addition, their beliefs often are inconsistent with their behaviors. Even though my research will not be verifying truths of the differences, I am able to discover regular differences. Through post-positivism and the uncovering of the differences in mathematics teaching assistants' beliefs and teaching practices, the answers of my research questions become knowledge and may help us understand what the differences in beliefs and teaching practices between international and U.S. domestic mathematics teaching assistants are. In addition, the answers provide opportunities to understand mathematics teaching assistants' realities and identities in their beliefs and teaching practices.

Because I have a post-positivist perspective, my research will explain the differences in beliefs and teaching practices of international and domestic mathematics teaching assistants. In addition, it will provide a good opportunity for readers to understand the differences, contribute toward mathematics teaching assistants' teaching, and encourage faculty to be interested in professional development of mathematics teaching assistants.

3.2 Research Design

This study is a case study within a bounded system (Creswell, 2007; Stake, 1995) as a qualitative research. It explores twelve MTAs' beliefs and practices at the University of Oklahoma and has two groups from the MTAs that consist of six international and six U.S. domestic MTAs within their nationality. According to Creswell (2007) and my multiple sources of data, which are observations, interviews, and close-ended questionnaires, my research is appropriate to fit a case study because I have clearly identifiable cases with boundaries. In addition, from these multiple data, the intent of this study is to understand differences in beliefs and practices between two groups.

3.3 Participants

This study is for purposeful sampling (Creswell, 2007, p. 125). According to criterion sampling, which is a sub-category of purposeful sampling (Creswell, 2007, p.127), I selected my participants by myself through face-to-face contact as a peer based on three criteria. After I explained my study to each of the twelve participants, all of them were interested in my research and agreed to participate in my research. Here are my three criteria. The first is that MTAs are in the Mathematics department at the University of Oklahoma. The second is MTAs' nationalities, such as U.S. domestic MTAs and IMTAs. One of the two groups is U.S. domestic MTAs who were born and at least completed high school in the U.S. and speaks English as their native language. In addition, the other group is

IMTAs who were born and at least completed high school out of the U.S. and are non-native speakers of English. The third is that MTAs teach their own class during the spring semester of 2010. Therefore, I selected twelve participants out of sixty nine MTAs in the Mathematics department at the University of Oklahoma during the spring semester of 2010 based on my first criterion. The twelve participating MTAs were all Ph.D. students. Six of the MTAs were U.S domestic mathematics teaching assistants. The other six MTAs were international teaching assistants. The Mathematics department at the University of Oklahoma assigns several tasks to MTAs such as grading exams and homework assignments, proctoring examinations, providing tutoring services to students, and teaching one or more sections of introductory mathematics courses. Because of my third criterion, my participants taught their own classes during the spring semester. Nine of the MTAs taught Math 1473- "Mathematics for Critical Thinking," Math 1503-"Introduction to Elementary Functions," Math 1523-"Elementary Functions," and Math 1643-"Pre-Calculus for Business, Life, and Social Sciences." Two of the other three taught Math 1743- "Calculus I for Business, Life, and Social Sciences." One of them taught Math 2123-"Calculus II for Business, Life and Social Sciences," which is more advanced. A summary of the class distribution chart appears in Table 3.1. There are approximately twenty five to thirty five students in each class. Students are able to enroll in Math 1743 and 2123 when they pass Math 1503, 1523, or 1643. MTAs teaching Math 1473 make their own teaching plan and all exams. The mathematics department provides uniform

exams and a common study guide including a schedule of the class and similar problems for tests in Math 1503, 1523 and 1643. Therefore, in general, MTAs teaching Math 1503, 1523 and 1643 teach their class based on the study guide. MTAs who teach Math 1743 and 2123 make their own teaching plan. However, the Mathematics department provides recommended homework assignments based on the uniform exams.

The number of MTAs	1473	1503	1523	1643	1743	2123	Total
U.S. domestic MTAs	1	2	1	0	2	0	6
IMTAs	0	0	2	3	0	1	6

Table 3.1 – The number of U.S. domestics MTAs vs. IMTAs

The Six U.S. Domestic MTAs

There were two females and four males. Two of the U.S. domestic MTAs were from 19 to 24, three of them were from 25 to 29, and the other was from 30 to 34. Two of the U.S. domestic MTAs have taught two semesters, two of them have taught five semesters, and the others have taught over five semesters at the

University of Oklahoma. Four of the U.S. domestic MTAs graduated from high school out of Oklahoma, and the others graduated from high school in Oklahoma. Five of the U.S domestic MTAs were granted their bachelors' degrees at the University of Oklahoma. Only one of them graduated from a Midwestern university in America. U.S. domestic MTAs are normally assigned to teach classes from the first year without passing any exams. For the six U.S. domestic MTAs, one teaches Math 1473, two of them teach Math 1503, one of them teaches 1523, and two of them teach 1743. A summary follows with Table 3.2.

Name	Nationality	Gender	Range of Age	Region of High School	Region of University	Degree	Class	Teaching experiences at OU (semesters)
Sam	American	M	19-24	Out of OK	Out of OK	Ph.D.	1503	2
Tony	American	M	30-34	OK	OU	Ph.D.	1743	More than 5
Brian	American	M	25-29	Out of OK	OU	Ph.D.	1743	More than 5
David	American	M	25-29	OK	OU	Ph.D.	1473	5
Alley	American	W	25-29	Out of OK	OU	Ph.D.	1523	5
Jane	American	W	19-24	Out of OK	OU	Ph.D.	1503	2

Table 3.2 – The six U.S. domestic MTAs

The Six IMTAs

There was one female and five males for my IMTA participants. Two of the six IMTAs were from 25 to 29 years old, two of them were from 30 to 34, and the others were over 35. The nationalities were diverse: a Japanese, a Turkish, a Nepali, a Chinese, and two Indians. Only one of the IMTAs has taught five semesters, and the others have taught over five semesters at the University of Oklahoma. The six IMTAs graduated from high school in their home countries. Five of them were granted bachelors' degrees in their countries. Only one of them was granted a bachelor's at a university in Oklahoma. In contrast to the U.S. domestic MTAs, the IMTAs are only able to teach after they fully pass English qualifying exams, which consist of speaking, teaching, and writing at the University of Oklahoma. Five of the IMTAs were qualified to teach their own class because of passing the three English qualifying exams. The other was qualified to teach his or her class without passing the English qualifying exams because he or she graduated from a university in Oklahoma. Two of the six IMTAs teach Math 1523, three of them teach Math 1643, and one of them teaches Math 2123. A summary appears in Table 3.3.

Name	National ity	Gend er	Range of Age	Region of High School	Region of University	Degree	Class	Teaching experiences at OU (semesters)
Brown	Japan	M	Over 40	Japan	OK in the U.S.	Ph.D.	1643	5
Griffin	Turkey	M	30-34	Turkey	Turkey	Ph.D.	2123	More than 5
Paul	India	M	25-29	India	India	Ph.D.	1643	More than 5
Daniel	India	M	25-29	India	India	Ph.D.	1643	More than 5
Jason	Nepal	M	35-39	Nepal	Nepal	Ph.D.	1523	More than 5
Kelly	China	W	30-34	China	China	Ph.D.	1523	1

Table 3.3 – The six IMTAs

3.4 Data Collection

Through triangulation (Creswell, 2007, p.209), I collected data using three instruments: an observation, questionnaire, and interview with a digital voice recorder. From three instruments, I gathered the data with the following procedures: 1) observations and making condensed field notes and expanded field notes 2) close-ended questionnaires 3) interviews with my participants with a digital recorder and transcripts of the digital voice recorder. I conducted the data collection the data by these procedures considering that the interview questions often influence my participants' teaching.

First, I observed my participants' classes for one class period as a non-participant (Creswell, 2007) in the physical science building during the spring semester in 2010 at the University of Oklahoma. Before observing their classes, I made appointments with them to attend their classes by email or in person. I did not participate in their class and made condensed field notes. For example, I sat down at the end corner of each classroom like a student because I tried to observe my participants' classes without students' and my participants' attention. During the observations, I focused on observing each itinerary, what kinds of practices they used, how they explained the definitions and introduced the concepts, how they used the class material, what kinds of activities their students do, and how they interacted with their students. Even though I found out their beliefs through the questionnaire and interview in the last period of my data collection, I also had an opportunity to come across their beliefs during the observation. Thus, I tried to guess what their beliefs are based on their teaching practices because I wanted to know the relationship between beliefs and teaching practices later.

I conducted data gathering from the questionnaires and then interviews in my office or their offices. The total time of the questionnaire (less than 15 minutes) and interview (less than 45 minutes) was less than one hour. I provided the questionnaire first because my participants were able to readily think about their teaching practices and beliefs before the interview. The questionnaire had 28 close-ended questions that consist of their background information, practices, and beliefs. Ten questions about background information asked for gender, age,

nationalities, major, teaching class this semester, and teaching experiences at the University of Oklahoma. From 7 questions about teaching practices, I would find out their preferences and tendencies. The last 11 questions on the questionnaire focused on my participants' beliefs about mathematics and student learning.

The interview was semi-structured with 12 open-ended questions with a digital voice recorder. When I met each participant to do the interview, we exchanged greetings and sat down. I gave a questionnaire for my participants to fill out. While my participants worked on the questionnaire, I made preparations for the interviews, such as setting a recorder and recalling the questions. If they had questions about the questionnaire, I answered them. Before starting the interview, I always introduced my research title and questions to my participants even though they already knew them. In addition, I let them know that they are able to decline to answer any of the questions. The interview questions were six questions about their teaching practices and six questions about beliefs. I took notes in shorthand during the interviews. In addition, I did appropriate reaction and follow-up probing questions to elaborate meanings of their responses. When my participants took time to think about their answers, I patiently waited for it. If they needed simple examples for a question, I gave examples to help them to come up their ideas. I did react to their answers with words such as "okay," "aha," "good," and "oh." Most participants' answers were long and went into detail because of our good relationships and my position as an MTA. The six questions of the teaching practices asked about their teaching practices and beliefs about

teaching such as “What kinds of activities do your students usually have in your class?” and “What kinds of teaching practices are the most efficient for your students to learn mathematics?” The other questions asked about my participants’ beliefs about mathematics and student learning and about their instructional goals of their classes. When I asked for their beliefs about mathematics, I also asked about their view of Calculus because they teach introductory level courses which are related to Calculus. To get information about my participants’ consistent beliefs, some of the questionnaire’s and interview’s questions are similar domains of practices and beliefs. For example, by asking the participants to rate their agreement with the statement, “Learning to think is more important than acquiring practical skills?” on the questionnaire, and by asking, “What are the important abilities that students should have in order to learn mathematics?” in the interview, I was able to get more reasonable information about my participants’ beliefs about student learning in mathematics. All interviewees were active because they actively participated in my research as my peers and were interested in other participants’ practices and beliefs to improve their teaching. I set up my recorder which was not in plain sight because I believe that my participants would feel more comfortable doing the interviews. After each interview, I transcribed the digital voice recorder immediately.

3.5 Data Analysis

This study was conducted with the intent to find patterns in order to find salient themes as inductive analysis (Le Compte & Preissle, 1993). I used inductive analysis (Le Compte & Preissle, 1993) because I could find differentiations through categories in terms of beliefs and teaching practices based on the MTAs' activities in class. I established four units of analysis based on several researchers' classifications of beliefs: beliefs about teaching, student learning, students, and mathematics (Cooney, 2003; Cooney, 1998; Cross, 2009; Ernest, 1989, Speer, 2005, 2008; and Thompson, 1992). In addition, the MTAs' teaching practices were analyzed by ten categories based on MTAs' activities in class. I saved all data, which are expanded field notes from the observations, transcripts from interviews, and questionnaires into NVIVO 8, software for analysis. Based on the strategy of Miles & Huberman (1994), I constantly read & re-read the expanded field notes, transcripts from interviews, and questionnaires.

First of all, I categorized each expanded field note in terms of the MTAs' activities in class and put codes to find the MTAs' patterns about teaching practices using NVIVO 8. I combined and reduced the codes as I continued reading & re-reading the data. I analyzed differences in teaching practices between two groups based on ten categories which were gained by combining and reducing the codes. From the transcripts through interviews, the MTAs' beliefs were classified by four categorizations which are beliefs about teaching, student

learning, students, and mathematics (Cooney, 2003; Cooney, 1998; Cross, 2009; Ernest, 1989, Speer, 2005, 2008; and Thompson, 1992). I put codes based on the MTAs' beliefs and then reduced and combined the codes. The questionnaires supported to reduce and modify the codes of the transcripts of interviews and expanded field notes. I identified tentative codes from the database and reduced and combined the codes as I continued reading & re-reading my database. According to my reflections from the thoughts presented in the database, I formed initial categories with the labels or codes. Repeatedly, I read the expanded field notes, transcripts and questionnaires to refine and modify the categories. In addition, I looked for various evidences from the database to support the categories. Through combining and refining the categories, I found several themes, which helped me to clearly find the differences in beliefs and teaching practices between two groups. Thus, I could establish relationships between MTAs' beliefs and teaching practices according to the themes.

3.7 Trustworthiness

As I was just one researcher, there were several concerns about validity for this study. I was concerned with the accuracy of transcripts, expanded field notes and my interpretations of the data. In addition, there were possibilities that my participants would provide answers which I preferred during the interviews because of pre-establish relationships. To solve these validity threats, I provided

the findings from the data to each participant for them to check. In addition, based on a good data triangulation such as observations, questionnaires, and interviews, I checked that the participants' statements were consistent in their teaching in class. My peers in a research methods class reviewed the data from the expanded field notes, transcripts of interviews as a "peer review."

3.8 Ethical issue

When I received the IRB consent form, I began to collect my data. To ensure the confidentiality of my participants and their data, pseudonyms were used for all subjects, and the key of the pseudonyms and names is in a locked file cabinet at my office separate from the data.

CHAPTER 4: RESULTS

In this chapter, I provide contrast between the U.S. domestic MTAs and IMTAs in terms of three classifications in beliefs and eight classifications in teaching practices. All classifications have hierarchical organizations. First, I provide the differences between the U.S. domestic MTAs and IMTAs in beliefs about teaching, student learning, and mathematics. Second, I show the differences between two groups regarding ten classifications of their teaching practices. While I put codes on the transcripts and expanded field notes, I found the eight

classifications of teaching practices which come from the MTAs' common activities in their classes. Third, I provide the relationships between MTAs' beliefs and their teaching practices. From the relationships, we can see how MTAs' four categories of beliefs influence their teaching practices in class. In addition, it presents consistence and inconsistence between MTAs' beliefs and teaching practices.

4.1 Beliefs

Several researchers (Cooney, 2003; Cooney, 1998; Cross, 2009; Ernest, 1989, Speer, 2005, 2008; and Thompson, 1992) suggest that beliefs are classified by teaching, student learning, students, and mathematics. I also classify my database based on the four classifications at first. While I analyzed my data base, I subtracted beliefs about students because of ambiguous categories between beliefs about students and student learning from my data base. Therefore, I provide the differences between the U.S domestic MTAs and IMTAs in beliefs about teaching, student learning, and mathematics. Through my databases, each belief has a hierarchical organization. For example, each top-level belief has several low-level beliefs.

4.1.1 Beliefs about Teaching

Under beliefs about teaching, I classified four middle-level topics such as important aspects of teaching mathematics, the most efficient teaching practices, MTAs' roles, and instructional goals based on interview questions.

Important Aspects of Teaching Mathematics

Even though the U.S. domestic MTAs had all different aspects of teaching mathematics, most them were related to how to help students solve problems and motivation such as explaining lessons' goals and reasons, approaching visual methods, explaining concepts by repetition (Figure 4.1.) On the other hand, IMTAs' aspects focused on teachers' abilities, which are their knowledge of mathematics and pedagogy, their preparations, how to help students understand lessons, and motivation for students to be interested in mathematics (Figure 4.2.) The IMTAs believed that teachers' abilities and preparations were more important for effective teaching mathematics than the U.S. domestic MTAs because of their cultural differences of aspects of teachers' abilities and preparations. In addition, the IMTAs had the view that teachers were tough and strict, had strong knowledge of mathematics, and were respected by students:

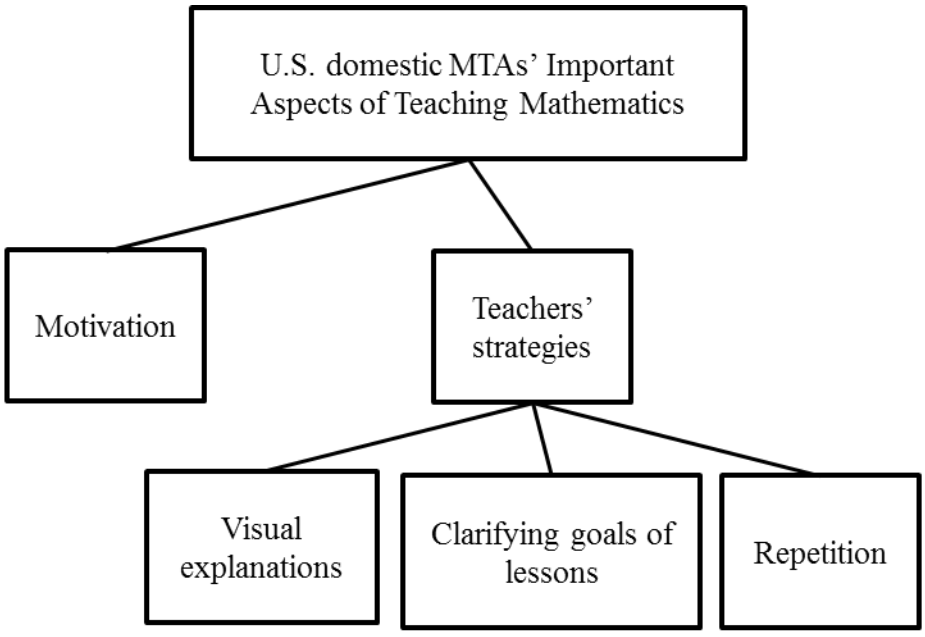


Figure 4.1 - U.S. domestic MTAs' Important Aspects of Teaching Mathematics

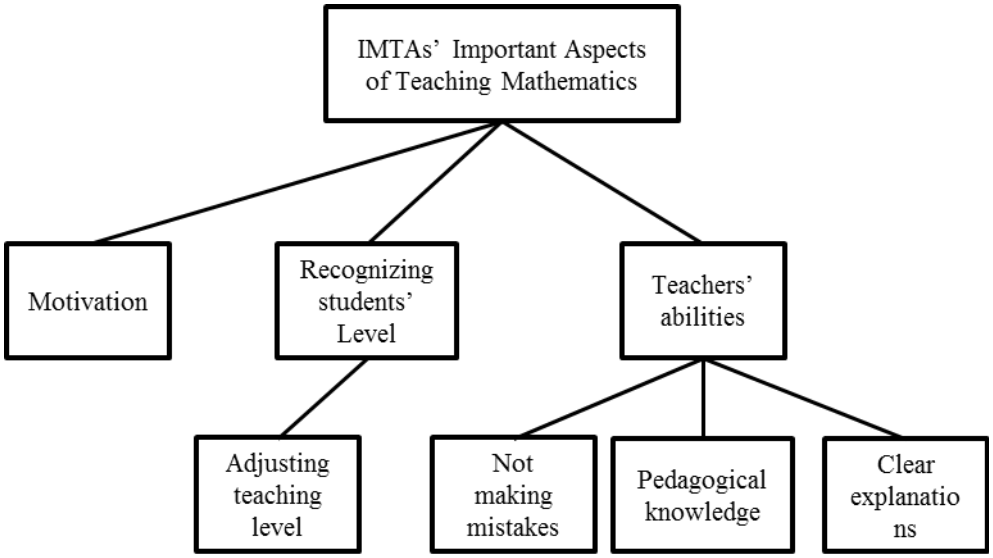


Figure 4.2 - IMTAs' important aspects of teaching mathematics

Paul: In India, teachers are tough, strict and very serious. You can't drink coffee and coke in class. Students can't work during class actual time period. Those kinds' things can't possible in India. In contrast, all those things are possible here. You don't try to strictly say to your students who talk each other during class here. In India and China, they are going to keep quiet because teacher will say something strictly. [2.3.10.204-208]

Daniel: I think that is very important that you should respect teachers and students. They should be like mutual aspect of teachers and students. Here I don't see that. Teachers don't really have any freedom they cannot say anything to the students. Students just don't respect teachers that much. Especially, if you are an international MTA, I am sure they don't care. [2.4.6.136-2.4.7.139]

Thus, the IMTAs believed that teachers' abilities and preparations strongly influenced teaching mathematics.

Although both groups had similar views on how to help students understand mathematics, we can still see differences between them. The IMTAs' views about helping students understanding primarily recognized students' level. However, the several U.S. domestic MTAs believed that they encouraged students to learn mathematics through clear explanations of why mathematical ideas were needed,

why these problems were important, and why mathematics was useful. Here is an interview quotation about the U.S. domestic MTAs' views about motivation:

David: I think the most important is trying to explain…um…why these processes are important. And exactly how they evolved more because I can teach the processes and I can actually teach you how to just use technology to figure it out. But if you don't know why it's important, then you uh…you probably won't remember it. And you probably…kind of what I'm trying to teach them is not really how to solve problems…even though that's what I'm doing. But, like, later on in life…when they…they have a real life problem…like…they need to use math so, they usually remember, like…they know, like, how to…or, like, what to look up…to find…the solution to the problem. [1.5.7.253-262]

David believed that it was important for students to understand why mathematics was valuable to motivate them to learn mathematics.

On the other hands, the IMTAs believed that students would be motivated by asking questions and providing problems during class. The IMTAs believed that instructors motivated their students through asking simple questions and providing several problems. In addition, Jason of the IMTAs believed that

instructors also motivated their students to learn mathematics using real life examples:

> Paul: For Pre-Calculus, you need to motivate students to understand subjects and should help them. And many of them you should give them challenging questions. [2.3.5.93-94]
>
> Brown: Interesting mathematics. Also, I have to motivate them to work on mathematical problems. [2.1.3.79]
>
> Jason: At the least, if they feel something, they are learning then they will encourage them to solve some problems. In addition, real life problems often help them. [2.5.3.59-61]

Teaching Assistants' Roles

The four out of six U.S. domestic MTAs believed that they answered students' questions, taught lessons, and graded students' class work as primary instructors (Figure 4.3.)

> Alley: Um…I don't really think of myself as a teaching assistant. I pretty much am the teacher…in 1523. So…you know, as far as that goes, the only thing is I've got my lesson planned stuff for me. For the most part…I am the

person they're going to interact with them, so I try and act like that. I take it very seriously. [1.2.5.167-174]

Tony: I view myself just like a teacher. Do answer questions, I feel like I understand and I feel well enough, they answer any questions they have. That is why a teacher is. A person who is able to answer all kinds of questions and they can guide a class. I go there and guide a class in a lecture and answering questions. [1.3.3.54-57]

Brian: Like, not as a T.A. Because, they…nobody else teaches them. You know, I teach every day. I could…I imagine it would be a little different in a calculus discussion section or something like that. Um…although, I do like them know that I'm not…uh, don't write the exams…and that…I don't set the course policies and everything like that. Um, so that respected…um…that's more of a…T.A. type role. But for the most part, the way that I…uh…that I teach and the way that I…grade class work and then conduct class on a day to day basis is…like the...the primary instructor. [1.4.7.263-1.4.8.268]

Thus, the four U.S. domestic MTAs believed that they taught classes as the primary instructor. Two of them thought their roles were to help their students through providing information and helping problem solving as much as the students want.

David: Like, showing them how…what they need to look at. And…I need to be able to…like, see when they're…how they do things wrong…and correct them. And the more…that I've been doing is…I…I'm starting to learn…how people mess up. Like, what are common errors. And…I can fix them. But, like, before…they…happen…where I can be ready for them. And like, let them happen…and…try to see if the student can learn from them. Like, show them the way…and help them when they…mess up. So, making sure that they…are working…on it…to…not like…I'm just doing…everything for them. [1.5.5.169-1.5.6.215]

Jane: I think that my role is to present the material as best I can and help them as much as they want. I don't think I can… I mean I try to motivate them. So I want to help them achieve whatever they want to achieve. [1.6.3.47-49]

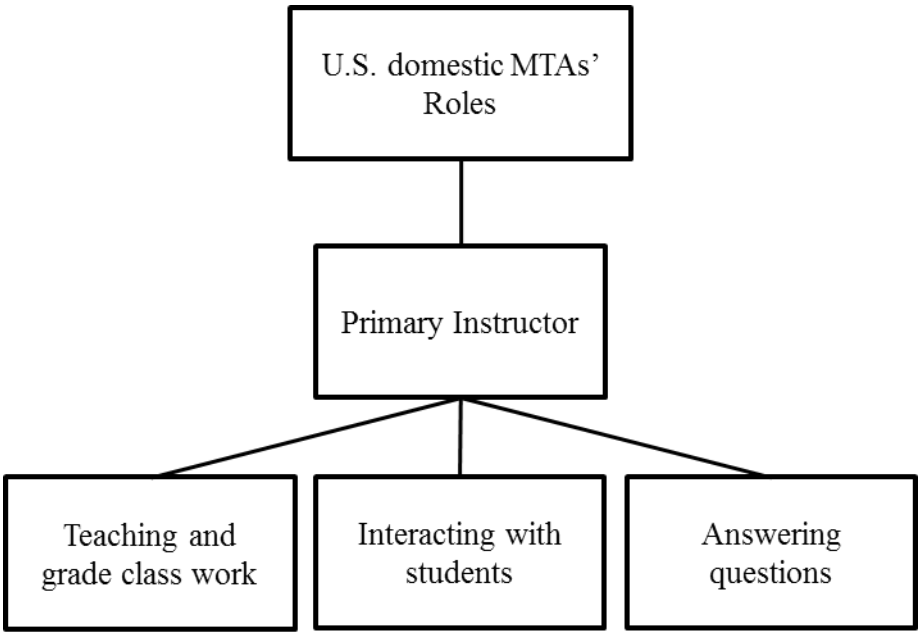


Figure 4.3 - U.S. domestic MTAs' roles

On the other hand, most IMTAs believed that their roles were to help students to learn mathematics. To help students, the IMTAs mentioned making materials easier by their own, sharing knowledge, and preparing exams for students (Figure 4.4.) Even though the IMTAs had their own teaching class, they believed that they were helpers for their students, not instructors.

Paul: My role is to help students. Helping them and then they have to get good grades. Only way to do this is to get exposed problems. Only way gives problems, give them work extra problems. [2.3.4.74-76]

Jason: Because my children, they are exactly same age. And I am there, not just for their instructor, not just as instructor, as their parents. I want to show I am one of them. I am there not just for my personal benefit, and just to be there help them. That is my intention. [2.5.5.110-113]

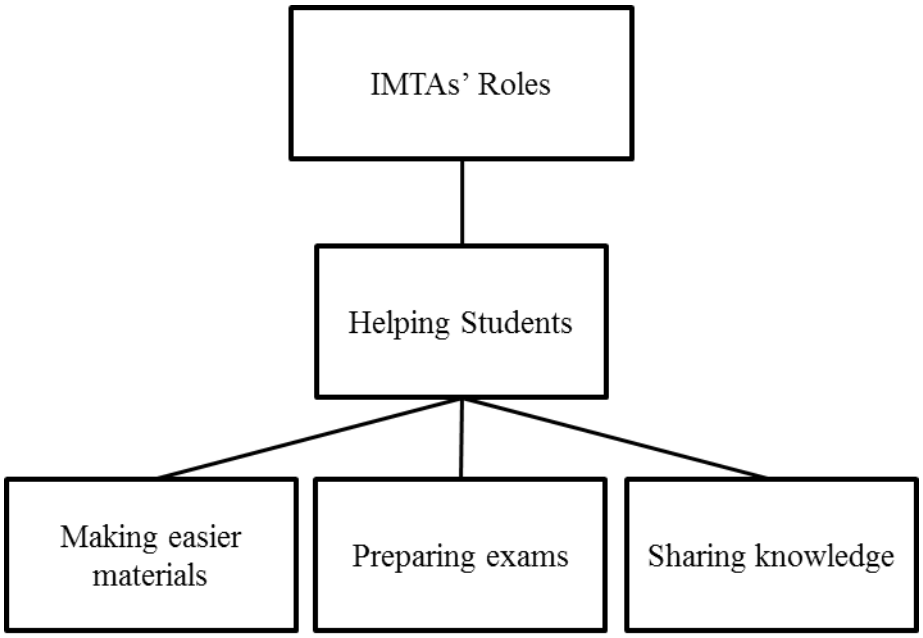


Figure 4.4 - IMTAs' Roles

The most Efficient Teaching Practices

The majority of the IMTAs considered that the most efficient teaching practice was clear explanation of materials by their own teaching methods because of the IMTAs' beliefs about student leaning, which is if students

understood concepts, students could solve all kinds of problems. They believed that using visual and algebraic explanations would help their students understand concepts: I quote two IMTAs' interviews and show Figure 4.5.

Daniel: I believe that if they really understand concepts, they can do any kind of problems. I also give them … using a calculator all day. I spend a lot of time making sure they understand what is happening. [2.4.3.62-64]

Jason: My idea is that I do not just solve problems but also give some definitions and something which is in my own ways. [2.5.1.4-6]

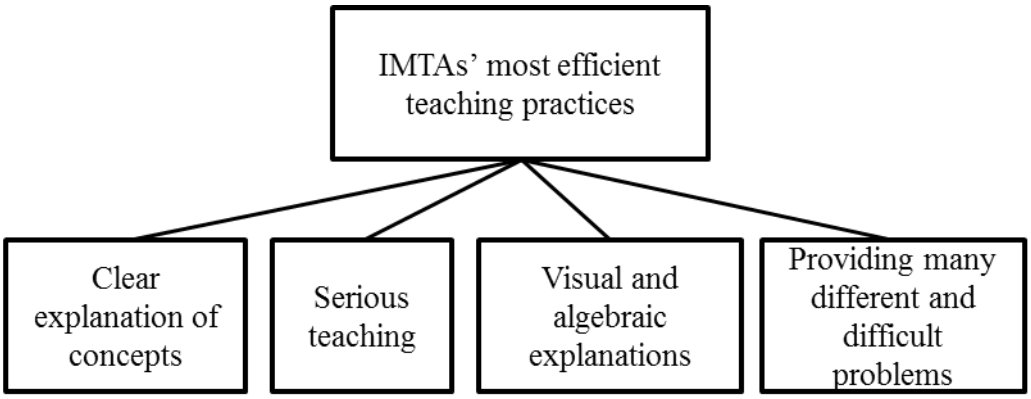


Figure 4.5 - IMTAs' most efficient teaching practices

The other IMTAs thought that exposing students to many different and difficult problems were effective teaching practices.

On the other hand, most U.S. domestic MTAs emphasized doing problems by repetition to learn the procedures for students. They gave homework problems and quizzes for students to have time to work problems on their own by repetition. Therefore, the IMTAs considered clear explanations of concepts for student more than the U.S. domestic MTAs. By contrast, the U.S. domestic MTAs provided many problems such as homework and quizzes by repetition to teach pattern recognition:

David: Um…I think they need to…like…do the problems a lot. They need some repetition to…actually…um…cause they kind of learn the processing…like, doing it once or twice. But they do it…few more times, so actually start…figuring out…why these things are happening. So…um…a lot of the times, like the homework problems…there will be similar problems on the quiz. So they'll do it, the homework problems…they'll do…do it, like, three or four times on homework…and then they'll do it again on the quiz…and I'll grade the quiz and see that…they're messing up or they're doing well. [1.5.4.137-145]

Alley: It's mostly repetition. You just got to keep practicing, keep doing examples, keep doing homework problems. And…hopefully by then, they'll…and there's a lot to memorize, of course. And the only way you're

going to remember it all is if you just keep using it and doing it and using it and doing it. [1.2.4.135-138]

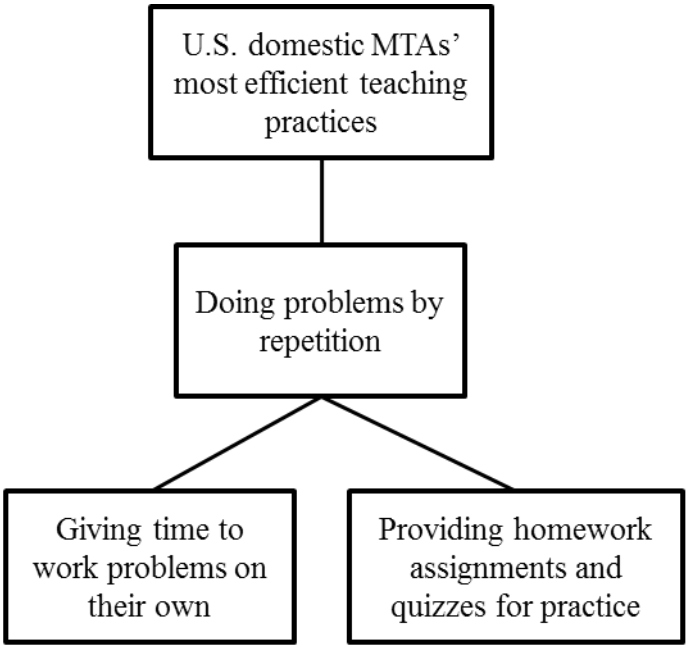


Figure 4.6 - U.S. domestic MTAs' most efficient teaching practices

The Instructional Goals

The U.S. domestic MTAs and IMTAs had similar top instructional goals: making their students understand lessons, and do well on exams. However, their next prior instructional goals were different. The IMTAs' next prior goal was to motivate their students to get into mathematics.

Daniel: My goal would be to get more people into mathematics. I want to motivate students to get into math. That is my only goal. I know a lot of people are not interested in math. You get a good math only after you finish a lot of classes. I want to motivate a lot of students to get into mathematics. That is my goal. [2.4.5.107-110]

By contrast, the U.S. domestic MTAs' next prior goals were to provide the best opportunities to learn mathematics and help prepare their students for upper level classes, such as Calculus I or Business Calculus.

Alley: the goal is to…get them prepared for going into Calculus, cause it's Pre-Cal. So…um, there's a large topic that they need to have seen before they go into Calculus cause Calculus assumes that they have seen it all before or that they have interacted with this stuff before. [1.2.9.316-318]

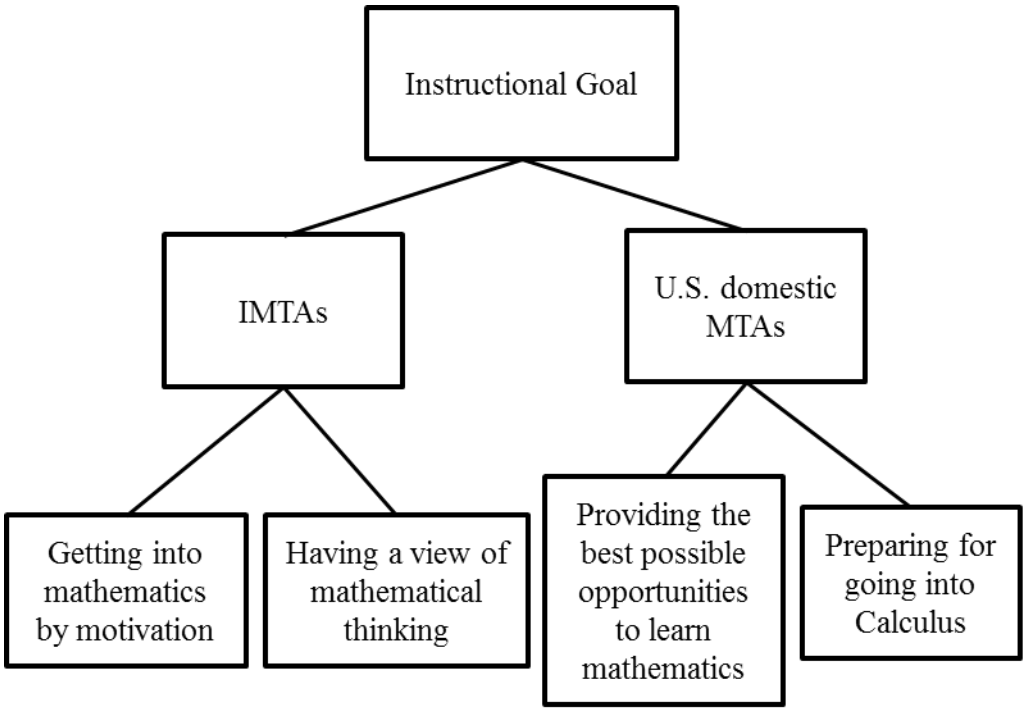


Figure 4.7 – Instructional Goal

4.1.2 Beliefs about Student Learning

According to the interview questions, these beliefs are classified by three low-level categories: the important abilities needed for students to learn mathematics, all students can learn mathematics, and requirements of students to learn mathematics.

The Important Abilities Needed for Students to Learn Mathematics

Both groups had many common beliefs about the important abilities

students needed. They believed that students needed curiosity, logical thinking, patience, diligence, dedication, and paying attention in class to learn mathematics. There was only one addition according to the two U.S. domestic MTAs, who believed that pattern recognition was an important ability to learn mathematics:

David: I give it to them…the exact same problem with a little bit different numbers and maybe a little bit different words. Like, instead of using…like, if we're doing…talking with probability…and they know how to do it…with, like, cards…blind cards, and if I switch it to…like, sandwiches or something like Fritos…and they, uh…they just…are stumped. And they don't…they don't see the connection between these problems. Even though that they are just different words…and they're different numbers. [1.5.11.395-401]

Jane: A lot of times students see a problem they should know how to do, but there is something slightly different about it. They'll think that they don't know how to do it when really they do, but they just get stuck on this one little part that's different. What I think that is really important is learning to look fast that and view what the question actually is and recognizing that they really do know how to do it. [1.6.5.105-110]

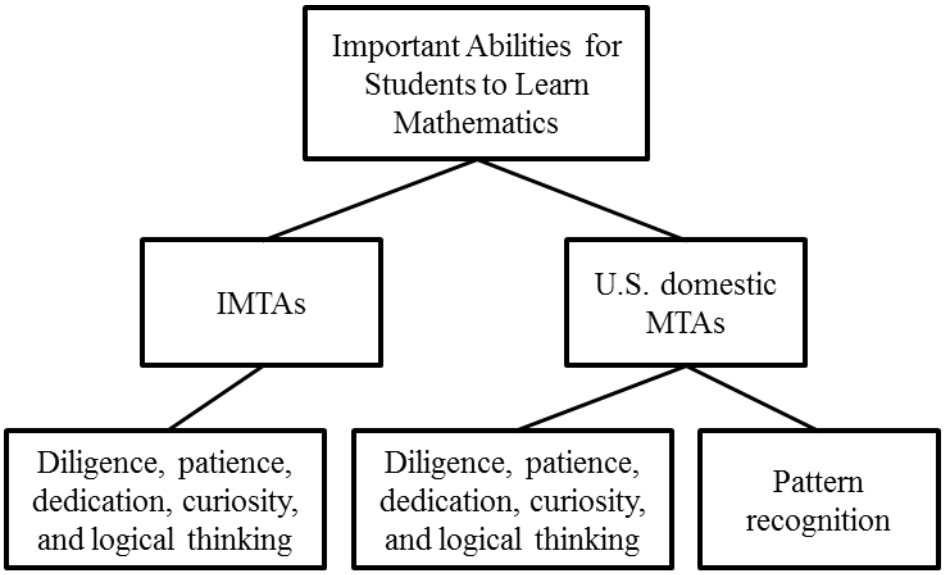


Figure 4.8 - Important abilities for students to learn mathematics

All Students Can Learn Mathematics

Both had similar beliefs under this step. Most U.S domestic MTAs and IMTAs believed that several students could not learn mathematics because of their attitude toward learning mathematics. They mentioned that some students did not attend the class with diverse excuses and did not make effort to learn mathematics:

Sam: All of my students? I can't think…say all are learning math. I mean…there are some people who just don't go to class. That. Not everyone…I prepare my lectures to be clear. I try everything. But if the

students have poor attitudes, I can't do anything about that really. They are adults now, you know. They're not children. So, it's hard. But I think…the people who try, I think they do get a lot of it. People come to office hours. But, if students don't try, nothing you can do. It's hard. [1.1.14.496-516]

Jane: I think the ones that don't want to are not. I think that they are…you know, if they come to class, they are learning. But so much of the learning takes place outside of the classroom. So, I think that the ones that want to are learning and I think that the ones that don't care are probably not. [1.6.6.114-118]

Daniel: I don't think so. Most of them, there are force to take a lot math classes. They don't really need it. Motivation factor is very important. But there are not many motivated students in the class. [2.4.6.123-126]

A few IMTAs and U.S. domestic MTAs believed that all students could learn mathematics because their students learned something new even if they did not have good grades. These MTAs assumed that all students attended their classes and believed that all students learned some logical thinking and saw that mathematics is useful through their class at least.

Alley: I think most of them are at least learning…some math. Whether or not they remember it later is not necessarily an important thing, but…it's that they've seen it, they've seen how this works, and then…they've played around with it a little bit. [1.2.12.455-463]

Brown: I think they learned much, although they could not do well on the exams. Still I think they are involving in mathematics learning. So, most students are learning mathematics. [2.1.5.127-129]

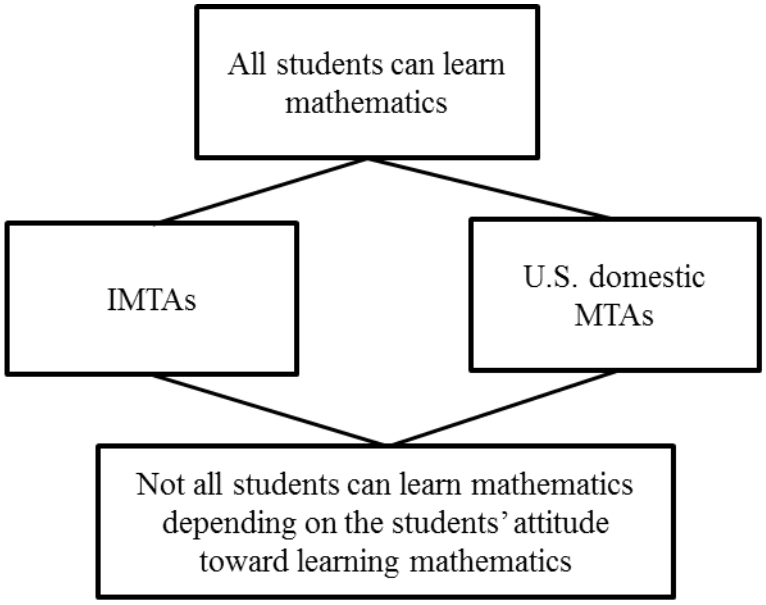


Figure 4.9 - All students can learn mathematics

Requirements of Students to Learn Mathematics

I examined the differences in requirements of students' attitudes about mathematics in the two groups. Most IMTAs required that their students had a positive attitude toward learning mathematics and concentrated on their lecture. The U.S. domestic MTAs required the same things (see Figure 4.10). Here are two interviews to show that the IMTAs wanted their students to have a positive attitude toward mathematics and to attend the IMTAs' classes to learn the materials:

> Paul: So what I want them to do is have open mind about math. I don't want them to be judgmental about it. I just want them to have open mind about it. try to concentrate on class and try to learn into the best their abilities. I will try to make sure that I have them understand. [2.3.8.156-159]

> Brown: I want them to be very very positive attitude to lean mathematics. At least, attending class and doing homework assignments are minimal. I mean the least things I like them to do. Many people don't. I like them to be more positive. [2.1.4.108-110]

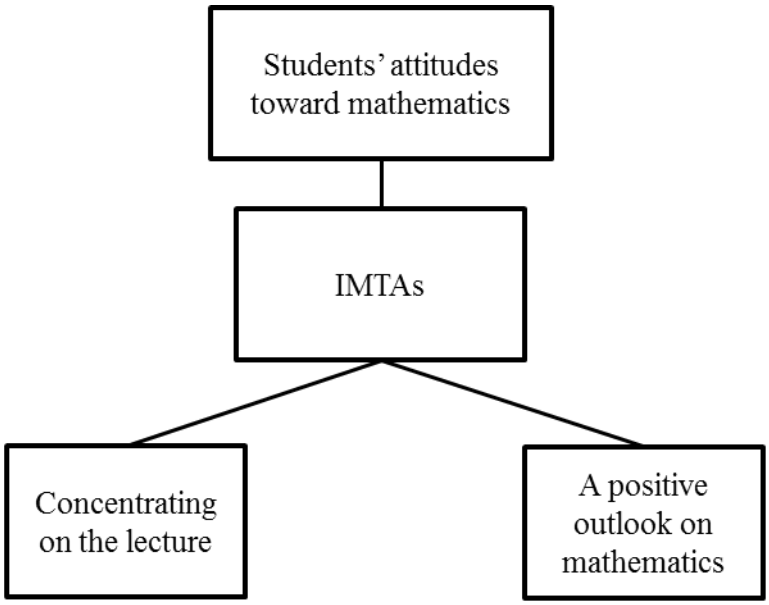


Figure 4.10 - Students' attitudes about mathematics (IMTAs)

One the other hand, the U.S. domestic MTAs added a desire for their students to realize that mathematics is useful and valuable:

> Jane: I want them to see that it is valuable whether they are interested in it or not. And even if they are going into writing, recognizing that even though math is not going to be foundational to what they do, it's foundational to the way that most the world work. I don't like the attitude of math is pointless. Math is useless. And that's what I don't want them to have. They don't have to love it but I want them to see that it is useful. [1.6.5.97-101]

Brian: I want them to…um…realize and be able to acknowledge…um…that…all this stuff that they were doing is for a purpose. And I want them to realize that…it's something that they can…and will probably have to use it some point if they end up going into…um…whether it is business or accounting or…or anything in general. [1.4.12.428-432]

David: it took us a long time to figure all this stuff out…and that's why it's hard…and that's why I want you to learn math…it's not like…really simply, you have to work at it…because it took us years…like…thousands…years…to figure stuff out. So…I just want them to realize that it's…um…important…and that people…have looked at it to…understand it, and…that it's worthwhile to…understand…[1.5.10.375-379]

In addition, the U.S. domestic MTAs wanted their students to respect them just like any other teacher, unlike the IMTAs:

Alley: Um…well, I expect the same respect out of them that they would give any other teacher. So…no talking, no…fooling around whenever in the back of classroom. [1.2.5.183-184]

Brian: I…I, for the most part, view myself as the…or maybe conduct myself as the…the primary instructor. Like, not…not as a T.A. Because, they…nobody else teaches them. You know, I teach every day. I could…I imagine it would be a little different in a calculus discussion section or something like that. [1.4.7.259-265]

Thus, the U.S. domestic MTAs wanted their students to realize that mathematics is practical and were more concerned about their students' respect for them than the IMTAs were as in Figure 4.11. On the other hand, the IMTAs did not consider their students' attitudes of respect for them because the IMTAs understood the different students' attitudes here as a cultural difference. Here are the two IMTAs' interviews which show their thoughts about cultural difference of students' attitudes toward respect for them:

Daniel: Um..sometimes I feel they don't really respect their teachers. It is cultural differences comparing to India or Korea. They don't really careful teachers. It does not motivate you to be like a real teacher. You would not care of that sometimes they do not respective. [2.4.6.156-158]

Paul: In India, teachers are tough, strict and very serious. You can't drink coffee and coke in class. Students can't walk at class actual time period.

Those kinds' things can't possible in India. In contrast, all those things are possible here. You can't try to strictly say to your students who talk each other during class here. In India and china, they are going to keep quiet because teacher will say something strictly. So, here are fundamental differences between U.S. culture and other cultures in politeness. It is different culture and different kind of people here. [2.3.10.204-210]

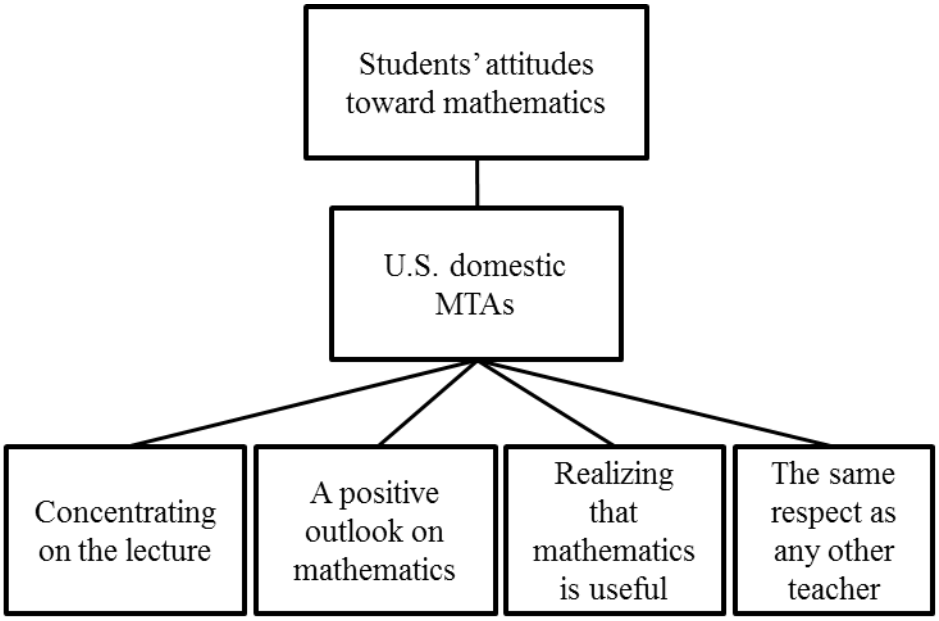


Figure 4.11 - Students' attitudes toward mathematics (U.S. domestic MTAs)

4.1.3 Beliefs about Mathematics

I classified two beliefs about calculus and advance mathematics, which is a graduate level course, under beliefs about mathematics.

Calculus

The IMTAs and U.S. domestic MTAs had the same view of Calculus as a foundation for mathematics. However, they had different views about who needs to learn Calculus. The U.S. domestic MTAs believed that Calculus is for students majoring in science, not every student. By contrast, the IMTAs suggested that everyone needed to learn Calculus up to the Calculus II-level. The IMTAs believed that Calculus basically helped students learning and understanding of other subjects as a foundation of other fields. Thus, they thought that every student needed to learn Calculus.

> Jason: Calculus is a foundation. Without Calculus, it is very difficult somebody to succeed in their particular field. That is why they understand cal. Understanding Calulus is helpful to be successful person in different field. [2.5.7.141-143]

> Paul: Calculus is one of the most basic math courses. Basic knowledge of calculus is required for all kinds of students because you should see students

in different departments trying to take calculus courses in math department. [2.3.5.100-102]

Daniel: I think calculus is a very important subject, very foundational subject. We all should at least learn to be Calculus II level. I think it is very important. [2.4.4.89-90]

However, the U.S. domestic MTAs believed that students, who are majoring in science, needed to only learn Calculus because it was a foundation for science majors.

Sam: You know, business calculus…they don't really care if they understand theory. They just have to be able to apply to the situation. So…but then, the challenges when you have them all…in, like, calculus one and calculus two…you might have, you know…pre-med majors, pre-medical school. [1.1.8.277-280]

Alley: I think it's essential for mathematician [laughs] but not necessarily to everybody in the university. [1.2.7.250]

David: I think it's…really…important for a lot of, like, engineers and scientists and stuff like that. Um…um…like, I'm…wondering…if, like, a lot of other people need it.

Jane: I think that it is very essential especially for any students going into any kind of engineering or physics or any kind of applied science at all. So I think it's very useful, necessary, and fundamental. [1.6.4.70-72]

The difference view was that several U.S. domestic MTAs believed that Calculus was a tool for science majors, but the IMTAs had the view of Calculus as a tool for all majors. (See Figure 4.12)

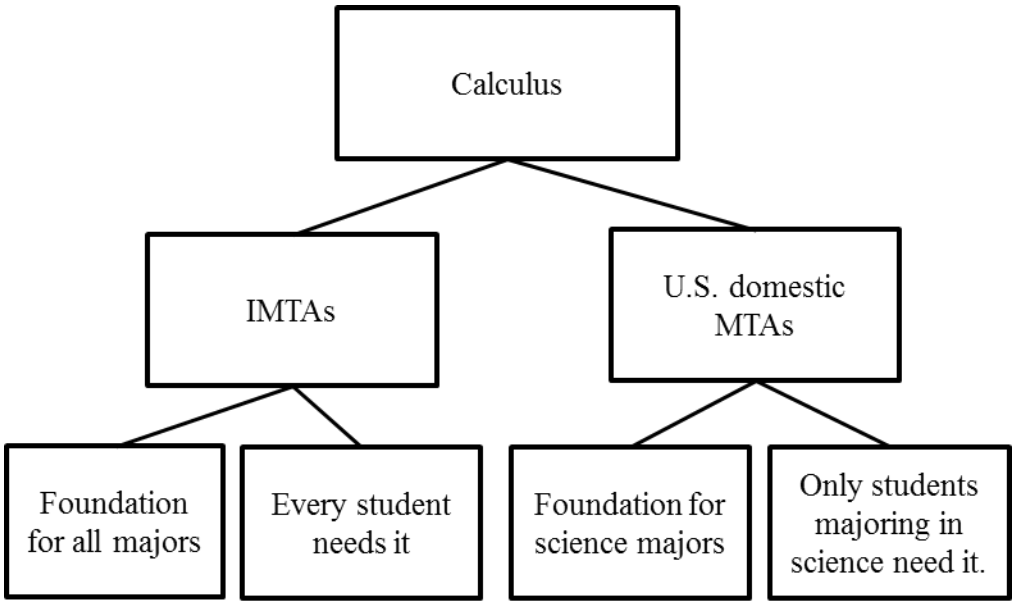


Figure 4.12 - Calculus

Advanced Mathematics

The two groups believed that Advanced Mathematics was not for everyone and is abstract. There were differences between the two groups concerning beliefs about Advanced Mathematics. Several IMTAs suggested that Advanced Mathematics was related to other subjects and a field of top on Calculus academically. They believed that the knowledge of the other advanced mathematics often helped them understand their course.

Kelly: I think it's all the mathematics…in some ways, in somehow they are related to each other. Even you have, like, topology, algebra, or analysis…that somehow they can be related to each other. [2.6.7.258-260]

Griffin: My view of areas of mathematics other than calculus is things that are field on top of cal. [2.2.9.192-193]

On the other hand, according to the answer of the questionnaire (# 27), the U.S. domestic MTAs strongly believed that Advanced Mathematics encouraged critical and independent thinking compared to the IMTAs' views. In addition, the U.S. MTAs emphasized that Advanced Mathematics was valuable and important, even though it was not practical now because it was as important discipline for learning other fields and would be eventually be needed for other fields in the future. For example, even if it was a very abstract field, it would be useful for other areas, such as computer sciences, physics, and engineering science, etc. (See Figure 4.13)

Brian: I think it's very important. Um…and I always tell people, well just because there's not an immediate practical application doesn't mean that it's…not important because…most of the stuff. People didn't know…it. It

wasn't developed…to be an application. It was developed theoretically just like a lot of the stuff is now. [1.4.11.390-393]

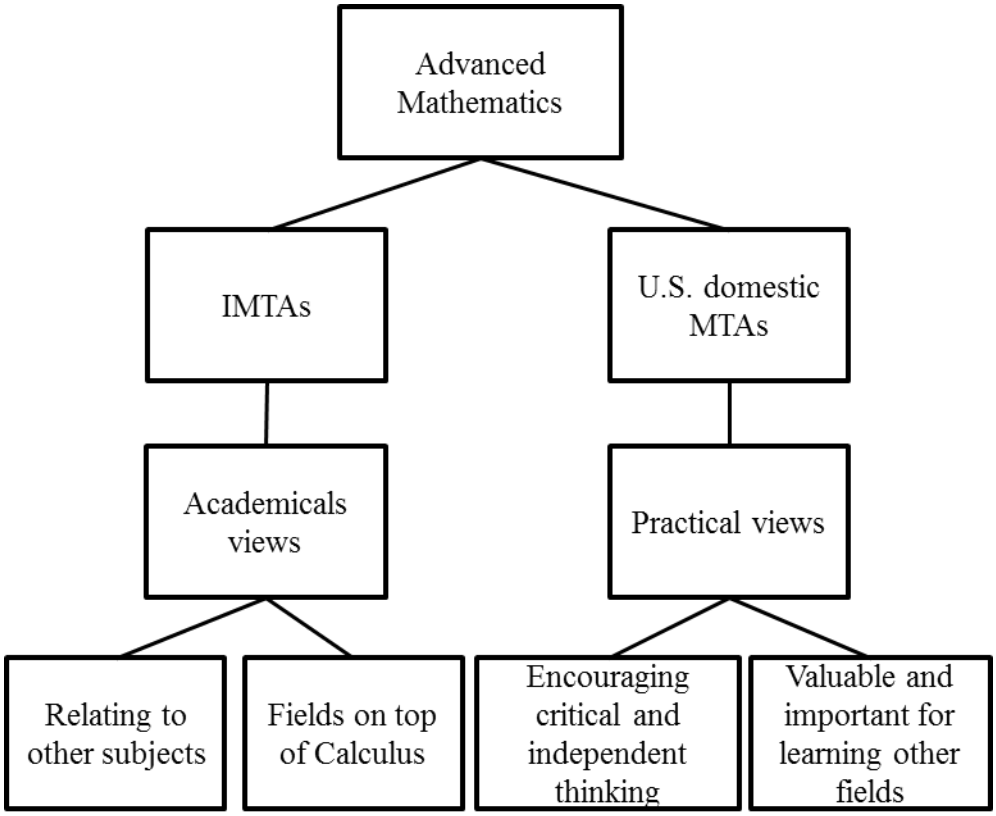


Figure 4.13 - Advanced Mathematics

4.2 Teaching Practices

I found several differences between the U.S. domestic MTAs and IMTAs in teaching practices through my expanded field notes of observation, the questionnaire, and interviews. After I classified eight categories, I investigated to find differences in teaching practices between them based on my expanded field notes. There are some differences and similarities under the eight classifications.

Teaching Organization

The IMTAs and U.S. domestic MTAs had a similar organization of teaching. The difference was only the location of the quiz in the order. The IMTAs believed that providing a quiz at the end of class was more beneficial than providing a quiz at the beginning of class because students tried to pay attention to their lecture and were able to review lessons. Here is a quotation from an interview:

> Paul: They know that quizzes are going to be after class. So they are listening class because I am going to ask questions from what I talk in class. They are listening at the same time they are kinds of preparing the quizzes. Which means that they go over it and stop by already talk. [2.3.9.185-188]

However, if the U.S. domestic MTAs provided a quiz, it would be at the beginning of class. They believed that taking a quiz at the beginning of class had several advantages: students could recall the last lesson and the quiz encouraged the academic atmosphere in which students were ready to pay attention to the MTAs' lecture:

> Brian: Um…some days, I do what I call practice quizzes. Um…where I start off class with a ten to fifteen minute…um…quiz I don't take up for a grade. It's just…so they can practice stuff that was in the homework and they go over the last class…And…and then after that I usually go over that problem to start off with. So it kind of reviews what we've done over the last class period. And then…start something new. [1.4.1.3-13]

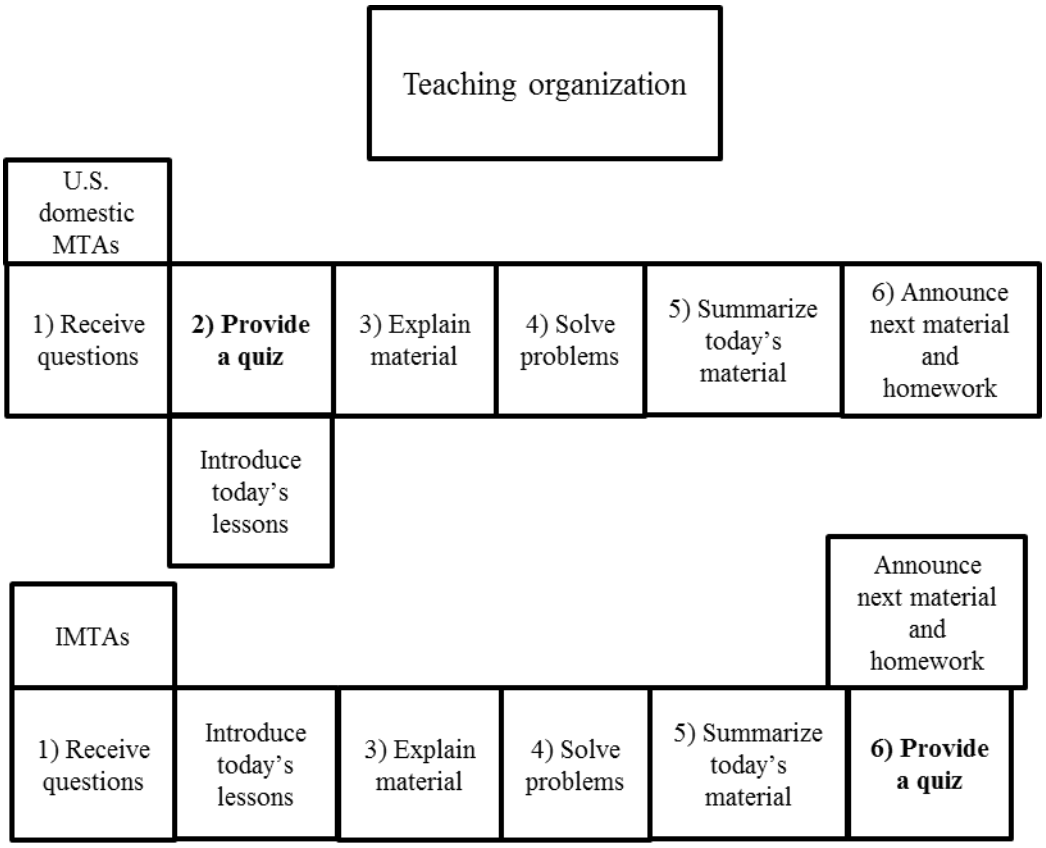


Figure 4.14 - Teaching organization

Characteristics of Explanation about the Material

According to the questionnaire (#12), all U.S. domestic MTAs answered that they used 30% of class time for explaining concepts. On the other hand, the IMTAs responded with diverse answers. Four of the six IMTAs spent over 30% of the time for explaining concepts. The other answered that they spent 10% of their class time explaining concepts.

The IMTAs focus on explanations of concepts and formulas to their students. They wrote symbolic definitions and then used problems in their own methods as a complement to help students understand the concepts. The IMTAs used many more mathematics symbols than U.S. domestic MTAs and repeat the concepts to help students understand. By contrast, U.S. domestic MTAs concentrated on motivation for students to learn the concepts through explaining why mathematical ideas were needed, why these problems were important, and why mathematics was useful through real life problems. In addition, after writing symbolic definitions, they rewrite those in plain English to help their students understand. This is the other differences at this level.

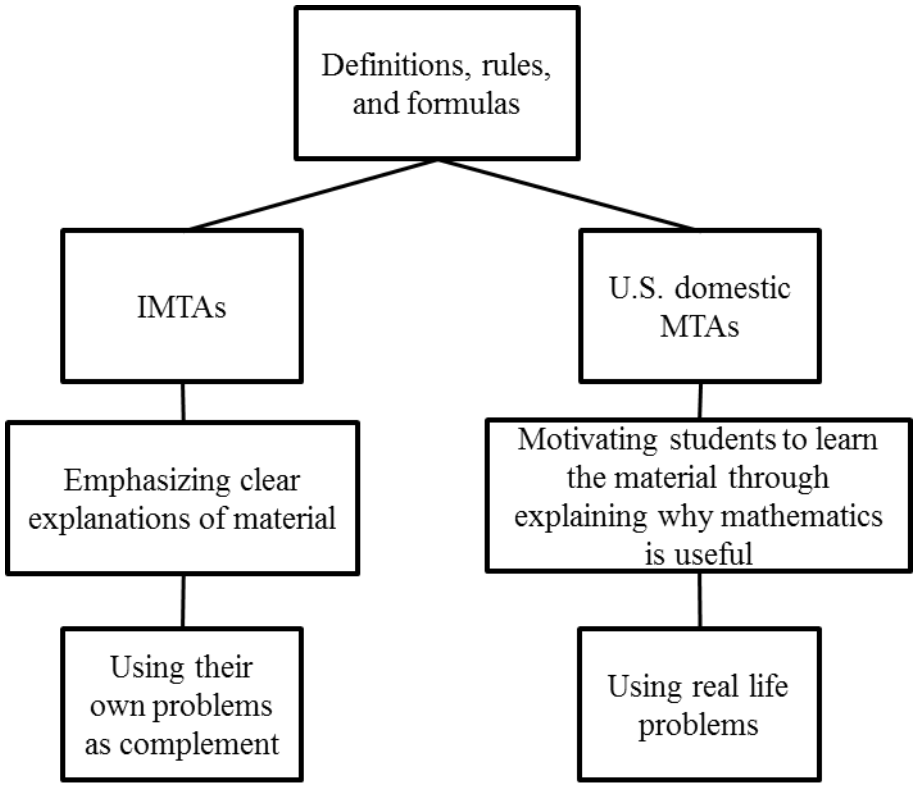


Figure 4.15 - Definitions, rules, and formulas

Characteristics of Explanation about Problem Solving

The U.S. domestic MTAs and IMTAs had similar characteristics about this. Both often used visual and algebraic methods to explain problems. Both motivated their students to pay attention to problems before solving them. In addition, they often reminded their students of prior definitions and concepts in the middle of solving problems. After finishing problems, they summarized the key points. I found some differences in teaching practices between the U.S.

domestic MTAs and IMTAs before solving problems in detail. Before solving problems, the IMTAs focused on explaining the purposes, requirements, and brief processes. On the other hand, the U.S. domestic MTAs often mentioned how it was used in real life before solving problems, unlike the IMTAs. In addition, the U.S. domestic MTAs tried to connect mathematics to real life in order to show that mathematics is useful while explaining problems. According to the questionnaire (#11), the U.S. domestic MTAs answered that they spent 70% of the class time on problem solving in their class. It indicates that the U.S. domestic MTAs were more concerned with problem solving than the IMTAs.

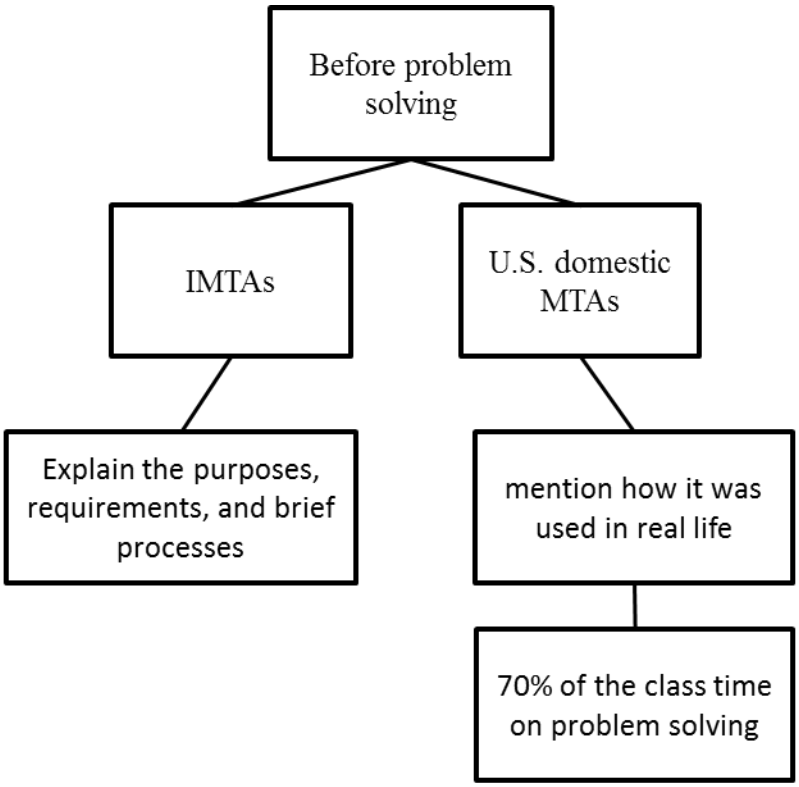


Figure 4.16 - Before problem solving

Teachers' Question Form

Both groups asked many questions but the questions' forms were different. Even though the IMTAs asked many questions that encouraged students to think about recall definitions, rules, problems or concepts, most questions were closed-ended questions to make sure their students understood. For example, "Do you understand that?", "Are you following me?", and "Do you have any questions?" Thus, they often tended to not wait much time for students' responses. On the other hand, the U.S. domestic MTAs used many open questions compared with the IMTAs. For instance, "How would you apply this definition and formula?" and "What does the problem want?"

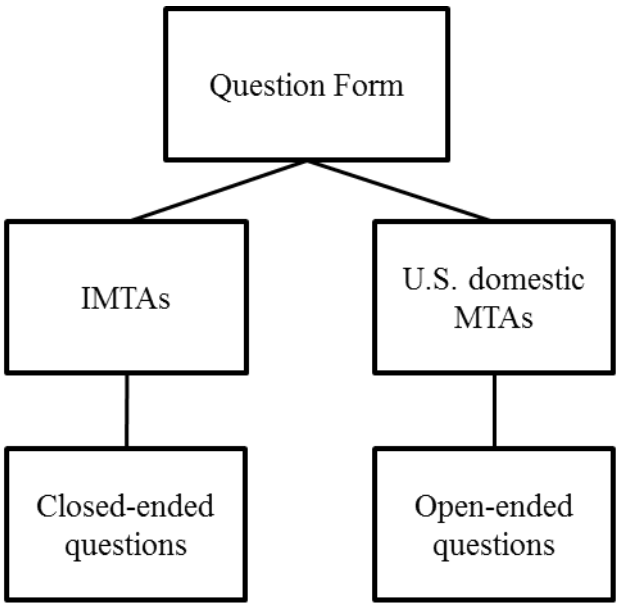


Figure 4.17 - Question Form

Responses to Students' Questions

Both groups responded to their students' questions with pictures and easier words on their own methods. The difference was that the U.S. domestic MTAs asked "How do you get it?" or "How come?" to students after listening to their answers. The U.S. domestic MTAs often provided opportunities for students to think about the material again through the MTAs' follow-up questions. According to the questionnaire (#14), it supports the U.S. domestic MTAs' responses about students' questions; most U.S. domestic MTAs spent 50% of class time teaching students how to think during class.

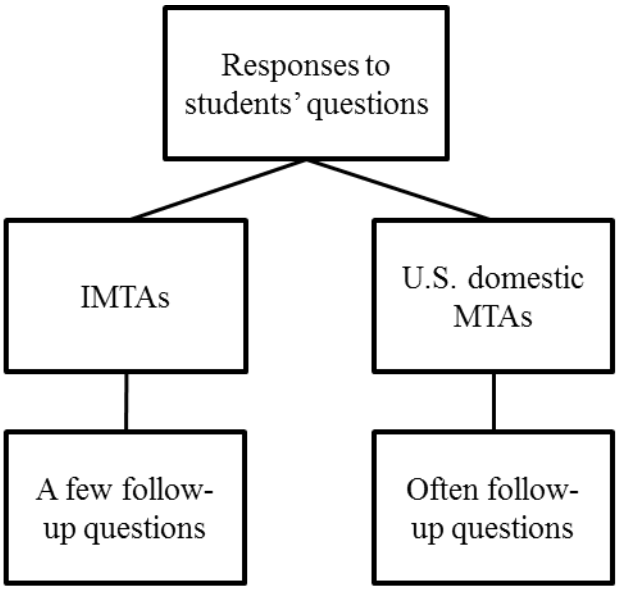


Figure 4.18 - Responses to students' questions

Methods to Encourage Students to Participate in the Class

At this level, both MTAs used questions to encourage their students to participate in class. The questions consisted of simple or open-ended questions. Some IMTAs, who had many teaching experiences, used intended mistakes for students to correct the solutions during lectures.

Methods of Summary

Compared to the U.S. domestic MTAs, the IMTAs spent relatively less time on summarizing their concepts and explaining how to solve problems. The U.S. domestic MTAs also summarized concepts and procedures of problems by asking their students questions. Through interaction with their students, the U.S domestic MTAs spent more time summarizing lessons than the IMTAs did. In addition, it connects with the answer of the questionnaire (#14). According to the answer of question (# 14), the U.S. domestic MTAs provided several opportunities for students to learn how to think.

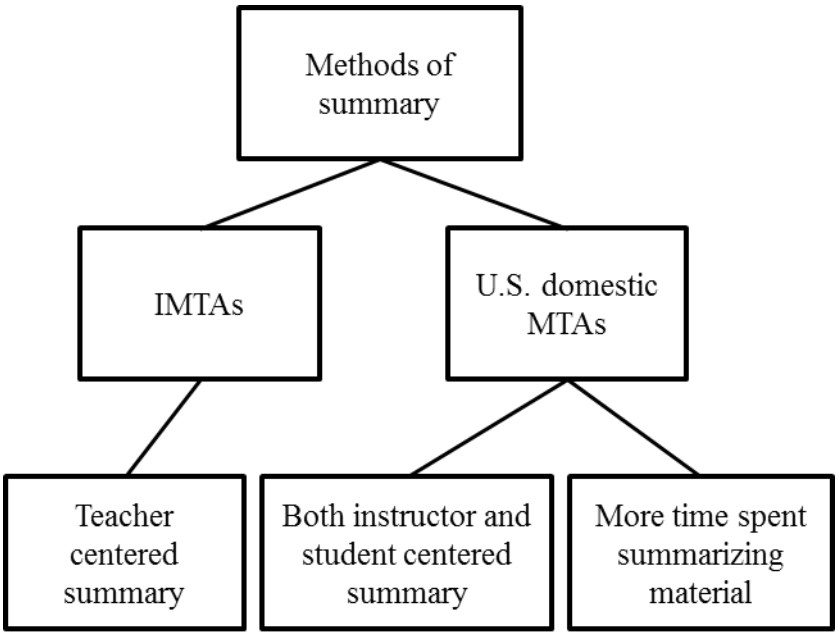


Figure 4.19 - Methods of summary

Methods for Teaching Material

The mathematics department provided materials such as study guides for 1504, 1523, and 1643. The U.S. domestic MTAs used only the study guide. However, the IMTAs used the study guide and additional materials which they made. In addition, the U.S. domestic MTAs only followed the teaching order of the study guide each lesson. On the other hand, the IMTAs taught each lesson in their own orders or methods based on the study guide. For example, even if there were six new terms and six problems related to the new terms on the study guide,

the IMTAs explained one term with a simple example and then went over the problem related to the term. Thus, the IMTAs used problems as complements to help students to understand new terms. By contrast, the purpose of explaining new terms of the U.S. domestic MTAs were to solve problems and show how these terms were used for students.

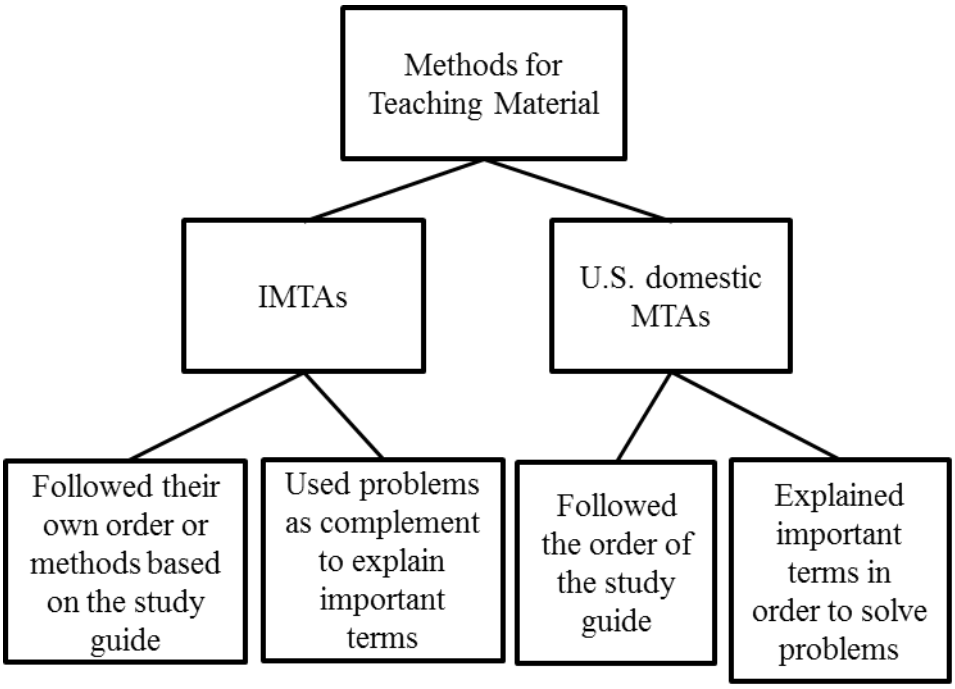


Figure 4.20 - Methods for teaching material

4.3 Relationships between Beliefs and Teaching Practices

According to the literature review, there are consistencies and inconsistences between beliefs and teaching practices. Through my databases, I investigate the relationships which are classified into three categories; relationships between beliefs about teaching and teaching practices, between beliefs about student learning and teaching practices, and between beliefs about mathematics and teaching practices.

Relationships between Beliefs about Teaching and Teaching Practices

The U.S. domestic MTAs and IMTAs had consistent relationships between beliefs about teaching and their teaching practices. According to the U.S. domestic MTAs' important aspects of teaching mathematics (Figure 4.1), they wrote new definitions out in plain English. In addition, they explained why mathematical ideas were needed, why these problems were important, and why mathematics was useful through real life problems to motivate their students to learn mathematics. For their roles (Figure 4.3), the U.S. domestic MTAs taught materials as primary instructors even if they did not write exams:

> Alley: So…I treat it like I am the only teacher. Dr. Matthews talked about tests and…course policies. But, for the most part…I am the person they're going

to interact with them, so I try and act like that. I take it very seriously. And if they don't do well, I kind of take it personally. [1.2.5.172-175]

For instance, they gave quizzes and homework assignments and also provided information as much as their students wanted. In addition, they spent much time interacting with their students. By the most efficient teaching practices (Figure 4.6), the U.S. domestic MTAs thought that problem solving was the most efficient method for students in order to understand materials:

Alley: It's mostly repetition. You just got to keep practicing, keep doing examples, and keep doing homework problems. And…hopefully by then, they'll…and there's a lot to memorize, of course. And the only way you're gonna remember it all is if you just keep using it and doing it and using it and doing it. [1.2.4.135-138]

Thus, the U.S. domestic MTAs spent 70% of their class time solving and presenting as many problems as they could for repetition: "I solve all of them as much as I can. I think I've missed…one problem this semester." [1.2.5.153-154] In addition, they often tried to show that mathematics was practical during problem solving. According to instructional goals (Figure 4.7), they helped their

students prepare for exams through solving many problems on the materials. In addition, they reviewed lessons for their students before exams.

The IMTAs prepared additional lecture notes on their own to explain new definitions and formulas because of the IMTAs' important aspects of teaching mathematics (Figure 4.2). In addition, they provided a simple example and then asked for the answers after explaining new definitions and formulas. This teaching method motivated their students to understand concepts. According to the IMTAs' roles (Figure 4.4), they helped students prepare for exams but providing practice problems and explaining new concepts as a helper. Through the most efficient teaching practices (Figure 4.5), according to the questionnaire (#12), they spent over 30% of their class time explaining new definitions and rules. They used simple problems as a complement to help their students' understand definitions and rules. In addition, they used visual and algebraic methods to help students understanding. For the instructional goals (Figure 4.7), several IMTAs focused on introducing how these formulas were developed and how these were related with others concepts. The answers of the IMTAs' questionnaire (#22) indicated that most IMTAs thought they could show the beauty of mathematics, which supported their instructional goals.

Relationships between Beliefs about Student Learning and Teaching Practices

There is consistency between beliefs about student learning and teaching practices. Both the U.S. domestic MTAs and IMTAs have similar beliefs about student learning. The difference is that the U.S. domestic MTAs emphasized pattern recognition for students' abilities to learn mathematics. Thus, the U.S. domestic MTAs solved problems during class as much as they could through quizzes and homework assignments. During the summary of each problem, they stressed main points for students.

Most MTAs believed if their students wanted to learn mathematics, they could learn mathematics. For example, both MTAs focused efforts on teaching their students by visual and algebraic ways in order to meet diverse students' learning abilities and used easier symbolic mathematics for their students to be interested in their classes.

In addition, most U.S. domestic MTAs wanted their students to recognize that mathematics is useful. Thus, they often used real life problems. From David's observation, "He told their students when this concept worked in real life and talked about his experiences related to this concept". [3.1.5.6-9] In addition, they wanted their students to show them the same respect as they do for other teachers:

Alley: Um…well, I expect the same respect out of them that they would give any other teacher. So…no talking, no…fooling around whenever in the back of classroom. [1.2.5.183-184]

Brian: For the most part, the way that I…that I teach and the way that I…grade class work and then conduct class on a day to day basis is…the primary instructor. [1.4.8.267-268]

In addition, they directly noticed some students who interrupted their lecture during class: "One student listened to music with earphones a little loud. The instructor said to him to turn off his music because the sound disturbed his lecture." [3.4.1.25] During problem solving, the U.S. domestic MTAs interpreted problems and provided most definitions and formulas. Thus, they taught their students seriously and seemed to like teacher-centered lectures.

The IMTAs wanted their students to have positive attitudes and attend their class at least to learn mathematics:

Paul: So what I want them to do is have an open mind about math. I don't want them to be judgmental about it, thinking that it is going to be hard and boring. I just want them to have an open mind about it, try to concentrate on

class and try to learn to the best of their abilities. I will try to make sure that I have them understand. [2.3.8.156-159]

Brown: I want them to have a very positive attitude to learn mathematics. At least, attending class and doing homework assignments are minimal. [2.1.4.108-110]

Thus, the IMTAs tried to help their students to understand basic concepts by visual and algebraic explanations and simple examples as complements. They also spent time emphasizing clear explanations of concepts than solving problems.

Relationships between Beliefs about Mathematics and Teaching Practices

There is also consistency at this level in both groups. The U.S. domestic MTAs had more practical views of mathematics than the IMTAs had. The U.S. domestic MTAs emphasized the purposes of problems, why these problems were important, and how they applied mathematical ideas to real life. Thus, they spent much time problem solving during class. In addition, they provided many kinds of problems as much as they could through homework assignments and quizzes.

On the other hand, the IMTAs focused on explaining concepts to help their students understand. They had strong academic views of mathematics because

they believed that all students needed mathematics to study their fields. They spent much time explaining concepts with simple examples and then solved problems for students to understand these concepts. According to these beliefs about mathematics, they explained short principles of definitions and formulas using several diagrams and provided many simple examples after explaining each definition.

CHAPTER 5: CONCLUSION

The significant differences in beliefs and teaching practices between the two groups are how to teach students to understand definitions and problems and how to motivate students to learn mathematics (See Table 5.1). First of all, the IMTAs used problems as supplements to help students understand concepts because their purpose is for students to understand concepts, not problem solving. The IMTAs believed that understanding concepts are fundamental to learning mathematics. If students know and understand concepts, they can solve all kinds of problems. According to IMTAs' beliefs about teaching, they believed that teachers' abilities and preparations are important for effective teaching mathematics. To help students to understand concepts, the IMTAs emphasized clear explanations of concepts and adjusted students' level. This shows consistency between beliefs about teaching and teaching practices. On the other hand, the U.S. domestic MTAs provided problems as much as they could while stressing main points

because they wanted their students to understand concepts from the problems. They believed that students are able to improve pattern recognition through solving many problems. The U.S. domestic MTAs taught students to understand materials by problem solving for students instead of clear explanations of materials. In addition, through problem solving, they showed that mathematics is useful and valuable. We can see that there is consistency between beliefs about teaching and learning and teaching practices.

I. Teaching	
International MTAs	The U.S. Domestic MTAs
Pedagogical Methods	
○ Spent time emphasizing clear explanations of concepts and adjusted lessons to the students' level ○ Used problems as a complement to help students understand concepts	○ Provided many problems that stressed main points for students rather than spending much time explaining definitions and concepts
Beliefs about learning	
○ Understanding concepts were fundamental	○ Students understood concepts from problems
Beliefs about teaching	
○ Teachers' abilities were more important for effective teaching mathematics than the U.S. Domestic MTAs were	○ Solving many problems helped students to improve the pattern recognition and to see that mathematics is useful and valuable

Table 5.1 - Teaching

Second, there is a significant difference in methods of how to motivate their students to pay attention in class and learn mathematics (Table 5.2). Because the IMTAs focused on students' understanding of concepts, they used simple examples on their own for motivation like providing simple problems. For example, after explaining concepts, they provided simple examples related to the concepts and then asked them what the answers were. Many students participated in solving the simple problems because the examples were not complicated. On the other hand, U.S. domestic MTAs focused on explaining why concepts were useful and valuable to motivate students to learn mathematics. They stimulated students' motive for learning mathematics and paying attention in class through explaining why these concepts are needed and why these problems are important. Thus, U.S. domestic MTAs emphasized reasons to learn mathematics for motivation.

II. Motivation	
International MTAs	The U.S. Domestic MTAs
Pedagogical Methods	
○ Used simple examples for motivation and asked students to solve the examples	○ Often stimulated students' motivation for learning mathematics and paying attention in class through explaining why mathematic ideas were needed, why these problems were important, and why mathematics was useful
Beliefs about learning	
○ Student self-confidence encouraged students to learn mathematics and understand concepts and definitions	○ Explaining why mathematic ideas were useful and valuable motivated students to learn mathematics
Beliefs about teaching	
○ Using simple examples developed students' confidence in the students' abilities to learn mathematics	○ Real life problems and repetition of problem solving would show students the significance of mathematics

Table 5.2 - Motivation

According to Speer (2005, 2008), and Thompson (1992), beliefs strongly influence teaching practices. The results from this study also support the

statement. From my findings, MTAs' beliefs about teaching, mathematics, and students' learning have close relationships with teaching practices. In addition, several researchers (McGivney-Burelle, DeFranco, Vinsonhaler & Santucci, 2001; Twale, Shannon & Moore 1997) suggest that different back-grounds and experiences influence beliefs. Thus, we can see that the IMTAs and U.S. domestic MTAs have significantly different beliefs because of different curriculums and experiences of mathematics.

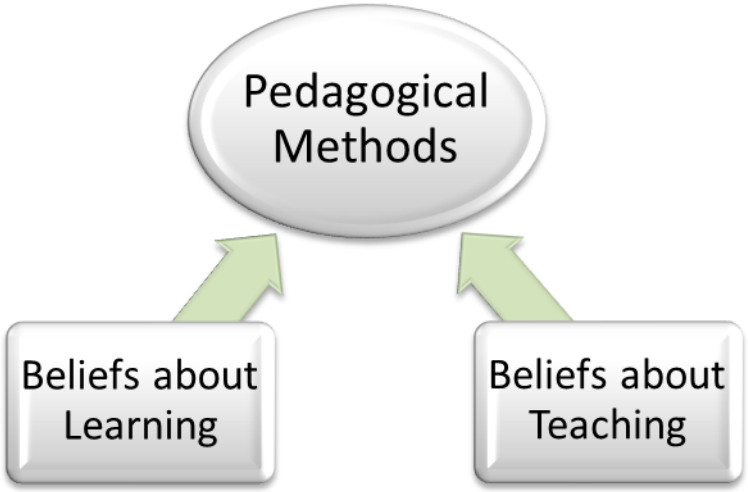


Figure 5.1 – Relationships between beliefs and teaching practices

Reflections

Strength

This study has the proper number of participants, which are six IMTAs and six U.S. domestic MTAs. Good relations are one of the necessary conditions for smooth interviews. As I am a peer with them, they willingly accepted my suggestion to be my research participants. Even though they were there as my participants for my research, not as friends, there was not an awkward situation during the interview. Because my participants were teaching classes and interested in my research, they were supportive of my research and carefully answered my questions. When some participants finished the interview, they were glad to reflect on their teaching through my interview and questionnaire. I did not have a hard time arranging the interview and observation schedule with my participants or finding a location because I was one of their peers. In addition, I have excellent answers for my research because I believe that my interview questions are strongly related to my research questions. This study presents a diverse perspective for MTAs' practices and beliefs because I have different experiences with MTAs' practices and beliefs as an IMTA.

Limitations

During the interviews, I had a difficult time understanding several participants' beliefs in English because of strong accents. Similarly, several IMTAs had a hard time explaining their beliefs through English and confused the meanings of some words. Some MTAs would not have accurate beliefs and organized teaching practices because of the lack of their teaching experiences and pedagogical knowledge.

In the future, I might continue to study MTAs. For example, I could explore the impact of differences in beliefs and practices between international and U.S. domestic MTAs on undergraduate students' learning. In addition, I may study MTAs' difficulties. Depending on my research interests, I may study the professional development training programs for international and U.S. domestic MTAs.

REFERENCES

Aguirre, J.M. and Speer, N.M. (1999). Examining the relationship between beliefs and goals in teacher practice, Journal for Mathematical Behavior, 18(3), 327-356.

Baiocco, S. & De Waters, J. (1998). Successful college teaching: Problem-sovling strategies of distinguished professors. New Jersey: Allyn & Bacon, Prentice Hall.

Ball, D.L., Lubienski, S. & Mewborn, D.S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. in V. Richardson (ed.), Handbook of Research on Teaching, American Educational Research Association, Washington, DC, 433-456.

Belnap, J. K., & Allred, K. N. (2006). Mathematics teaching assistants: Their instructional involvement and preparation opportunities. Manuscript submitted for publication, Brigham Young University.

Bullough, R.V., Knowles, J.G. and Crow, N.A. (1991). Emerging as a Teacher, Routledge, London.

Calderhead, J. and Robson, M. (1991). Images of teaching: Student teachers' early conceptions of classroom practice. Teaching and Teacher Education, 7, 1–7.

Calderhead, J. (1996). Teachers" Beliefs and Knowledge. In D.C. Berliner and R.C. Calfee (eds.), Handbook of Educational Psychology, Macmillan Library Reference USA:Simon and Schuster Macmillan, New Yourk, 709-725.

Cohen, D.K. (1990). A revolution in one classroom: The case of Mrs. Oublier, Educational Evaluation and Policy Analysis, 12(3), 327–345.

Cobb, P., & Steffe, L. (1983). The constructivist researcher as teacher and model builder. Journal for Research in Mathematics Education, 14, 83–94.

Commander, N. E., Hart L., & Singer, M. (2000). Preparing tomorrow's faculty: An assessment model to determine institutional needs. Journal of raduate Teaching Assistant Development, 7(2), 93-111.

Cooney, T. (2003). Mathematics teacher education in rural communities: Developing a foundation for action. Paper presented at the ACCLAIM Research Symposium, McArthur, OH.

Cooney, T., Shealy, B., & Arvold, B. (1998). Conceptualizing belief structures

preservice teachers secondary mathematics teachers. Journal of Research in Mathematics Education, 29(3), 306–333.

Creswell, J. (2007). Qualitative inquiry & research design: Choosing among five approaches. Thousand Oaks, CA: Sage.

Cross, D. (2008). Creating optimal mathematics learning environments: Combining argumentation and writing to enhance achievement. International journal of Science and Mathematics Education. doi: 10.1007/s10763-008-9144-9.

Cross, D. I. (2009). Alignment, cohesion, and change: Examining mathematics teachers' beliefs structures and their influence on instructional practices. Journal of Mathematics Teacher Education, 5(12), 325-346.

Crotty, M. (1998). The foundations of social research: Meaning and perspective in the research process. Thousand Oaks, CA: Sage.

Dionne, J. J. (1984). The perception of mathematics among elementary school teachers. Paper presented at the Sixth Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education, University of Wisconsin, Madison.

Ernest, P. (1988). The impact of beliefs on the teaching of mathematics. In paper presented at the ICME VI, Budapest, Hungary.

Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. Journal of Education for Teaching, 15(1), 13-33.

Furinghetti, F. and Pehkonen, E.(2002). Rethinking characterization of beliefs. in G.C. Leder, E. Pehkonen and G. Torner (eds.), Beliefs: A Hidden Variable

in Mathematics Education?, (31), Kluwer Academic Publishers, Dordrecht/Boston/London,33-58.

Green, T. (1971). The activities of teaching. New York: McGraw-Hill.

Kuhs, T.M. and Ball, D. (1986). Approaches to teaching mathematics: Mapping the domains of knowledge, skills, and dispositions. Michigan State University, Center on Teacher Education, East Lansing, MI.

Lerman, S. (1990). Alternative perspectives of the nature of mathematics and their influence on the teaching of mathematics. British Educational Research Journal, 16(1), 53-61.

Latulippe C. (2007). Environments that Encourage Mathematics Graduate Teaching Assistants: The Effects of Institution Type and Availability of Training. Unpublished doctoral dissertation, University of Montana State University, MA.

LeCompte, M. D., & Preissle, J. (1993). Ethnography and qualitative design in educational research. San Diego: Academic Press.

McGivney-Burelle, J., DeFranco, T. C., Vinsonhaler, C. I. & Santucci, K. B. (2001). Building bridges: Improving the teaching practices of TAs in the mathematics department. Journal of Graduate Teaching Assistant Development, 8(2), 55-63.

McLeod, D. and McLeod, S. (2002). Synthesis-Beliefs and mathematics education: Implications for learning, teaching, and research. In G.C. Leder, E. Pehkonen and G. Torner (eds.), Beliefs: A Hidden Variable in Mathematics Education?,(31), Kluwer Academic Publisher, Dordrecht/Boston/London,115-126.

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook (2nd. ed.). Thousand Oaks: Sage.

Nespor, J. (1987). The role of beliefs in the practice of teaching. Journal of Curriculum Studies, 19(4), 317-328.

Skott, J. (2001a). The emerging practices of a novice teacher: The roles of his school mathematics images. Journal of Mathematics Teacher Education, 4(1), 3–28.

Speer, N. (2005). Issues of methods and theory in the study of mathematics teachers' professed and attributed beliefs. Educational Studies in Mathematics, 58(3), 361-391.

Speer, N. (2008). Connecting Beliefs and practices: A Fine-Grained Analysis of a College Mathematics Teacher's collections of Beliefs and Their Relationship to His instructional Practices. Cognition & Instruction, 26(2), 218-267.

Speer, N.,Gutmann, T., & Murphy, T. J. (2005). Mathematics Teaching as Assistant Preparation and Development. College Teaching, 53(2), 75-80.

Speer, N. (1999). Examining the relationship between beliefs and goals in teacher practice. Journal of Mathematical Behavior, 18(3), 327-356.

Pajares, M.F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. Review of Educational Research 62(3), 307-332.

Prawat, R. (1992). Teachers' beliefs about teaching and learning a constructivist perspective. American Journal of Education, 100(3), 354–395.

Thompson, A. (1984). The relationship of teachers' conceptions of mathematics teaching to instructional practices. Educational Studies in Mathematics, 15, 105-127.

Thompson, A. (1985). Teachers conceptions of mathematics and the teaching of problem solving. In E. Silver (ed.), Teaching and Learning Mathematical Problem Solving: Multiple Research Perspectives, Lawrence Erlbaum Associates, Hillsdale, 281-294.

Thompson, A. (1992). Teachers' beliefs and conceptions: A synthesis of the research', in D. Grouws (ed.), Handbook of Research on Mathematics Teaching and Learning, Macmillan, New York, 127-146.

Torner, G. (2002). Mathematical beliefs – A search for a common ground: Some theoretical considerations on structuring beliefs, some research questions, and some phenomenological observations. In G.C. Leder, E. Pehkonen and G. Torner (eds.), Beliefs: A Hidden Variable in Mathematics Education?, (31), Kluwer Academic Publishers, Dordrecht/Boston/London, 73-94.

Twale, D. J., Shannon, D. M., Moore, M. S., (1997). NGTA and IGTA training and experience: Comparisons between self-ratings and undergraduate student evaluations. Innovative Higher Education, 22(1), 61-77.

APPENDIX A

Interview Protocol

Interview Protocol

Introduction

Thank you for time and willingness to participate. As you know, I am interested in the differences in beliefs and teaching practices of international and U.S. domestic mathematics teaching assistants. Particularly, I am trying to find:

a) What are the differences in beliefs and teaching practices between international and U.S. domestic mathematics teaching assistants?
b) How are mathematics teaching assistants' different teaching practices shaped by their beliefs about mathematics?

If the questions are general and abstract, you may volunteer any detail you wish. Depending on your responses, I may ask probing questions. You also have the option of declining to answer – passing on – any of the questions. Do you have any questions before we start?

Interview Questions

[Teaching practices]

1. What is your a normal daily routine for your class?
2. How do you make sure that students understand your lessons?
    - How do you interact with your students?
3. What kinds of activities do your students usually have in your class?
4. What kinds of teaching practices are the most efficient for your students to learn mathematics?
    - Why did you choose them?
5. What is your view about your role as a teaching assistant in your class?

- Based on that role, how do you conduct your class?

6. What are the most important aspects of teaching mathematics?

[Beliefs]

7. What is your view of calculus?
8. What is your view of areas of mathematics other than calculus?
9. What are the instructional goals of your mathematics class?
10. What attitude do you want your students to have about mathematics?
11. What are the important abilities that students should have in order to learn mathematics?
12. Do you think that all your students are learning mathematics?
    - (If no) Why do you think that?
    - (If yes) How do you promote learning for all of your students?

Closing

Now that we are done, do you have any questions you'd like to ask me about this research project? If you want to contact me later, here is my contact information: Minsu's Cell Phone: 405-414-7256, email: minsu95@ou.edu, and office: Room 1012 of the Physical Sciences Center, 601 Elm Avenue, on the OU Norman Campus. Also, I may need to contact you later for additional questions or clarification. Can I also have your follow-up contact information?

APPENDIX B

Questionnaire

Introduction

Thank you for time and willingness to participate. As you know, I am interested in the differences in beliefs and teaching practices of international and U.S. domestic mathematics teaching assistants. Your responses to these questions will provide data relating to your teaching practices and beliefs in mathematics. Please mark you answer to the following questions:

Background Information

1) **Gender:** ***(Select one)***
   - Male
   - Female

2) **Age:**
   - 19 - 24
   - 25 - 29
   - 30 - 34
   - 35 - 39
   - Over 40

3) **How do you identify yourself?** ***(select one)***

- Asian
  - China
  - Korea
  - Japan
  - India
  - Nepal
  - Iran
  - Other Asian (Specify)

- North American
  - Yes (If yes, specify the state where you are currently living)

- South American
  - Colombia
  - Other (Specify)

- Europe
  - Denmark
  - Turkey
  - Other (Specify)

4) **Where did you graduate from high school?**
   - Oklahoma
   - Other state in the U.S. (Specify)
   - Other countries (Specify)

5) **Where did you graduate from university?**
   - Oklahoma
   - Other states in the U.S. (Specify)
   - Other countries (Specify)

6) **Type of degree program which you are pursuing**
   - M.A.
   - M.S.
   - Ph.D

7) **What is your major area for your current degree?**
   - Topology
   - Algebra
   - Geometry
   - Analysis
   - Applied math
   - RUME (Research in Undergraduate Mathematics Education)
   - Other (Specify)

8) **Do you have experience of teaching mathematics at other universities besides the University of Oklahoma?**
   - If yes, how long and where? (Specify)
   - No

9) **How long have you been teaching mathematics at the University of Oklahoma?**
   - One
   - Semester
   - Two semester (One year)
   - Three semesters
   - Four semester (Two years)
   - Five semesters
   - More

10) What class are you teaching this semester?

- Math 1473 – Math for critical thinking
- Math 1503 – Introduction to Elementary Functions
- Math 1523 – Elementary Functions
- Math 1643 – Pre calculus for Business, Life, and Social Sciences
- Math 1743 – Calculus I for Business, Life, and Social Sciences
- Math 1823 – Discussion section
- Math 1823 – Calculus and Analytic Geometry I

	1	2	3	4	5
11) How much time do you spend on problem solving in your class?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
12) How much time do you spend explaining definitions, rules, or formulas for solving problems?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
13) How often do you use real life problems to explain definitions, rules, or formulas?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
14) How much time do you spend on teaching students to learning to think in your class?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
15) How much time do you spend on encouraging students to be interested in mathematics during your class?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
16) How often do you give team projects in your class?	[10%]	[30%]	[50%]	[70%]	[Over 90%]
17) How often do you use technology in your class?	[10%]	[30%]	[50%]	[70%]	[Over 90%]

Beliefs about Mathematics

This survey is based on the following definition: "M*athematics*" means high and undergraduate level mathematics such as Algebra, Pre-calculus, Business Calculus, Calculus I, and Calculus II, etc. "Advanced mathematics" means the graduate level and focuses on abstract concepts such as topology and real analysis. Based on your experiences, select how much you agree or disagree with the following statements about mathematics:

	Strongly disagree	disagree	Neutral	Agree	Strongly agree
18) *Mathematics* helps students to improve their logical thinking.	1	2	3	4	5
19) *Mathematics* helps students' entire lives.	1	2	3	4	5
20) *Mathematics* helps students to improve real problem solving skills.	1	2	3	4	5
21) If students pass a calculus class, they are also able to learn *advanced mathematics*.	1	2	3	4	5
22) You are able to show your students the beauty of *mathematics*.	1	2	3	4	5
23) Students are able to figure out the beauty of *mathematics*.	1	2	3	4	5

	Strongly disagree	disagree	Neutral	Agree	Strongly agree
24) To learn *mathematics* is to memorize formulas.	1	2	3	4	5
25) Learning to think is more important than acquiring practical skills.	1	2	3	4	5
26) *Mathematics* encourages critical and independent thinking.	1	2	3	4	5
27) *Advanced Mathematics* also encourages critical and independent thinking.	1	2	3	4	5
28) Recall ability is more important than a connection between "Knowledge" and "Understanding" in mathematics.	1	2	3	4	5

Now you are done, thank you for your participation

APPENDIX C

CODE BOOK

Code Book I - Beliefs

Beliefs		MTAs		
Teaching	Important aspects of teaching mathematics	IMTAs	Motivation	
			Recognizing students' level	Adjusting teaching level
			Teachers' abilities	Not making mistakes
				Knowledge of mathematics and methods
		U.S domestic MTAs	Motivation	Explaining why mathematical ideas are needed
			Teachers methods	Visual explanations
				Clarifying goals
				Repetition
	Teachers' roles	IMTAs	Helping students	Making easier materials
				Preparing exams
				Sharing knowledge
		U.S domestic MTAs	Primary instructor	Teaching and grade class work
				Conduct class
				Answering questions
	Most efficient teaching methods	IMTAs	Clear explanations of concepts	
			Serious teaching	
			Visual and algebraic explanations	
			Providing many different and difficult problems	

		U.S domestic MTAs	Doing problems by repetition	Give time to work problems on their own
				Providing homework assignments and quizzes for practice
	Instructional Goal	IMTAs	Getting into mathematics by motivation	
			Having a view of mathematical thinking	
		U.S domestic MTAs	Providing the best possible opportunities to learn mathematics	
			Preparing for going into Calculus	
Student learning	Important abilities for students to learn mathematics	IMTAs	Diligence, patience, dedication, curiosity, and logical thinking	
		U.S domestic MTAs	Diligence, patience, dedication, curiosity, and logical thinking	
			Pattern recognition	
	All students can learn mathematics	IMTAs	Not all students can learn mathematics depending on the students' attitude toward learning mathematics	
		U.S. domestic MTAs		

	Students' attitudes toward mathematics	IMTAs	Concentrating on the lecture	
			A positive outlook on mathematics	
		U.S. domestic Mathematics	Concentrating on the lecture	
			A positive outlook on mathematics	
			Realizing that mathematics is useful	
			The same respect as any other teacher	
Mathematics	Calculus	IMTAs	Foundation for all majors	
			Every student needs it	
		U.S. domestic MTAs	Foundation for science majors	
			Only students majoring in science need it	
	Advanced Mathematics	IMTAs	Academicals views	Relating to other subjects
				Fields on top of calculus
		U.S. domestic MTAs	Practical views	Encouraging critical and independent thinking
				Valuable and important for learning other fields

Code book II – Teaching Practices

Teaching Practices	MTAs		
Teaching Organization	IMTAs	Provided a quiz at the end of class	
	U.S. domestic MTAs	Provided a quiz at the beginning of class	
Definitions, Rules, and Formulas	IMTAs	Emphasizing clear explanations of material	Using their own problems as a complement
	U.S. domestic MTAs	Motivating students to learn the material through explaining why mathematics is useful	Using real life problems
Before Problem Solving	IMTAs	Explained the purposes, requirements, and brief processes	
	U.S. domestic MTAs	Often mentioned how it was used in real life	70% of the class time on problem solving
Question Form	IMTAs	Closed-ended questions	
	U.S. domestic MTAs	Open-ended questions	
Responses to students' questions	IMTAs	A few follow-up questions	
	U.S. domestic MTAs	Often follow-up questions	
Methods to Encourage Students to Participate in Class	IMTAs	Simple or open questions	
	U.S. domestic MTAs		

Methods of Summary	IMTAs	Teacher centered summary	
	U.S. domestic MTAs	Both instructor and student centered summary	
		More time spent summarizing material	
Methods for Teaching Material	IMTAs	Followed their own order or methods based on the study guide	
		Used problems as complement to explain important terms	
	U.S. domestic MTAs	Followed the order of the study guide	
		Explained important terms in order to solve problems	

APPENDIX D

Subjectively Statement

Subjectively Statement

I often have wondered why mathematics teaching assistants have different teaching practices even though a mathematics problem has only one answer and they learned the same definitions, theorems, and properties from the same professors. Based on this question, I will study the differences in teaching practices among mathematics teaching assistants and their beliefs between international and U.S. domestic mathematics teaching assistants. I will assume that a) mathematics teaching assistants have different beliefs about mathematics, b) IMTAs and U.S. domestic MTAs have different teaching practices, and c) MTAs' have different teaching practices due to their beliefs. The research questions of this study are: what are the differences in beliefs and teaching practices between international and U.S. domestic MTAs? How are MTAs' different teaching practices shaped by their beliefs? My participants are twelve teaching assistants in mathematics at Oklahoma University. Here are my three criteria. The first is that MTAs are in the Mathematics department at the University of Oklahoma. The second is MTAs' nationalities of the U.S. domestic MTAs and IMTAs. One of the two groups is U.S. domestic MTAs who were born and at least completed high school in the U.S. and speaks English as their native language. In addition, the other group is IMTAs who were born and at least completed high school out of the U.S. and are non-native speakers of English. The third is that MTAs teach their own class during the spring semester of 2010. MTAs have had the experience of teaching a class at least one semester at the University of Oklahoma

or other universities. The title of my research is "Differences in Beliefs and Teaching Practices between International and U.S. Domestic Mathematics Teaching Assistants."

I learned applied mathematics in Changwon National University as an undergraduate student in South Korea. Before being a university student, I expected the professors would teach me mathematics through special methods. However, their teaching practices were similar to middle and high school teachers. For example, they introduced definitions, theorems, and properties and then students had to solve some problems on the board during class. If a student could not solve the problem, the professor strictly subtracted points as a punishment. When I went to graduate school, the professors used similar teaching practices. Why were their teaching practices similar during this time in Korea? What factors influenced their teaching practices? What were the differences between teaching practices of high school teachers and professors? How did the professors learn and develop their teaching practices? Most of the professors learned their teaching practices through K-12 teaching programs because they were high school or middle school teachers in the same region before being professors in Korea. After graduating from Changwon National University, I applied for the mathematics department at the University of Oklahoma to learn how to understand and approach advanced definitions and theorems in mathematics, to join the pedagogy program and to experience a diversity of teaching practices. I have experienced the same processes as a Ph.D. student in mathematics, although I wanted to join

the pedagogy program. I had to take three Mathematics qualifying exams, which are for all MTAs, and three English qualifying exams, which are for international students to be allowed their own teaching classes at the University of Oklahoma. When I was done with those exams in the fall of 2008, I became qualified to teach undergraduate students as an instructor. As an instructor at the University of Oklahoma, I have had plenty of opportunities to compare other MTAs' teaching practices, beliefs about mathematics, and backgrounds to my own.

I believe mathematics helps people to distinguish cause from effect and to anticipate the results from analyzing the cause. Mathematics is not just memorizing formulas and accurately solving problems. The key to mathematics is learning to understand the process and reason of formulas and what definitions and theorems mean. MTAs' beliefs due to their experiences would influence their teaching practices. For example, due to my beliefs, I teach students why we need formulas, definitions, and theorems, why we study these concepts, and how to apply the concepts in reality rather than just memorizing formulas. Finally, I encourage my students to acquire the process and skill of thinking by solving problems. I always wonder what other MTAs' beliefs and teaching practices are. This question and my beliefs make me want to research the area. I have an advantage studying my research project because I will understand and examine MTAs' teaching practices from a diverse perspective as an international MTA. However, I had difficulties understanding MTAs' beliefs when they responded in English. I had difficult analyzing the interviews because international MTAs find

it hard to explain their beliefs through English as well. In addition, some MTAs would not have accurate beliefs and organized teaching practices because they do not have much teaching experience and focus on researching pure mathematics rather than being interested in their teaching practices.

Therefore, my research should be a good opportunity for faculty to understand the differences and relationships in multiple MTAs' teaching practices, beliefs and experiences with mathematics. It would classify MTAs' teaching practices from their beliefs and backgrounds. In addition, my study would encourage faculty to be interested in what MTAs need in order to develop their teaching practices and MTAs' noteworthy roles at universities.