

AN EXPLORATION OF MATHEMATICS  
GRADUATE TEACHING ASSISTANTS' TEACHING  
PHILOSOPHIES: A CASE STUDY

By

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Submitted to the Faculty of the  
Graduate College of the  
Oklahoma State University  
in partial fulfillment of  
the requirements for  
the Degree of  
DOCTOR OF PHILOSOPHY  
August, 2014

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## ACKNOWLEDGEMENTS

It gives me an immense pleasure to express my gratitude to all those who supported me to complete this dissertation study. This dissertation study would not have been completed without the continuous guidance from my supervisor Douglas B. Aichele. I am impressed with his incredible talent for research and am grateful for the insights he brought during the course of this study. I thank him for the continuous support he provided in each step of this study. I am also grateful to my other committee members Chris Francisco, Jesse Johnson and Mindy McCann for their feedback during the course of this study. I also express my thanks to mathematics faculty members Alan Noell, Lisa Mantini, William Jaco, Yanqiu Wang and Jiahong Wu. I would also like to express my gratitude to Professors Kathryn Castle and Dennis Blum who always offered their help when I needed. I am also thankful to my other colleagues, especially Melissa Mills and Ben Wescoatt for their cooperation throughout the course of my graduate study at Oklahoma State University. Moreover, I am thankful to my research participants and also to Mr. Chris Hayden for proofreading my dissertation.

I express my thanks and love to my wife Dr. Bal Kumari Khatiwada, who always supported me in every ups and downs during the course of my dissertation study. It would have been very difficult to complete this work without her support. I am very grateful to my parents Jaya Prasad Nepal and Bed Kumari Nepal for their love and relentless support they provided; they are the true source of my inspiration. I am also thankful to my brothers Tek Prasad Nepal, Eka Raj Nepal, Rudra Prasad Nepal, Purushottam Nepal and my sister Parbati Nepal. I also express my gratitude to my uncles Ganga Prasad Nepal, Kul Prasad Nepal and Tika Bhattarai for their support throughout my study.

Last but not the least, I thank the department of mathematics and Oklahoma State University for providing this opportunity for pursuing my graduate study. I will be a true and loyal OSU alumnus throughout the rest of my life.

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Date of Degree: AUGUST, 2014

Title of Study: AN EXPLORATION OF MATHEMATICS GRADUATE TEACHING ASSISTANTS' TEACHING PHILOSOPHIES: A CASE STUDY

Major Field: MATHEMATICS

**Abstract:** This multi-case study is an exploration of mathematics graduate teaching assistants' teaching philosophies. It focused on the cases of four purposefully selected beginning mathematics graduate teaching assistants (MGTAs) including two domestic and two international MGTAs. Using qualitative research methods, this dissertation study focused on the beginning and changing teaching philosophies of these MGTAs over a pre-service semester-long teaching assistant preparation program, and the subsequent in-service teaching experience phase. The factors that affected these MGTAs and their teaching philosophies during both phases were also studied. Three written teaching philosophy statements were collected from each participant at different stages of the pre-service preparation program during the fall 2012 semester. Three one-on-one interviews were conducted with each participant in three academic semesters during the in-service phase.

The participants expressed varying opinions about teaching and learning mathematics in their beginning teaching philosophy statements. They described mostly the teaching behaviors of their role model teachers from their undergraduate or high school periods; however, they expanded on these opinions involving their previous teachers in their later teaching philosophy statements during the pre-service preparation phase.

As they entered into the in-service phase, some changes were noted in their teaching philosophies. Their teaching philosophies were still strongly influenced by their own experience as students, especially by their role model teachers from the past. Some of the changes noted in their teaching philosophies included incorporating more student-centered instructions, being prepared for the class, desire to have more independence in teaching, and the use of technology. Also, all the participants developed a strong belief that they will improve their teaching based on their own teaching experience, but they saw little importance of the opportunities for professional development. Moreover, they all reported a belief that students should also put enough effort into their learning.

Some of the factors that influenced their beginning and evolving teaching philosophies were their past experience as students, especially their role model teachers, their current teaching experiences, class observations, and other instructors. Although they said that they learned from the preparation program course, they said that it had little influence in their evolving teaching philosophies.

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## CHAPTER I

### INTRODUCTION

#### **1.1 Background and Context**

Mathematics Graduate Teaching Assistants (MGTAs) in US universities play many significant roles in undergraduate mathematics instruction (Belnap, 2005; Speer, Gutmann & Murphy, 2005). These roles of MGTAs vary from school to school. Some MGTAs support other instructors by grading, tutoring, and conducting labs or recitation sections, but most are assigned to teach lower division undergraduate mathematics courses (Belnap, 2005). This trend is especially common in research universities, where up to fifty percent of such courses are staffed by MGTAs (Chae, Lim & Fisher, 2009).

The MGTA population consists of both domestic and international students. In the US, international mathematics graduate teaching assistants (IMGTA) now make up a sizable portion of graduate students in mathematics, earning more than 50% of awarded PhDs (American Mathematical Society, 2012). It is expected that the number of IMGTA in US universities will continue to grow in the future. Due to this increase, it is possible that IMGTA will serve more undergraduates than their domestic counterparts in the future, especially in the research universities. Regardless of where these MGTAs (domestic or international) come from, they have tremendous influence on undergraduate students' experiences with mathematics (Speer, Gutmann, & Murphy, 2005).

Even though MGTAs play significant roles in undergraduate mathematics instruction, they have minimal preparation to teach (Belnap, 2005; Kung & Speer, 2007; Speer, Gutmann & Murphy, 2005). Due to the availability of limited number of professional development opportunities, not only are new MGTAs not well prepared to teach, even many beginning faculty members are unprepared and uncertain as teachers (Boice, 1992b; Sorcinelli, 1994). Fewer professional development opportunities are provided to these ‘unprepared and uncertain’ college teachers. Even though there has been significant attention paid to the relationship between teacher qualities and student mathematical achievement in secondary level, there is little such attention paid to the post-secondary level (Harris, Froman & Surlis, 2008). Not only mathematics teaching in college, but college teaching, in general, is taken as a unique profession. There is a common belief that those with a thorough understanding of their subject should have a natural ability to convey that understanding to the students (Montgomery, 1989).

Contrary to these peoples’ assumptions, MGTAs, many of whom become mathematics faculty members in the future, are well equipped with the subject-matter knowledge but have minimal preparation to teach (Kung & Speer, 2007). Increasing roles of MGTAs but their inadequate preparation to teach certainly increases concerns of undergraduate students, their parents and college/university administrators. Indeed, it is unreasonable to assume effective student learning without good teaching.

There is an agreement among mathematics teachers, educators and researchers that teachers need more than just content knowledge. They need to be equipped also with pedagogical content knowledge (PCK) for good teaching and learning to occur (Shulman, 1986). In fact, research in K-12 levels shows that there is no direct connection between the number of mathematics courses taken by mathematics teachers and their students’ performance (Clotfelter, Ladd, & Vigdor, 2007).

In order to prepare MGTAs for classroom teaching, mathematics departments in many universities in the United States offer pre-service teaching preparation programs, which range in complexity from multi-day workshops or orientations to semester long academic courses (Belnap, 2005; Speer, Gutmann & Murphy, 2005). Even though mathematics departments put significant effort into these pre-service programs, they typically suffer from two problems. First, some beginning MGTAs believe that the best way to learn about teaching is by experience, and they do not see benefits of pre-service professional development programs (Chae, Lim & Fisher, 2009; Harris, Froman & Surles, 2008). Second, once MGTAs begin to teach, many believe that their pre-service preparation did not adequately prepare them for classroom teaching (Moore, 1991; Travers, 1989).

There is a research journal ‘The Journal of Graduate Teaching Assistant Development’ entirely devoted to the preparation and development of teaching assistants. This journal has published many research articles pertaining to graduate teaching assistants’ issues. Even though the findings from research on graduate teaching assistants from one discipline can be useful to the preparation of graduate teaching assistants from other disciplines, there are certain issues and concerns that are unique to some specific disciplines like mathematics. The problems and issues of MGTAs are somewhat unique in the sense that mathematics is perceived as one of the most difficult subjects. In spite of the high level of perceived difficulty in mathematics, only limited numbers of studies have been conducted on MGTAs in the past. However, the issue of teaching preparedness of MGTAs is receiving more attention from mathematics education researchers and other stake holders in the recent years.

Research shows that MGTAs’ beliefs and philosophy about teaching and learning have significant impact on their classroom practices and decisions (Kim, 2011; Speer, 2008; Thompson, 1992). Since MGTAs come from a diverse background, they bring their own experiences, perspectives, beliefs and philosophies about teaching mathematics and student learning with them. The perspectives, beliefs and expectations brought from one context can be different from that of undergraduate students,

parents and administrators in another context. The diversity of MGTAs, their different beliefs and philosophy of teaching adds more challenges to the teaching of mathematics and student learning.

To date, the research conducted on MGTAs has focused primarily on designing pre-service training programs and their potential impact on changing MGTAs' teaching practices. Some other studies have attempted to examine the relationship between MGTAs' beliefs and their classroom decisions (Belnap, 2005; Kim, 2011; Speer & Murphy, 2008; Peterson, 2004). These studies have shown that teachers' existing knowledge and their beliefs inform and guide their classroom practices. Since teachers' philosophies of teaching (collection of beliefs and views about teaching) change over time, careful examination of beginning and evolving teaching philosophies may provide insight into the support structures (for MGTAs) necessary to facilitate effective classroom instruction (Simmons et al., 1999). Understanding beginning MGTAs' philosophies of teaching provides rich opportunities for mathematics educators and researchers to design pre-service professional development activities to change or nurture MGTAs' beliefs and future classroom practices.

Pre-service programs may provide a valuable beginning point for MGTAs' professional development, but they do not address the need for continuous in-service support. As these pre-service programs are typically the only resource offered by mathematics departments and universities, this leaves MGTAs with little or no institutional support for their ongoing professional development. Being myself an MGTA, I have realized that in-service MGTAs should also be provided with opportunities to participate in professional development activities. But in order to understand the need of in-service MGTAs and thus design appropriate in-service professional development activities, it is necessary to understand MGTAs' perspectives and evolving teaching philosophies during their in-service phase. But little research exists that attempts to understand and describe changes in pre-service MGTAs' teaching philosophies, and how these philosophies evolve during the in-service phase. Moreover, very few studies have described factors that could affect MGTAs and their teaching philosophies as they transition to the in-service phase. During the in-service phase, external forces are decreasing but

acquisition of teacher autonomy is increasing. This study is an attempt to fill this gap by conducting a small case study, as suggested by Speer, Gutmann & Murphy (2005), on a few purposefully selected MGTAs.

This study has examined the evolution of MGTAs teaching philosophies, both as pre-service and in-service instructors. As described above, this research has employed a qualitative case study methodology focusing on a small number of MGTAs as suggested by Speer, Gutmann, & Murphy (2005). Four of the beginning MGTAs from a large state university in the mid-western United States were selected. Those MGTAs who have completed the mandatory course entitled ‘Seminar and Practicum in the Teaching of College Mathematics’ (SPTCM), a pre-service professional development program, in the fall 2012 semester were selected. The SPTCM was a specially designed course integrating seminar and practicum experiences (See Chapter III for the detailed description of this course). The study has attempted to describe participants’ initial teaching philosophies before they underwent pre-service training, then track how their philosophies evolve during training, and during the subsequent transitional in-service phase. The study has also attempted to describe external factors that affect MGTAs and hence their philosophies of teaching as they transition from a pre-service phase to an in-service phase. I expect that the findings of this study would inform training practices and offer new insights into effective ways of providing support for MGTAs.

The remainder of this chapter begins with the statement of the problem, statement of the purpose and research questions. These sections are followed by a brief discussion around research approach, as well as the researcher’s perspectives and assumptions. The chapter ends with a discussion of the rationale and significance of this study, as well as definitions of some of the terminology being used.

## **1.2 Problem Statement**

Research shows that the design of MGTA preparation programs is often based solely on faculty’s wisdom and experience, and rarely reflects and incorporates MGTAs’ philosophies and perspectives

on their teaching and training. Hence despite significant effort put by mathematics departments and MGTAs on these preparation programs, both are often dissatisfied with the outcomes of these preparation programs. There is little information as to what beginning MGTAs' philosophies of teaching are, how their philosophies change during their pre-service and in-service phases, and what factors affect MGTAs and their teaching philosophies.

### **1.3 Statement of the Purpose and Research Questions**

Although there is a lot of research conducted on teaching assistants, only limited numbers of them are conducted on MGTAs. To date, the research conducted on MGTAs has focused primarily on designing pre-service training programs and their potential influence on changing MGTAs' teaching practices. Some studies have attempted to examine the relationship between MGTAs' beliefs and their classroom decisions (Belnap, 2005; Kim, 2011; Speer & Murphy, 2008). However, little research exists concerning in-depth understanding of beginning MGTAs' philosophies of teaching and describing changes in their evolving philosophies at different stages of their graduate study.

Moreover, very few studies have described factors that could affect MGTAs and change or nurture their philosophies of teaching. The purpose of this study relates to exploring with four purposefully selected MGTAs their beginning and changing philosophies of teaching during their pre-service and in-service phases as mathematics instructors. It also relates to describing the factors that affect their philosophies of teaching during the transition period when external forces are decreasing but acquisition of teacher autonomy is increasing. More specifically, it attempts to answer the following research questions:

1. What are the teaching philosophies of beginning MGTAs? How do their philosophies evolve during the pre-service phase?



2. How do their evolving philosophies of teaching (developed during pre-service phase) change/nurture as they transition to an in-service phase when external forces are decreasing but acquisition of teacher autonomy is increasing?
3. What are the major contributing factors that affect MGTAs and their teaching philosophies during the externally motivated (pre-service) and internally motivated (in-service phases)?

With the in-depth understanding of MGTAs' philosophies of teaching and major contributing factors that affect them and their philosophies, my anticipation is that MGTA preparation program designers can use more informed decisions to incorporate MGTAs' perspectives on teaching and training to make such programs more effective.

#### **1.4 Research Approach**

After receiving approval from the University's Institutional Review Board (IRB), four MGTA (two domestic and two international) participants were selected purposefully. Then in-service MGTAs who had completed the SPTCM course during their fall 2012 semester were selected. Pseudonyms were assigned to all participants in order to protect their identity; the description of the participants are presented in the results section.

This investigation is a qualitative case study, individual interviews being the primary method of data collection. Participants' written teaching philosophy statements from the SPTCM course was also collected. The prompts for writing the teaching philosophy statements were discussed between the instructor of the SPCTM course and the researcher before they were given to the MGTAs.

One-on-one interviews were audio recorded and transcribed verbatim, and interview data were coded using the constant comparative methods (Strauss & Corbin, 1998) using mostly open coding technique. To help analyze the data, I will seek feedback from peers and mathematics education experts at different stages of the coding and developing categories. A 'member check' strategy was

also employed, in which the researcher's initial interpretations of the data was presented to the study participants, in order to confirm or disconfirm the researcher's interpretation and also to elicit their opinions about the data from their own interviews.

### **1.5 Researcher's Assumptions**

Based on the researcher's experiences as an MGTA and as a student of mathematics education, and on his observation of the fall 2012 SPTCM class, the following primary assumptions were made prior to conducting this study:

- 1) MGTAs' initial teaching philosophies tend to reflect beliefs about teaching and learning typical of their native culture where they experience teaching as students, even though some degree of individual variation is to be expected. This assumption is based on the premise that people's opinions are influenced by culture and society, and that they conceptualize teaching and learning mathematics based on how the subject was taught to them as students.
- 2) The evolution of MGTAs' teaching philosophies is a slow, gradual process. Since MGTAs are adults, their beliefs about teaching and learning are deeply ingrained, making them very resistant to change.
- 3) In their initial teaching philosophy statements, MGTAs often incorporate ideas from outside sources rather than accurately representing their own philosophies. This practice is most common among international teaching assistants, but still widespread among American teaching assistants. The driving motivation for this behavior is the desire to receive a higher grade on the assignment, which leads them to imitate available models of teaching philosophy statements rather than depicting their own philosophy.
- 4) MGTAs' pre-service teaching philosophies evolve when they enter the in-service phase, as they gradually realize that they held unrealistic views about teaching and learning. This assumption is

based on research in secondary education that documented this phenomenon among novice in-service teachers.

5) Factors that may affect the evolution of MGTAs' teaching philosophies include social networks, departmental culture, graduate coursework, undergraduate students' mathematical backgrounds, and undergraduate students' attitudes toward their instructors and toward learning mathematics.

## **1.6 The Researcher**

The researcher is pursuing his doctoral degree in mathematics education while working as an MGTA. He therefore has firsthand knowledge of the challenges experienced by the study's potential research participants. This insider knowledge and peer status will likely make participants comfortable expressing their beliefs and feelings.

## **1.7 Rationale and Significance**

As a student of mathematics education and an instructor of mathematics, the researcher is interested in finding ways to support MGTAs and to enhance undergraduate mathematics instruction. It is the researcher's contention that one of the ways to enhance mathematics instruction is by better preparing MGTAs for classroom teaching. The rationale for this study comes from the researcher's desire to understand and incorporate MGTAs' perspectives in MGTA preparation programs, in order to make such programs more effective. Research-based MGTA preparation programs will benefit all stakeholders, including undergraduate students, their parents, MGTAs and school administrations.

## **1.8 Definitions of Terminology**

*Externally motivated activities* – Professional development activities that are recommended or required by outside authorities, such as mentors, instructors, and departmental administrators.

*Internally motivated activities* – Self-motivated professional development activities that MGTAs participate in without any instruction or prescription of authorities. For example, reading journal articles on teaching and student learning, writing quizzes and exams, observing classes of mathematics faculty or peers, writing reflection on their teaching etc.

*In-service phase* – Period of time after the conclusion of the SPTCM course when MGTAs begin to teach and assume other responsibilities such as grading, maintaining the course grade book and posting student grades online.

*Mathematics graduate teaching assistants (MGTAs)* – Mathematics graduate students who are supported by a teaching assistantship from their department. They are typically assigned to teach lower division mathematics courses, or to grade faculty instructors' homework and quizzes.

*Pedagogical content knowledge (PCK)* – It is “that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding” (Shulman, 1987, p. 8).

*Pre-service phase* – MGTAs' first semester of their graduate program, when they take the SPTCM course but do not teach or assume any other TA duties.

*Professional development activities* – Activities that are intended to prepare MGTAs for teaching mathematics in classrooms.

*Research universities (extensive)* – The universities which award 50 or more doctoral degrees per year across 15 disciplines or more (Carnegie Foundation, 2001).

*Research universities (intensive)* – The universities which award 20 or more doctoral degrees overall per year, or at least ten doctoral degrees per year across three or more disciplines (Carnegie Foundation, 2001).

*Seminar and practicum in the teaching of college mathematics (SPTCM)* – A graduate course offered by the mathematics department in a large mid-western public university. It is intended to prepare new MGTAs for classroom teaching and other teaching related assignments. See Chapter III for a detailed description of the course.

*Teacher autonomy* – Teachers’ ability to make their own decisions about instructional concerns (such as what to teach or how to teach) without being influenced by other authorities. MGTAs usually cannot exercise complete autonomy because they are being supervised by course coordinators. However, experienced MGTAs may enjoy more autonomy than new MGTAs.

*Teaching assistant preparation program* – Course, workshop or orientation that is intended to prepare MGTAs for classroom teaching. These programs are offered by department or university, and include a wide variety of professional development activities.

## **1.9 Chapter I Summary**

In summary, this chapter provided an introduction of this dissertation study. The chapter began with the background and context. This section was followed by the problem statement, statement of the purpose, and research questions. Also included were the discussion around the research approach, researcher’s perspectives and assumptions, and rationale and significance of the study. The chapter ended with the definitions of some of the terminology being used in the study.

## CHAPTER II

### REVIEW OF THE LITERATURE

The purpose of this study was to examine the evolution of MGTAs teaching philosophies, both as pre-service and in-service instructors. The study has attempted to describe teaching philosophies of four purposefully selected MGTA participants before they undergo pre-service training, then track how their philosophies evolve during training, and during the subsequent transitional in-service phase. The study also attempted to describe external factors that affect MGTAs and their teaching philosophies, focusing on the transition from the pre-service to the in-service phase, when external forces are decreasing but acquisition of teacher autonomy is increasing. More specifically, the research attempts to understand:

1. What are the teaching philosophies of beginning MGTAs? How do their philosophies evolve during the pre-service phase?
2. How do their evolving philosophies of teaching (developed during pre-service phase) change/nurture as they transition to an in-service phase when external forces are decreasing but the acquisition of teacher autonomy is increasing?
3. What are the major contributing factors that affect MGTAs and their teaching philosophies during the externally motivated (pre-service) and internally motivated (in-service) phases?

## **2.1 An Overview of Literature Review**

This review of the literature focuses on four major areas (1) pre-service training and teaching preparedness of mathematics graduate teaching assistants (MGTAs), (2) teachers' beliefs about teaching and learning, (3) effects of social and cultural factors on MGTAs, and (4) general theories of learning.

The reviewed literature on pre-service training of MGTAs gives an overview of the problems and challenges they face. It also provides an overview of different types of teaching preparation programs employed by universities in the United States, as well as the issues, challenges, and limitations of such programs. The reviewed literature on teachers' beliefs about teaching and learning focuses on the relationship between their beliefs and their classroom practices. The reviewed literature on social and cultural factors affecting MGTAs focuses on how their perspectives and values are rooted in the cultural contexts in which they were born, raised, and educated. The reviewed literature on general theories of learning offers different perspectives on how MGTAs learn about teaching and learning, and how their teaching philosophies evolve as they enter new cultural and educational settings.

To conduct the literature review, multiple sources of information such as books, research journals, periodicals and digital dissertations were used. These sources were accessed through Digital Dissertations, Eric (through EBSCO), ProQuest and Google Scholar. During the literature review process, especial emphasis was given to research on MGTAs, contexts and assumptions that the studies were based on, findings and implication of the studies for preparing MGTAs and the gaps in the literature.

## **2.2 Teaching Preparedness of Mathematics Graduate Teaching Assistants**

Mathematics Graduate Teaching Assistants (MGTA) in US universities play many significant roles in undergraduate mathematics instruction but they have minimal preparation to teach

(Belnap, 2005; Speer, Gutmann & Murphy, 2005). These roles of MGTAs vary from school to school. Some MGTAs support other instructors by grading, tutoring, and conducting labs or recitation sections, but most are assigned to teach lower division undergraduate mathematics courses (Belnap, 2005). This trend is especially common in research extensive universities, where up to fifty percent of such courses are staffed by MGTAs (Chae, Lim & Fisher, 2009). However, the MGTAs in such universities perceive less departmental support for teaching than their counterparts in the research intensive universities (Latulippe, C.L., 2007).

In order to prepare MGTAs for classroom teaching, mathematics departments in many universities in the United States offer pre-service teaching preparation programs, which range in complexity from multi-day workshops or orientations to semester long academic courses (Belnap, 2005; Speer, Gutmann & Murphy, 2005). Even though mathematics departments put significant effort into these pre-service preparation programs, they are often dissatisfied due to the poor outcomes of such programs (Chae, Lim & Fisher, 2009). According to Belnap (2005), many MGTAs are also not consciously aware of how such programs may have affected their teaching. They do not see the benefits of pre-service professional development programs because they believe that the only way to learn about teaching is by experience (Chae, Lim & Fisher, 2009; Harris, Froman & Surles, 2009). However, as MGTAs begin to teach, many believe that their pre-service preparation did not adequately prepare them for classroom teaching (Moore, 1991).

College mathematics teachers, in general, experience less professional development activities and training in comparison to the primary and secondary school teachers (Harris, Froman & Surles, 2009). As many of the MGTAs have minimal or no previous teaching experiences, they experience several challenges teaching mathematics in undergraduate classrooms (Chae, Lim & Fisher, 2009). Except for some pre-service professional development activities, they do not experience significant support and training from the mathematics departments and universities.



According to Chae, Lim & Fisher (2009), international mathematics graduate teaching assistants (IMGTAs) face even greater challenges than their domestic peers due to cultural differences. Differences in communication styles and behaviors may have contributed to the negative interactions and misunderstandings with their students, and hence the decreased teaching effectiveness (Liu, Sellnow, & Venette, 2006; McCroskey, 2003). American undergraduate students have been found to show unwillingness to have international teaching assistants as their mathematics teachers and also to interact with them (McCroskey, 2002). According to McCroskey (2003), East Asian teachers have been perceived less positively than Latin American and European teachers. Although some attribute this problem to the lack of English language proficiency, it is evident from research that lack of English language proficiency is not the only reason of IMGTA's less effective teaching (Tang & Sandell, 2000).

Trainings of graduate teaching assistants have been found to impact them and their teaching in many ways. According to Harris, Froman & Surlis (2009), MGTAs who participated in semester long professional development activities perceived 'increased confidence and comfort levels' than the ones who did not participate. In a multi-day workshop to promote teaching philosophies of graduate teaching assistants, Schussler et al. (2011) found that the participants identified change in their teaching philosophies from teacher-centered instruction to student-centered instruction. They attributed such changes in their philosophies to the reading of education theories and experienced faculty feedback. Research on participants from a similar workshop showed that workshop attendees tended to change their teaching practices from teacher-centered instruction to student-centered instruction (White et al., 2012).

Among several types of professional development programs such as departmental and campus-wide trainings, GTAs have been found to take mentoring as the most effective form of training (Jones, 1993). In a research conducted on international teaching assistants, Chae, Lim & Fisher (2009) found that the participants did not see the importance of reflecting on their teaching

practices as long as the visible outcomes of their teaching such as their students' average test scores were reasonable.

### **2.3 Teaching Philosophies of Teachers**

Schussler et al. (2011) define the philosophy of teaching as a personal statement of a teacher which answers the question of what it means by teaching and learning to him. Teachers' meaning of teaching and learning are based on their own logic and reasoning. And since peoples' logic and reasoning are different, so are their beliefs and teaching philosophies. Therefore, one of the most important characteristics of a teaching philosophy is its individuality (Chism, 1998; Jenkins, 2011; Schönwetter et al. 2002).

Even though teaching philosophies are highly personal, they also depend on social contexts (Jenkins, 2011). Some education researchers believe that teaching philosophies also depend on particular disciplines. According to Schönwetter et al. (2002), a teaching philosophy statement is a "systematic and critical rationale that focuses on the important components defining effective teaching and learning in a particular discipline and/or institutional context" (p. 84).

Some researchers describe teaching philosophies of teachers as a set or collection of beliefs related to teaching and learning. According to Jenkins (2011), a person's teaching philosophy is "a set of beliefs that reside internally as thoughts and feelings or as a professed set of interrelated beliefs that motivate action" (p. 75). Some describe teaching philosophies as unique views of individuals which describe what they want to accomplish as a teacher and how they think they can accomplish. According to Chism (1998), teaching philosophies are the teachers' description of how they think teaching and learning occurs and how they can intervene in the learning process. For example, what strategies they use for mentoring and engaging students, developing and using resources, and creating a learning environment. Along this line, Schönwetter et al., (2002) also defined a teaching philosophy as "a distinctive set of aims, values, beliefs and

convictions that provide an organizing vision of the teacher's direction and a rationale towards which his or her efforts are geared" (p.84).

## **2.4 Connection between Teachers' Philosophy of Teaching (or Beliefs) and Teaching Practices**

There has been a long debate on whether there is consistency between teachers' beliefs and their classroom practices. Many studies have confirmed that there is a connection between teachers' beliefs and their classroom practices (Jenkins, 2011; Kim, 2011; Lloyd, 2002; Speer, 2008; Thompson, 1992). Jenkins (2011) found that there was a strong relationship between adult educators' beliefs and their teaching practices. It is also worthwhile to note that implementation of reform-oriented teaching practices and teachers' efforts are highly influenced by their existing beliefs, as teachers sometimes modify ideas of reform in order to fit their existing beliefs (Cuban, 1982).

While some researchers claim a strong relationship between teachers' beliefs and their classroom practices, Rimm-Kaufman et al. (2006) stated that teachers holding a set of beliefs do not necessarily translate those beliefs in action, allowing them instead to form "a framework that organizes meaning and inform practices" (p. 143). They state that even the holders of beliefs are sometimes not aware of the ways in which their actions are guided by their beliefs.

Although researchers' opinions vary, most believe that there is a connection between teachers' teaching philosophies (or beliefs) and their teaching practices to some degree. Therefore, it can be inferred that we need to understand the nature of beginning MGTAs' beliefs if we want to help them change their teaching practices.

## **2.5 Nature of Teachers' Beliefs**

Teachers' philosophies of teaching (or beliefs) have been found to change at different stages of their career (Simmons et al., 1999). But they already have made some firm beliefs about teaching and learning by the time they become teachers. The beliefs about teaching develop early due to exposure to formal schooling where they experience or observe teaching by other people (Jenkins, 2011). Their conceptions of teaching are deeply ingrained in their minds due to their exposure to at least 16 years of formal schooling before becoming teachers. These beliefs are initially resistant to change but change slowly as a result of their experience over time (Golombek, 1998).

According to Rimm-Kaufman et al. (2006), teachers' beliefs

(1) are based on judgment, evaluation, and values and do not require evidence to back them up, (2) guide their thinking, meaning-making, decision-making, and behavior in the classroom, (3) may be unconscious such that the holder of beliefs is unaware of the ways in which they inform behavior, (4) cross between their personal and professional lives, reflecting both personal and cultural sources of knowledge, (5) become more personalized and richer as classroom experience grows, (6) may impede efforts to change classroom practice, and (7) are value laden and can guide thinking and action (p. 143).

Teachers' existing beliefs and knowledge "shape how new information and experiences are understood and how new knowledge develops" (Speer, 2008, p. 221). Even experienced teachers' learning and new experiments in teaching are dependent on their earlier knowledge and beliefs about teaching, learning, and students (Borko & Putnam, 1996). Even though teachers' beliefs and philosophy of teaching are resistant to change, they have been found to be influenced by teaching preparation programs and other professional development activities (Richardson, 1996). Their beliefs vary according to the experience they have and the type of training they receive (Rimm-Kaufman et al, 2006).

## **2.6 Significance of Studying Teachers' Philosophy of Teaching (or Beliefs)**

Since teaching philosophies of teachers provide rich sources of information, they have become an important part of the job application and promotion process in many academic institutions

(Ratnapradipa & Abrams, 2012; Schönwetter et al., 2002). The general assumption among teacher educators and researchers is that writing a teaching philosophy statement not only promotes personal and professional development, but also encourages teachers to reflect on their teaching practices and the impacts that their teaching is having on their students (Boyer, 1990). Sharing of teaching philosophy statements with colleagues in the workplace could initiate professional dialogue among teachers, creates opportunities to learn from each other and has potential to identify and develop innovative teaching strategies (Goodyear & Allchin, 1998).

As mentioned earlier, teachers' philosophies of teaching constitute a set of beliefs about teaching and learning. According to Speer (2008), examining a collection of beliefs makes it possible to "describe a teacher's perspective in a manner that reflects the interconnected, distributed nature of beliefs" (p. 235), whereas examining individual beliefs separately will fail to capture the complexity of the teacher's overall views about teaching and learning.

Since teachers' philosophies of teaching have been found to change at different stages of their career (Simmons et al., 1999), an explanation of the teachers' changing conception of teaching and learning provides insights into the goals of teachers, how they teach, how they justify their practices, and how their teaching has or will have impact on student learning (Schönwetter et al., 2002). They are powerful means for understanding their knowledge, perspectives, and classroom practices, making them a rich source of information. Therefore, careful examination of teaching philosophies provides insight into the possible support structures teachers might need for effective classroom instruction and designing effective preparation programs (Hart, 2004; Simmons et al., 1999). Failure to examine pre-service or beginning teachers' beliefs and intervene accordingly can slow down their development as teachers (Morton et al., 2006). According to Pajares (1992), "unexplored entering beliefs may be responsible for the perpetuation of antiquated and ineffectual teaching" (p. 328). These statements would imply that examining the entering beliefs of beginning teachers, like MGTAs in this study, would be beneficial for the

purpose of designing and training. As these MGTAs come from different parts of the world, they bring their own perspectives about teaching and learning with them. It is reasonable to assume that incorporating MGTAs' perspectives in teaching preparation programs would be beneficial to change or nurture their views about teaching. Jenkins (2011) found that many teachers often expressed dissatisfaction with professional development activities that did not incorporate their perspectives, perceiving them as "controlling and irrelevant" (p. 85) to their teaching practices. She argues that professional development activity "that fails to take into account teachers' philosophies of teaching is doomed to disappointing results" (p. 77).

It is evident from research, as mentioned before, that there is connection between teachers' beliefs and their classroom practices. Like other teachers, if MGTAs' beliefs are resistant to change, so are their classroom practices. In order to understand the beliefs and perspectives of beginning MGTAs on teaching and their professional development, researchers and teacher educators have suggested studying individual teachers in depth (Thompson, 1992; Speer, Gutman & Murphy, 2005). However, little research exists that attempts to examine and describe beginning and evolving teaching philosophies of MGTAs.

## **2.7 Theoretical Framework**

The framework for this study is based on the extension of Vygotsky's sociocultural theory to adult learning, the context-based adult learning theory.

The model of sociocultural learning theory posits that there needs to be a context for learning to occur, and the learning is shaped by the culture and the tools available in the learning situation (Vygotsky, 1978). According to Wertsch (1991a), one of the fundamental assumptions of the sociocultural theory is that "human mental functioning is inherently situated in social, interactional, cultural, institutional, and historical contexts" (p. 86). Learning is not just

something that happens inside someone's brain, it cannot be separated from the context and the experience of the learner (Hansman, 2001; Merriam & Caffarella, 1999).

Some important concepts of sociocultural theory are *zones of proximal development (ZPD)*, *internalization*, *scaffolding*, *intersubjectivity*, *cognitive apprenticeship*, and *assisted learning* (Vygotsky, 1978). The term ZPD is the distance between two developmental levels: what learners can do independently and what they can do with external guidance. The ZPD is understood to be a zone that is beyond the reach of learners attempting to solve a problem independently but can be brought within their reach if proper external support is provided (Bonk & Kim, 1998). As learners can perform an activity effectively with the support of the more knowledgeable person, the process becomes gradually internalized as self-regulatory. This process, which happens after the ZPD is created, is called internalization. According to Vygotsky (1978), learning occurs first at the social level and then at the individual level. During the process of internalization, the experience or skills learned from a social context is processed inside the learner's mind and an understanding is developed to fit into his own independent use (Bonk & Kim, 1998).

*Scaffolding* is a step by step guidance provided to the learner in order to gain a skill, complete a task which the learner would not be able to complete independently without the external aid. According to Bonk & Kim (1998), the process of scaffolding includes understanding learner's interest, motivating him, controlling his frustration, providing emotional support, reducing complexity, hinting, elaborating, linking, and gradually fading the support. During scaffolded learning, according to Palincsar (1986), the learner not only completes a task by gaining mastery but also notices his flaws and generates new hypotheses (as cited in Bon & Kim, 1998, p. 70). Gaining mastery of skills would have been very difficult without external help.

*Intersubjectivity* refers to the shared thoughts, values and understanding among the members of a group. It is a “temporary shared collective reality of basic processes, thoughts, ideas, emotions, content, values, or goals” (Bonk & Kim, 1998, p. 71). It is those common values and understandings that help people “negotiate meaning, construct new knowledge and restructure problems in terms of the perspectives of another” (Bonk & Kim, 1998, p. 71).

Although Vygotsky’s sociocultural theory is focused on children’s learning, researchers contend that its tenets can also be extended to adult learning. Millis, Davidson, and Cattel (1994) argue that adult educators are already changing adult education curricula to more interactive learning experiences, a departure from traditional teacher-centered curricula which focus on memorizing and acquiring skills of context (as cited in Bonk & Kim, 1998, p. 73). Effective adult learning occurs when adults are provided with self-directed learning opportunities, and their prior knowledge and experiences are valued and respected (Bonk & Kim, 1999). In collaborative learning, working adults receive learning assistance from their friends or other more experienced and knowledgeable members of the community as well as from tools such as books, mass media and computers (Bonk & Kim, 1999).

An important theory in context-based adult learning is *situated cognition*, which incorporates many of the aspects of Vygotsky’s sociocultural theory. *Situated cognition* refers to the idea that learning occurs primarily in the social context. The relationship among people in a social context, the activities they participate in, and the tools they use all play vital roles in the learning process. The context itself cannot contribute enough for effective learning to occur if there is no meaningful interaction of the learner with other learners in the group (Hansman, 2001). From a situated perspective, Fenwich (2000) argued that new members learn from more experienced others in the group as they become actively involved in the community, interact with each other and participate in its assumptions, rules and cultural values (as cited in Hansman, 2001, p. 46). In



the context of practice, the interactions among learners are “characterized by modeling of both mastery of practice and the process of gaining mastery” (Jacobson, 1996, p. 23).

Ideas of adult learning from other more experienced member of the community has given rise to a concept called cognitive apprenticeships (Farmer, Buckmaster, & LeGrand Brandt, 1992; Hansman, 2001; Rogoff, 1990). The term refers to a relationship between a mentor and his mentees in which a mentor helps mentees develop their cognitive skills in a socially interactive learning environment. In continuing professional education, such relationships occur in five sequential phases: *modeling*, *approximating*, *fading*, *self-directed learning*, and *generalizing* (LeGrand Brandt, Farmer & Buckmaster, 1993). According to Hansman (2001), *modeling* has two parts: behavioral modeling and cognitive modeling. In behavioral modeling, learners develop by observing more experienced and knowledgeable members in action. In cognitive modeling, more knowledgeable experienced members of the community deliberately share their skills and knowledge as ‘tricks of the trade’ with other participants (Hansmen, 2001). According to Hansman (2001), *approximating* allows learners to clearly articulate their thoughts about what and why they plan to do something before performing an activity. Once the activity is performed, it also allows the learners to reflect on their activities and compare their performance with that of the experts. During this phase, experienced members or experts provide scaffolding to learners such as physical aids, modeling tasks, and coaching in order to facilitate learning while minimizing the risks (Hansmen, 2001). In the *fading* process, as the new members become more experienced and able, the scaffolding provided by the experts begins to fade gradually. During the *self-directed learning* phase, the participants begin to perform activities independently in the real world based on what they learned from modeling. Experts provide occasional support as per the request of the learners. During the *generalizing* phase, the learners generalize their learning from discussion and their own practices, and employ their learning in the real world situations.

In the case of this dissertation study, the context was teaching mathematics while pursuing a graduate study in that discipline at a single university. In this context, MGTAs learn formally as well as informally through social interactions among themselves, and also with their instructors, mentors, course coordinators, and undergraduate students. The tools they used include books, journal articles, electronic resources, calculators, and computers. Mentors, instructors and experienced peers are the ‘experts’ from whom they model good teaching. MGTAs thus “move through apprenticeships with coaching and scaffolding... within academic culture” (Hansman, 2001, p. 47).

Beginning MGTAs have already conceptualized teaching and learning mathematics from at least 16 years of their experience as students. Their teaching practices and attitudes reflect the ways they were taught. Therefore, these perspectives are a function of culture and social interactions. As they begin interacting with people in the new context and culture, they begin to learn about teaching in accordance with the norms and values of that context. Their beliefs, views, and philosophy of teaching largely depend on their current knowledge. As they accumulate knowledge about teaching and learning gradually through the interaction with other people and their own teaching experiences, their philosophy of teaching also change.

## **2.8 Chapter II Summary**

In summary, the chapter discussed an overview of the literature review. This review of the literature focused on pre-service training and teaching preparedness of MGTAs, teachers’ beliefs about teaching and learning, effects of social and cultural factors on MGTAs, and general theories of learning. The chapter ended with a description of the theoretical framework employed to understand the learning of MGTAs about teaching mathematics.

## CHAPTER III

### METHODOLOGY

The purpose of this study is to examine the evolution of mathematics graduate teaching assistants' (MGTAs) teaching philosophies, both as pre-service and in-service instructors. The study attempts to describe teaching philosophies of four purposefully selected MGTA participants before they undergo pre-service training, then track how their philosophies evolve during training, and during the subsequent transitional in-service phase. The study attempts to describe external factors that affect MGTAs and their teaching philosophies, focusing on the transition from the pre-service to the in-service phase, when external forces are decreasing but acquisition of teacher autonomy is increasing. The researcher expects that the findings of this study would inform training practices and offer new insights into effective ways of providing support for MGTAs.

Based on the researcher's experiences as an MGTA and as a student of mathematics education, and on my observation of the fall 2012 teaching assistant preparation class, I perceived that MGTAs from different countries bring different cultural values and perspectives about teaching and learning mathematics with them. The teaching assistant preparation course 'Seminar and Practicum in the Teaching of College Mathematics' (SPTCM) is a specially designed course integrating seminar and practicum experiences (see Chapter III for the description of this course).

The researcher also perceived a value conflict between the instructor of the SPTCM course and the MGTAs and also among the MGTAs. During informal discussions with the researcher, many MGTAs expressed their feeling that content knowledge and fluency in English was sufficient for classroom teaching.

It has been established that MGTAs' beliefs and philosophies of teaching guide their classroom practices (Kim, 2011; Speer, 2008). These philosophies have been shown to vary at different stages of their career, so careful examination of their evolving philosophies can help us understand how they view themselves as instructors, and may provide insight into support structures needed for effective classroom instruction (Simmons et al., 1999).

Some studies have attempted to examine the relationship between MGTAs' beliefs and their classroom decisions (Belnap, 2005; Kim, 2011; Speer, 2008). These studies found that there is a relationship between teachers' beliefs and their classroom practices. But little research exists concerning in-depth understanding of beginning MGTAs' philosophies of teaching and describing changes in these philosophies during pre-service and in-service. Moreover, very few studies have described factors that affect MGTAs and their teaching philosophies. I am therefore interested in understanding:

1. What are beginning MGTAs' teaching philosophies? How do their philosophies evolve during the pre-service phase?
2. How do their evolving philosophies of teaching (developed during pre-service phase) change or nurture as they transition to an in-service phase when external forces are diminishing but acquisition of teacher autonomy is increasing?
3. What are the major contributing factors that affect MGTAs and their teaching philosophies during the externally motivated (pre-service) and internally motivated (in-service) phases?

This chapter describes the rationale for the research design, as well as the methods that was employed to conduct the study. It is organized into the following sections:

- Theoretical Perspectives
- Rationale for choosing a qualitative research design
- Rationale for conducting case studies
- Selection of research participants
- Data collection and data analysis
- Research participants and setting
- Ethical considerations
- Ensuring trustworthiness
- Limitations of the study
- Summary

### **3.1 Theoretical Perspectives**

The epistemology underlying this dissertation study is constructionism. Construction is sometimes also referred to as radical constructivism (VonGlaserfeld, 1995). The epistemology of constructionism adopts the view that social phenomena cannot be described purely objectively because their descriptions vary from person to person based on their interpretations of the phenomena. The interpretations of the phenomena are determined by the interactions of the humans with their world. According to Crotty (1998), meaningful reality is constructed in and out of the human interaction with their world and among each other.

The researcher therefore also constructs his understanding based on his interaction with the research participants and being engaged with the data. Any interpretation and understanding of the data is determined by the subjectivity of the researcher. The researchers therefore should make their perspectives and assumptions explicit before conducting this study. They should also articulate all the steps of the research process including the procedures for data collection and analysis. This epistemology of constructionism guided the researcher's analysis of the data: constructing meaning by constantly engaging with the data in an iterative manner.

### **3.2 Rationale for Qualitative Research Design**

Qualitative methods was employed to conduct this study. Qualitative research is “grounded in an essentially constructivist philosophical position, in the sense that it is concerned with how the complexities of the sociocultural world are experienced, interpreted, and understood in a particular context and at a particular point in time” (Bloomberg & Volpe, 2008, p. 80).

Emphasizing the differences between qualitative and quantitative research, Merriam (1995) writes:

Qualitative research assumes that reality is constructed, multidimensional, and ever-changing; there is no thing as a single, immutable reality waiting to be observed and measured. Thus, there are interpretations of reality; in a sense the researcher offers his or her interpretation of someone else's interpretation of reality. (p. 54)

The goal of qualitative study is to enter the world of others, examine their social situation, and attempt to gain an in-depth understanding of their perspectives and experiences (Maxwell, 2005; Patton, 1990). A qualitative study is focused on discovery and description rather than testing hypotheses and generalizing facts (Bloomberg & Volpe, 2008). It is concerned with describing a social situation or experience of individuals in that situation and interpreting the meaning of these experiences or situations to the individuals (Denzin & Lincoln, 2000). Qualitative study attempts to understand the perspectives, feelings, and emotions of subjects, which are difficult to measure by numbers and generalize from one context to another. These and other key features of a

qualitative study such as “understanding the processes by which events and actions take place, developing contextual understanding, facilitating interactivity between researcher and participants and adopting an interpretive stance” (Bloomberg & Volpe, 2008, p. 80) make qualitative research the best fit for my study. This is because the purpose of this study is to understand and describe the teaching philosophies of MGTAs, their thoughts, feelings, and perspectives in a context of teaching mathematics while pursuing a graduate study at one particular university.

Quantitative research, based on the description of the research, is less suitable for obtaining the rich data necessary to examine MGTAs’ situations and answer the research questions of this study. A quantitative study offers less flexibility to examine and understand situations as events, and the study, unfold.

### **3.3 Rationale for Choosing Case Study Methodology**

The primary intention of this study is to gain an in-depth understanding of MGTAs’ philosophies of teaching mathematics, to describe how these philosophies change over time and what factors are responsible for such a change at different stages of their period as graduate teaching assistant. As a form of qualitative research design, the researcher believes that multi-case study is the most suitable research design for this study. A case study, according to Merriam (1998), is a research design in which the primary goal of a researcher is to gain a deep and holistic understanding of a situation and meaning for the participants involved. It is “a detailed, intensive study of a particular, contextual and bounded phenomenon that is undertaken in real life situations” (Luck, Jackson, & Usher, 2006, p. 104). One would use a case study method if he or she wants an in-depth understanding of a real life phenomenon (Yin, 2009) but such understanding should encompass important contextual conditions that are pertinent to the phenomenon of study. According to Swanborn (2010), a case study refers to

a social phenomenon in which the researcher focuses on process-tracing: the description and explanation of social processes that unfold between persons participating in the process, people with their values, expectations, opinions, perceptions, resources, controversies, decisions, mutual relations and behavior, or the description and explanation of processes within and between social situations. (p. 13)

### **3.4 Selection of Research Participants**

A purposeful sampling procedure was employed to select a sample of 4 MGTAs in the mathematics department. A purposeful sampling is a sampling strategy in which the researcher selects an information-rich sample based on his/her logic and judgment. Qualitative inquiry, as Patton (1990) writes, “typically focuses in depth on relatively small samples, even single cases (n=1), selected purposefully” (p. 169). Within the purposeful sampling, the researcher used the Maximum Variation Sampling strategy to select the sample. In a Maximum Variation Sampling, participants are selected because they represent “the widest possible range of the characteristics being studied” (Bloomberg & Volpe, 2008, p. 191). A great deal of heterogeneity among participants of small sample could be a problem because individual cases could be so different from each other. However, any common patterns emerging from such variation are of “particular interest and value in capturing the core experiences and central, shared aspects or impacts of a program” (Patton, 1990, p. 172). Four MGTAs, two domestic and two international, who have completed the Seminar and Practicum in the Teaching of Collegiate Mathematics (SPTCM) course in fall 2012 semester, were selected. Among the four participants, to include the maximum variation possible, two male and two female students were selected to participate in the study. The researcher’s assumption was that the proposed sample of MGTAs best represents the MGTA population in the mathematics department at this large public university and other similar research universities in the United States.

### **3.5 Overview of Research Design**



Besides the literature review process, the following provides an overview of my research design to conduct the study:

- The researcher acquired an approval from the Institutional Review Board (IRB) to conduct the study. The review process consists of submitting to the IRB the procedures and process to conduct the study. This also includes an adherence to the standards of conducting qualitative research on human subjects.
- Potential research participants were contacted and requested in person to participate in the study. Potential participants were current MGTAs who had completed the SPTCM course in the fall 2012 semester.
- The researcher collected and analyzed the written teaching philosophy statements of the member participants who agreed to participate. These teaching philosophy statements are those statements that MGTAs have submitted to the course instructor when they were enrolled in the SPTCM course.
- Three semi-structured interviews were conducted with each selected participant: first in the summer 2013, second in the fall 2013, and the third in the spring 2014 semester. The interviews were audio taped and transcribed verbatim. These interview transcriptions will be analyzed.
- Faculty and peer feedback was sought while analyzing and interpreting the data.
- Member check strategy was employed to confirm or confront some initial interpretations of the data or some misleading information provided by the research participants.

### **3.6 Data Collection and Data Analysis**

In order to get an in depth understanding of the phenomenon under study, the researcher employed a number of data collection strategies. According to Creswell (2007), multiple techniques and sources of data collection “provide corroborative evidence of the data obtained” (p. 82).

As archival documents, electronic copies of the teaching philosophy statements of MGTAs from their pre-service phase was collected. These were the same philosophy statements that they had submitted to the instructor of the SPTCM course during their enrollment in the course. The instructor who taught the course in the 2012 semester retained these philosophy statements, and provided to the researcher with the consent of the participants. The researcher also conducted one-on-one interviews and member check with the participants. Merriam (1998) states that interviews are the most common form of data collection method in a qualitative case study research. Interviews are usually helpful to find out information such as beliefs, attitudes, feelings and emotions from the people that cannot be observed directly. We cannot observe what meaning people attach to the world around them (in this context, teaching and student learning of mathematics) and therefore we need to ask them questions to know that (Patton, 1992, p. 341). According to Bloomberg & Volpe (2008), qualitative interviewing is an “attempt to understand the world from the subject’s point of view, to unfold the meaning of peoples’ experiences, to uncover their lived world...” (p. 82). The researcher believes that interviewing is most suited to know what meaning MGTAs attach to teaching mathematics and student learning, how their teaching philosophies of teaching are changed over time and what factors are responsible for such a change. Semi-structured interviews were conducted and audio-taped, which were then transcribed verbatim for analysis.

The data was analyzed based on the constant comparative method (Strauss & Corbin, 1990), using mostly open coding techniques. After carefully reading all the teaching philosophy statements and interview transcripts, the researcher identified the texts in each data source that he

felt were the important pieces of information regarding the research questions. All those pieces of information such as participants' quotes were transferred in separate index cards as an initial step of data analysis. The source information (such as interview one with second participant etc.) and the location (page number, line number etc.) of the texts in each such card were noted. These cards were sorted into different groups according to the information noted in the cards that I think would go together. Once the researcher completed the grouping process, he reread each sorted group and assigned the group a category name. The cards were reshuffled and the same process was repeated until no new categories emerged (Emerson et al., 1995). The themes that emerged from the process were then identified and recorded.

In order to confirm/contradict initial findings, the researcher used 'member check' strategy. A member check strategy is one in which a researcher seeks participant's opinion on researcher's initial interpretation of the data extracted from the participant. During member check, researchers also seek more information or clarification on some misleading information (if any) provided by the participants.

### **3.7 Research Participants and Setting**

The participants of this dissertation study are the mathematics graduate teaching assistants who had completed a pre-service preparation program during the fall 2012 semester from a Midwestern research institution. The participants were pursuing their graduate study and also teaching lower division mathematics courses during the period of this study. Below are a short description of the pre-service preparation program, and the research participants.

### **3.8 Seminar and Practicum in Teaching College Mathematics**

Seminar and Practicum in Teaching College Mathematics (SPTCM) was a mandatory semester-long preparation program for beginning mathematics graduate teaching assistants (MGTAs) during the first semester of their graduate program. They did not have any teaching or grading

assignments during the semester. This plan provided beginning MGTAs with an opportunity to make necessary adjustments in their graduate program, and to complete prerequisite language requirements for international MGTAs. In order to prepare them for actual classroom teaching assignments, they were required to participate in this professional development program.

MGTAs in this course learned pedagogical knowledge and other classroom management skills through a combination of weekly discussion with the instructor and their peers, and classroom practicum experiences. The principal elements of this seminar/practicum in support of meeting the course objectives were the following.

*Weekly Seminars.* MGTAs were expected to complete all out of class assignments such as written assignments (syllabi, lessons, exams, papers, etc.) and retain them as part of their course portfolios.

*Classroom Practicum.* MGTAs are placed with experienced instructors who serve as their mentors. MGTAs were expected to participate in all assigned activities prescribed by their mentors. MGTAs are expected to maintain logs of their practicum experiences in their course portfolios; following each class meeting, they were required to write down their observations, questions, and reflections on the class session in their practicum logs - these were discussed in the regular seminar meetings each week. Periodically, the logs are reviewed by the instructor.

MGTAs prepared and delivered actual classroom presentations under the direct supervision of their mentors. MGTAs were required to write reflections of their own presentations, discuss these reflections with peer MGTAs (who also wrote reflective comments related to their observations of the presenter), and revisit their presented lessons. Mentors submitted an evaluation of the MGTAs' performance at the end of the semester.

*Enthusiasm.* MGTAs were expected to participate enthusiastically in all seminar and practicum activities. Weekly class discussions, readings and writing assignments were crafted to improve international MGTAs' English language skills.

A faculty member was assigned as a mentor for each MGTA. MGTAs were required to observe their mentors' classes and visit their offices for completing assigned activities and asking any questions they had. It was intended to establish a professional relation between them which could provide MGTAs opportunity for a long term professional development even after the conclusion of the course.

Almost every weekly seminar began with a repertoire of student issues related to decision making and classroom management initiated by the instructor or MGTAs. They were encouraged to express their opinion about how they would respond or act to such student issues. This type of discussion gave MGTAs some opportunities to learn about instructional decision making.

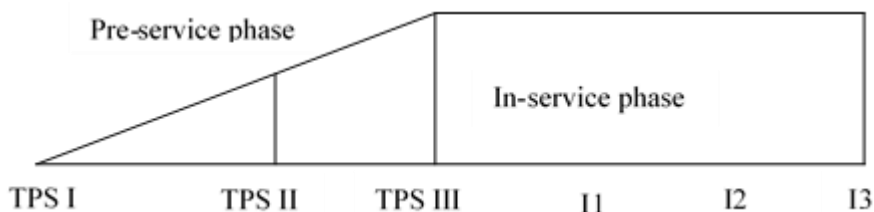
MGTAs were required to learn routine activities such as preparing syllabi, writing exams, using technology in the classroom, maintaining grade book, and posting student grades from their mentors. During the discussions, they were encouraged to share their learning from the mentors, and share their observations, questions, and reflections they had noted from class observations. This provided MGTAs opportunities to learn from multiple perspectives.

MGTAs were involved in activities such as grading actual student homework and exams. In the following week, they are required to present and justify their grading algorithm. This activity provided them an opportunity to learn how others see things differently and also to reflect on their own decisions.

Besides several other reading and writing assignments, MGTAs were assigned a particularly introspective assignment related to 'Developing Your Philosophy of Teaching'. This assignment was completed in three installments. The first one was assigned at the beginning of the semester,

one at the middle of the semester and the last one at the end. The intention of such writing assignments was to encourage them to reflect on their beliefs and revise about what an effective teaching meant for them. The tentative model that illustrates MGTAs' increased assumptions of responsibility is shown in Figure 1.

**Figure 1: Model that Illustrates MGTAs' Increased Assumptions of Responsibility**



In summary, the intention of this preparation program was to provide opportunities for MGTAs to learn from a combination of seminar and practicum experiences; experienced faculty and self-reflection. The intention was also to provide them opportunities to seeing things from multiple perspectives and model their own philosophy of teaching.

### 3.9 Description of the Participants

*Participant I: David.* David was a 23 year old first year Master's degree student during the fall 2012 semester. He was an international graduate student who came from a south Asian country. He completed high school in his home country before pursuing a bachelor's degree in a medium-sized university in the mid-western US. He planned to pursue a Ph.D. degree in applied mathematics and his career goal was to become a mathematics professor. He was fluent in spoken English, but with a noticeable accent.

His only previous teaching experience was tutoring mathematics as an undergraduate. He observed his mentor's college algebra class during the SPTCM experience in the fall 2012 semester. He conducted two recitation sections of business calculus course (MATH 2103) in the

spring 2013, did not teach any course during the summer 2013, taught two sections of college algebra course as an instructor in the fall 2013, and two sections of trigonometry course (MATH 1613) in the spring 2014 semester.

During the seminar sessions of the teaching assistant preparation course Seminar and Practicum in the Teaching of Collegiate Mathematics (MATH 5902), the researcher noticed that he used to answer the instructor's questions, but he was not an active participant in the class discussion. He observed his mentor's classes and submitted his course assignments on a regular basis.

*Participant II: Andrew.* Andrew was a 27-year-old domestic graduate student who was working on a Ph.D. in pure mathematics. He grew up in the southwestern United States, where he was home schooled during the last three years of high school. He then went to a nearby junior college, before transferring to a university in the same part of the country, where he finished his undergraduate degree. He said that he had a lengthy undergraduate experience because he switched his major a couple of times.

His only previous teaching experience was tutoring undergraduate students during his undergraduate study years. He observed the differential equations class during his SPTCM experience. He taught two sections of Functions (MATH 1483) in the spring 2013 semester, and a section of business calculus course (MATH 2103) during the summer 2013 semester, and two section of Calculus I (MATH 2144) in the fall 2013 and one section of the same course in the spring 2014 semester. He said that he did not want to teach in his future career.

*Participant III: Rebecca.* Rebecca was a 23 years old masters' student in applied mathematics and did not have a plan to pursue her Ph.D. She completed her undergraduate degree in mathematics and information technology at a small Catholic University in the mid-western United States. She also graduated with a minor in accounting. Her career goal was to work in the

private sector after graduation, but said that she would return to teaching if she did not enjoy the private sector.

She did not have any classroom teaching experience before starting her graduate program in mathematics. Her only previous teaching experience was tutoring freshmen while she was an undergraduate. She observed college algebra course during the SPTCM experience during the fall 2012 semester. She taught a section of a precalculus course (MATH 1715) in the spring 2013, a section of college algebra course (MATH 1513) in the summer 2013, and two sections of the calculus I course (MATH 2144) in each of the fall 2013 and spring 2014 semesters. The researcher noticed that Rebecca was an active participant in the seminar discussions.

*Participant IV: Jennifer.* Jennifer was a 30-year-old international student who completed her high school, undergraduate, and masters' degrees in a north-east Asian country. She was a Ph.D. student in pure mathematics, and her career choice was to become a mathematics professor in the future. She spoke English with a foreign accent; during the interviews, she had difficulty understanding some of the interview questions and expressing her opinions.

She taught college mathematics in her home country for five years, she said that she taught mostly upper division undergraduate mathematics courses. During the fall 2012 semester, she observed differential equations course during the SPTCM experience. In the spring 2013, she taught two recitation sections of business calculus, but did not teach any courses during the summer 2013 semester. She conducted two recitation sections of pre-calculus course in each of the fall 2013 and spring 2014 semester.

The researcher noticed that Jennifer was not an active participant during the seminar discussions. She used to express her opinions only if she was asked.

An outline of these research participants' experiences during their pre-service and in-service phases is summarized in the Table 1.



**Table 1:** Outline of MGTAs experiences

Participants	Fall 2012	Spring 2013	Fall 2013	Spring 2014
David	SPTCM course* Observed college algebra	Taught business calculus Role: recitation leader	Taught college algebra Role: instructor	Taught trigonometry Role: instructor
Andrew	SPTCM course* Observed diff. equations	Taught functions Role: instructor	Taught calculus I Role: instructor	Taught calculus I Role: instructor
Rebecca	SPTCM course* Observed college algebra	Taught precalculus Role: instructor	Taught calculus I Role: instructor	Taught calculus I Role: instructor
Jennifer	SPTCM course* Observed diff. equations	Taught business calculus Role: recitation leader	Taught precalculus Role: recitation leader	Taught precalculus Role: recitation leader

\*Enrollment in the SPTCM course (Math 5902) was mandatory for all beginning MGTAs.

### 3.10 Ethical Considerations

A qualitative researcher should always be respectful of participants' privacy and be mindful of the consequences of participation in the study (Patton 1990, Creswell, 2007). A qualitative researcher is responsible for informing and protecting the research participants (Bloomberg & Volpe, 2008).

A number of ethical considerations was considered before conducting the study. First of all, an approval was sought from the Institution Review Board (IRB) to conduct the study and the potential participants were requested to participate in the study. Second, each research participant was asked to fill out an informed consent form about voluntarily participating in the research study. In the informed consent form, the purpose of the study and the participants' rights to continue or discontinue participating in the research study was clearly explained. Third, all the basic information of the participants such as their names and any other information that would potentially identify the participants was kept confidential. Each participant was assigned a pseudonym for the purpose of reporting the research findings. Finally, all necessary measures to

keep the research related documents and records secured were employed so that only the researcher had access to those materials.

### **3.11 Ensuring Trustworthiness**

Trustworthiness in qualitative research is the counterpart of validity and reliability in quantitative studies. The issues of validity and reliability in qualitative and quantitative research are different. According to Merriam (1995), “studying people and human behavior is not the same as studying inanimate matter” (p. 55). Because human behavior is never static, replicating a phenomenon in qualitative research as in quantitative research is very difficult, if not impossible. Also, perspectives and interpretations vary from individual to individual, “there is no benchmark by which one can take repeated measures and establish reliability in the traditional sense” (Merriam, 1988, p. 170) in qualitative studies.

To describe the trustworthiness of quantitative and qualitative studies, there are four terms that qualitative researchers generally use: *credibility*, *dependability*, *confirmability*, and *transferability* (Bloomberg & Volpe, 2008).

#### *Credibility*

In qualitative research, credibility refers to the issue of “whether the findings are accurate and credible from the standpoint of the researcher, the participants, and the reader” (Bloomberg & Volpe, 2008, p. 86). Credibility depends on three distinct but related elements: the credibility of data collection and analysis techniques, the credibility of the researcher, and the philosophical beliefs in the value of qualitative inquiry (Patton, 1999).

To ensure the credibility of the study, qualitative researchers usually triangulate data sources and the methods of data collection. Researchers also use analyst triangulation, in which multiple people or experts are asked to analyze the data. Triangulation in qualitative research refers to the

use of multiple sources and methods of data collection and analysis, and also the use of multiple analysts. According to Bloomberg & Volpe (2008), "... gathering data from multiple methods yields a fuller and richer picture of the phenomenon under review" (p. 86). In this study, the researcher used triangulation in data sources and data collection methods, using written philosophy statements, multiple one on one interviews, and member checks. Feedback on the researcher's initial interpretation of the data from the research participants was sought (through member checking) as a means to test the credibility of my findings. Analyst triangulation was also used by asking two other mathematics education experts to code and analyze all three written teaching philosophy statements of two participants.

### *Dependability*

Qualitative researchers use the term *dependability* instead of the term 'reliability' that researchers in hard sciences generally use (Lincoln & Guba, 1985). Dependability refers to "whether one can track the processes and procedures used to collect and interpret the data" (Bloomberg & Volpe, 2008, p. 78). According to Merriam (1995), qualitative researchers are concerned with whether the findings of the research are dependent or consistent on the data collected, not with whether similar findings are obtained from other such studies. She has suggested using three strategies to ensure the consistency between data and results: triangulation, peer examination and audit trail (p. 56).

The researcher paid special attention to whether the findings would be dependent or consistent with the data and the data collecting procedures. To do so, the analysis of two mathematics education experts was compared with that of the researcher, and the differences in the interpretations were seen and addressed carefully. The researcher is open to making the data available for other researchers for review.

The term 'audit trail' in qualitative research, first used by Guba and Lincoln (1981) refers to the detailed description of how the study was conducted, how the data were collected, analyzed and interpreted. It is similar to the audit of a business account in which an auditor verifies the account of the business. The description of the study should be so detailed that "other researchers can use the original report as an operating manual by which to replicate the study" (Goetz & LeCompte, 1984, p. 216). The researcher has attempted to provide a detailed description of the study including the methods of data collection and analysis, decisions made, and the interpretation of the study when reporting the findings of the study.

### *Confirmability*

The term *confirmability* in a qualitative study is the counterpart of the term 'objectivity' in the pure sciences. While conducting a qualitative study, there is a danger of investigator's bias being included in the findings. A qualitative researcher should be careful, as far as possible, to help ensure that the findings of the research are "the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher" (Shenton, 2004, p. 72). In other words, the findings of the research should be kept distant from the biases and the subjectivity of the researcher. To achieve this, Bloomberg and Volpe (2005) state that a qualitative researcher must "identify and uncover the decision trail for public judgment" (p. 87). They further emphasize that a researcher must describe in detail why their approach was favored over other approaches and how their data "can be traced to its origins" (p. 87). According to Shenton (2004), "detailed methodological description enables the reader to determine how far the data and constructs emerging from it may be accepted" (p. 72). An 'audit trail' (Lincoln & Guba, 1985) allows the readers "to trace the course of the research step-by-step via the decisions made and procedures described (Shenton, 2004, p. 87). The researcher should also admit the weakness of the techniques employed to conduct the study.

The researcher has attempted to provide the detailed methodological description of the approaches employed to conduct the research while reporting findings to provide readers an opportunity to assess the findings of the research and the context in which the study was conducted.

### *Transferability*

*Transferability* is “the fit or match between the research context and other contexts as judged by the reader” (Bloomberg & Volpe, 2008, p. 78). It is the qualitative equivalent to the quantitative concept of generalizability. Qualitative findings are not expected to be generalizable but it is important for readers of qualitative research to be able to transfer a study’s methods to other settings. To facilitate this transfer, the researcher has attempted to provide a detailed, ‘thick description’ of the study’s context and participants.

### **3.12 Limitations of the Study**

Delimitations are the boundaries that the researcher set in order to narrow the scope of this study. Some delimitations of this study include that this study focuses on the MGTAs at only one research institution. The results of this study therefore cannot be generalizable to all other settings, however, it may be transferrable to other similar contexts.

There are some limitations of this study. One such limitation is related to the limitation of the qualitative research methods itself, although qualitative research methods was considered to be the best fit by the researcher. Interpretation of the data is limited by the subjectivity of the researcher. However, the researcher attempted to minimize this limitation of this study by seeking feedback of other mathematics education experts at several stages of the research process. Two other colleagues were asked to code some portion of the data in order to establish the intercoder reliability.

Another limitation is that the number of participants is too small, which may not best represent the actual MGTA population in the American universities. For example, the international MGTA participants represented only two countries, but several other countries are the sources of international MGTAs.

MGTAs went through different experiences even if they were in the same institution. For example, they observed different classes of different instructors, and also taught different courses. The roles of these MGTAs were different; some taught courses as instructors of record while a participant was just a recitation leader in all three semesters. Moreover, they had different mentors and course coordinators which is likely to cause some variations in the learning of these MGTAs.

### **3.13 Chapter III Summary**

In summary, this chapter provided a detailed descriptions of the research methodology employed to conduct this study. Rationale for choosing a qualitative research design, rational for conducting case studies, selection of research participants, data collection and data analysis, research setting and participants were described in the chapter. Moreover, ethical considerations, ensuring trustworthiness, and limitations of this study were also discussed.

Qualitative methods was applied in an attempt to understand MGTAs' philosophy of teaching, how their philosophy of teaching changes over time and the factors that are responsible for such a change. The participant sample was chosen purposefully, and data included MGTAs' teaching philosophy statements and individual interviews. The audio-taped interviews was then transcribed and analyzed using the constant comparative method, mostly using the open coding techniques.

Issues of trustworthiness were addressed by triangulating between data sources and data collection methods, employing peer examination, and providing a detailed description of the research study when reporting findings. The researcher believes that the knowledge generated

from this study would be useful for MGTA preparation program designers to make more informed decisions to incorporate MGTAs' perspectives on their teaching and training to make such programs more effective.

## CHAPTER IV

### RESULTS

The purpose of this study relates to exploring with four purposefully selected mathematics graduate teaching assistants (MGTAs) their beginning and changing philosophies of teaching during their pre-service and in-service phases as mathematics instructors. It also relates to describing the factors that affect their philosophies of teaching during the pre-service phase and the subsequent transitional in-service phase. This chapter will present the results of this multi-case study from the data analysis employed to examine the following research questions.

1. What are beginning MGTAs' teaching philosophies? How do their philosophies evolve during the pre-service phase?
2. How do their evolving philosophies of teaching (developed during pre-service phase) change or nurture as they transition to an in-service phase when external forces are diminishing but acquisition of teacher autonomy is increasing?
3. What are the major contributing factors that affect MGTAs and their teaching philosophies during the externally motivated (pre-service) and internally motivated (in-service) phases?



This section presents the results of the data analysis obtained by analyzing three teaching philosophy statements collected from each of the four participants from the pre-service phase, and three one-on-one interviews with each participant from the subsequent in-service phase. The themes obtained from data analysis, and the factors that influenced these research participants' teaching philosophies are presented in alphabetical order.

#### **4.1 Case 1: David**

David was a 23 year old first year Master's degree student during the fall 2012 semester. He was an international graduate student who came from a south Asian country. See the complete description of the participants in the Methodology chapter. Below are the themes and factors obtained from analyzing the teaching philosophy statements and the interviews.

##### **4.1.1 Teaching Philosophy Statement I**

David submitted his 1½ -page long teaching philosophy statement (TPS I) on August 28, 2012. He began his statement by writing that teaching is a challenging job. Describing his view of teaching mathematics, he said: "In my opinion, simply to teach the students is not hard but to make all the students in a classroom understand the content clearly and in a required amount of time is always a challenging thing to do."

He wrote that he became interested in teaching when he was in high school; he was interested in explaining mathematical concepts to his peers, and also in teaching mathematics to elementary school students. He used to wonder why some teachers had difficulties in making students understand mathematical concepts, and some teachers were able to do so in a short period of time. Coding resulted in the following themes (presented in alphabetical order) from his TPS I: conceptual understanding, equal treatment of students, high expectation for students, learning environment, positive attitude, and preparation.

### **Conceptual Understanding**

David's teaching philosophy statement implied that the first and foremost goal of mathematics instructors is to help students understand mathematical concepts. He wrote: "I believe that the goal of teaching is not simply to teach students in order to prepare them to give correct answers, or ask them to memorize facts, but most importantly students should truly understand the concepts that are being examined." This statement implies that he would like his students to gain conceptual understanding, not just be prepared for an exam.

### **High Expectation for Students**

David believed that a math instructor should have high expectations for his students. Recalling his role model teacher's classes, he wrote that the teacher had high expectations for his students, which pushed them to work very hard, understand concepts, and learn even more mathematical ideas. He did not provide further elaboration on what he meant by high expectations. During the first one-on-one interview (Interview I), when he was asked to elaborate further, he said that he did not want his students to be restricted to just what had been taught in the class. He said that he would like his students to learn some mathematics by themselves. He said that he liked to assign challenging problems to the students at the end of each class period because that would encourage students to do more independent study or research.

### **Learning Environment**

David believed that a mathematics instructor should create a favorable learning environment for students. In order to create a favorable environment, he believed that teachers should try to change students' attitudes toward mathematics, and that they also needed to keep students awake by using humor. The following are a short descriptions of how he thought he could create a good learning environment.

*Creating positive feeling for mathematics.* David's role model high school mathematics instructor never said that mathematics was hard to learn. Instead, that instructor tried to create a positive feeling for any mathematical concepts he taught. He implied that students' negative attitudes toward mathematics could hinder their mathematics learning, and that a teacher should try to change students' mindsets.

*Equal Treatment of Students.* He wrote, without any further elaboration, that one can be a successful teacher by treating all students equally. Describing his role model instructor, he wrote: "I also saw fairness in his teaching. He used to treat the students equally in all the situations which I think is a very important key for a teacher to be successful. He never treated one gender or a group of students differently."

When asked how he came to develop this belief during the last interview, he said that some high school teachers in his home country used to pay attention to only those students who were good in the subject matter. He said that he does not like to care about only good students, but also about average and weak students. He also said that he would like his students to feel that he cares about all of them.

*Humor.* His teaching philosophy statement implied that an instructor should have a good sense of humor. He wrote that he was impressed with the role model teacher's sense of humor, which he thought helped to make that instructor's class more enjoyable, and his students more attentive.

### **Positive Attitude**

David believed that a math instructor should have or develop a positive attitude toward mathematics teaching in order to become successful. Recalling the mathematics classes taught by his role model high school mathematics teacher, he wrote that he always found him with a positive attitude towards teaching.

## **Preparation**

He felt that a teacher was more likely to be successful if he or she had a good preparation of content. Recalling his own experience as a student, he wrote, “I felt that the teachers who have prepared well enough over the subject matter that they will be discussing in class before they go to class are more confident and clear but those who haven’t done so are less confident and ineffective.” He therefore believed that an instructor’s confidence and his clarity in explanation were directly related to his preparation of mathematical content.

### **4.1.1.a Summary**

David believed that the first and foremost goal of a mathematics instructor was to help students understand mathematical concepts. In order to do so, he believed that instructors should prepare the mathematical content they are going to teach, and create a favorable learning environment. To create such an environment, he believed that they should create a positive feeling for mathematics and try to change the students’ mindset that “math is hard”. Moreover, he thought that using humor could also help to create an enjoyable classroom environment that promoted attentiveness.

He believed that a teacher should have a positive attitude towards teaching, and that he or she needed to treat students equally. He also believed that a teacher could be successful or effective by having high expectations of students, so that they would be encouraged to learn more than just what had been taught in the classroom.

In the closing paragraph of his TPS I, he wrote that the teaching could yield desirable results if “right ideas and beliefs” were implemented in the classroom. However, he did not elaborate on what he meant by this phrase. He said during Interview I that he meant to create a conducive learning classroom environment. Summarizing his teaching philosophy statement, he wrote, “One can be an effective or a successful teacher if he/she prepares well on the subject matter

before going into class, develops positive attitudes, high expectations, and fairness in his/her teaching.”

#### **4.1.1.b Factors**

David’s TPS I was highly influenced by the teaching he had experienced as a student, especially by his role model high school math teacher. Although he wrote that he used to wonder why some teachers were not able to make their students understand the mathematical concepts they taught, he did not discuss any aspects of those teachers’ teaching. He only cited his role model teacher throughout his statement. All the aspects of teaching (themes) detected in his TPS I were learned from being a student in that role model teacher’s class. He gave examples of good teaching behaviors demonstrated by the role model teacher while discussing the characteristics of a good math instructor.

#### **4.1.2 Teaching Philosophy Statement II**

David’s second teaching philosophy statement (TPS II), submitted on October 28, 2012, was not significantly different from his first statement (TPS I); he even repeated most of the sentences from his first statement. He wrote that he was always curious to know what skills a teacher should develop in order to succeed as a teacher; even though he acknowledged that there were no strict guidelines to do so.

All the TPS I themes were also found in TPS II. In addition to these, the following new themes were also identified in the coding: explanation, maintaining teacher authority, and organization. The following is a description of these new themes, and some changes in the old themes.

#### **Explanation**

David wrote that based on his experience up to that point of his educational career, a teacher should also have an ability to explain things clearly to the students, in addition to many other characteristics.

### **Learning Environment**

David believed that creating a favorable learning environment is important in order to succeed as a teacher. As he wrote in TPS I, he still believed that mathematics instructors should treat students equally, should try to create a positive impression of mathematics, and that they needed to change students' mindset that "math is hard". In TPS II, he added that he needed to be caring, and also needed to interact with students in order to create such a learning environment.

*Caring.* He wrote that his role model teacher had a caring attitude. During interviews, he said that he learned from the instructor of the teaching assistant preparation course (MATH 5902) that a caring attitude was one of the characteristics of a successful teacher. This belief will be discussed in more detail in the interview results.

*Interaction with students.* Without any further elaboration, he mentioned that math teachers are more likely to be successful if they interact with students and promote student learning. Later during the member check process in interviews, he explained that promoting learning would encourage students to approach and interact with him, thereby contributing to a positive learning environment.

He did not write in TPS II that being humorous could help create an enjoyable classroom environment and keep students attentive, as he had in TPS I. However, this did not necessarily mean that he had changed that belief. He repeated in interview I that having a good sense of humor is a good characteristic of a successful teacher.

### **Maintaining Teacher Authority**

David wrote that a teacher with a “great personality” is more likely to be successful, but he did not provide any details. He wrote, “...up to this time of my education career, I have found that a teacher who has a great personality, who is well-organized and clear, and who interacts to the students and promotes the learning is more likely to be a successful teacher.”

He did not elaborate on what he meant by “great personality” of a teacher in his TPS II, but when he was asked to describe during the first one-on-one interview, he said that he meant to maintain the role of a teacher authority figure.

When asked what kind of problems would be created if a teacher does not have the kind of “personality”, he responded, “I mean they won’t they might ignore you, they may not respect you, it’s not like I don’t say they won’t respect you at all, but they won’t respect you as much as they respect to some professor.”

David perceived that students are less likely to respect their teacher if the teacher is of their age. The instructor of the course Seminar and Practicum in the Teaching of Collegiate Mathematics (SPTCM) had mentioned in class that a teacher should maintain a professional relationship with the students. Moreover, David had taught two recitation sections of the business calculus (MATH 2103) course. Based on his cultural background, his teaching experience, the behavior of his students, and the knowledge he learned from the SPRCM course, he might have generalized that a teacher needed to maintain a professional relationship with the students. This topic will be addressed in more detail in the discussion of his interview.

### **Organization**

Without elaborating, David wrote that a person is more likely to be a successful as a math teacher if he or she is well-organized. It was not evident from the data on how he came to see the importance of being well-organized; he might have developed this belief from observing his mentor’s classes. He did not write explicitly on what he really meant by being well-organized.

## **Preparation**

David wrote that a teacher can be successful by being well-prepared before entering the classroom. He had also expressed similar opinion in his TPS I, when he wrote that teachers are more likely to be successful if they prepare well on the subject matter. However, in TPS II, he wrote: “One can be an effective or a successful teacher if he/she spends more time outside the classroom on preparing the teaching material and developing effective teaching techniques”. It is evident that he started to realize that the preparation of content alone was not enough. He also realized that the amount of preparation that he thought would be enough was not enough, as evident in his wording “MORE time” in his last quote above. It was not possible to attribute this change to any single reason; he might have learned from different activities such as classroom observation, the instructor of the Math 5902 course and his mentor, reading assignments, and classroom discussion.

### **4.1.2.a Summary**

In summary, his TPS II was not so different from TPS I. He still believed that the first and foremost goal of a mathematics instructor was to help students understand mathematical concepts. He believed that he needed to be prepared before entering the classroom. He shifted his focus from content preparation in TPS I to the preparation of teaching material, and spending even more time on developing “effective teaching techniques” in TPS II. He also realized that the amount of preparation that he thought would be enough was not enough.

Beside the teacher’s preparation for classroom teaching, he believed that he or she should also create a favorable learning environment for the students. To create such an environment, as he discussed in TPS I, he wrote that the teacher should create a positive feeling for mathematics, and should also try to change most students’ mindset that “math is hard”. He added in TPS II that having a caring attitude and interacting with students would also help to create a better learning



environment. He also believed that a good sense of humor could create an enjoyable classroom environment, and keep students more attentive.

He believed that the teacher should have a positive attitude towards teaching, and that he or she needed to treat students equally. He also believed that teachers could be successful or effective if they had high expectations of their students, so that the students would be encouraged to learn more than just what had been taught in the classroom. He added in TPS II that teachers are more likely to be successful if they are well-organized, explain mathematical concepts clearly, and retain their authority by maintaining a professional distance.

#### **4.1.2.b Factors**

David's TPS II contained only minor revisions from his TPS I, so his TPS II still depicted him as being heavily influenced by the teaching he had experienced as a student, mostly from his role model high school math teacher. He added a few new beliefs in his TPS II, but it was difficult to say with certainty what factors caused him to develop these beliefs. Some factors that may have influenced him include the instructor of the SPTCM course, his mentor, class observations, peers, and reading assignments.

David wrote in TPS II that the role model high school teacher was very caring. Later during the interview I, he said that he learned to show caring attitude to the students from the SPTCM course instructor. He also wrote that teachers are more likely to be successful if they interact with students. It was not visible in TPS II, but several factors may have caused the development of this belief: the SPTCM course instructor, discussions with other MGTAs during the seminar sessions of this course, his mentor, and his class observations. Regardless, based on this data, there is a good chance that he learned about this aspect of teaching from the pre-service preparation program, the SPTCM Course.

He learned from SPTCM course that he needed to maintain a teacher authority figure role and keep a professional distance while dealing with students, he said. According to him, he learned that he needed to maintain a professional space with the students so that they would not treat him as their peer, but would obey and respect him. This topic will be addressed in more detail in the discussion of his interviews.

Although he said that he had already learned from his role model high school math teacher that teachers should treat their students equally, he said during interviews that this belief strengthened based on his learning from the SPTCM instructor. He termed the concept of treating students equally as “being consistent” to the students. As an example, he said that he needed to be consistent in giving partial credit while grading student work.

He added another belief in TPS II: organization. As a graduate teaching assistant, he might have realized that it was difficult to balance his own coursework with his TA duties. They had to do a variety of things in the course, such as observing their mentor’s classes 3 times a week, completing several reading and writing assignments, and preparing for classroom discussion. It is possible that he learned the value of organization from the pre-service period, even though it is difficult to say with a high degree of certainty which factor contributed the most.

Another new theme detected in his TPS II was: explanation. It was not clearly evident how he developed these new beliefs. But In summary, it is safe to assume that several factors from the pre-service phase contributed to the changes in his teaching philosophy; although it was difficult to identify which particular factor or a combination of factors contributed to the development of those new beliefs.

#### **4.1.3 Teaching Philosophy Statement III**

David submitted his third teaching philosophy statement (TPS III) on December 11, 2012. This was the final teaching philosophy statement collected during the pre-service phase. It is important

to note that David was regularly observing the classes taught by his mentor from the beginning, and had also given a teaching presentation in a mathematics classroom after he submitted his TPS II.

In addition to the themes detected in TPS I and TPS II, additional themes found in TPS III were effective teaching methods, experience, language and culture, and passion for teaching.

The themes conceptual understanding, explanation, and maintaining authority were also found in TPS III, and no changes were detected. As these themes were already discussed earlier in the context of TPS I and TPS II, they will not be discussed here. The new themes that were detected in TPS III, and the old themes with some changes detected are discussed below. The old themes with some changes detected were learning environment, and preparation.

### **Effective Teaching Methods**

From his teaching presentation, he learned that a teacher needed to use effective teaching methods. He, however, did not elaborate what he meant by “effective” teaching methods. He might have learned from self-reflection of his teaching, students’ reaction, or the feedback on his teaching provided by his fellow TAs, his mentor, and MATH 5902 instructor. It is difficult to identify which one of these factors was more influential.

### **Experience**

He wrote that he learned a lot from his first few teaching presentations in actual mathematics classrooms. From an opportunity to teach one class period of college algebra course to around 40 students, he found that spending 50 minutes in class talking about a mathematical topic was not a challenging task. The real challenge was to make every student in the class understand the concept within such a short time frame. He realized that he needed more such opportunities in order to develop as a teacher. He wrote:

After I got an opportunity to teach a college algebra class of total 40 students for one whole class period in my Math 5902 class, first teaching experience of my life in a real classroom like that, I could clearly experience that just to go to class and spent 50 minutes on talking a topic was not a big deal but in order to make every students of that class understand the content I taught was very challenging and required more exercises to do, gain experience and use of effective teaching methods.

### **Learning Environment**

As in TPS I and II, David again wrote that learning environment plays an important role in student learning. He still believed that creating a positive feeling for mathematics and being caring could contribute to the creation of a positive learning environment. He termed the creation of a good classroom environment as “classroom management”, and wrote that the classroom management skill is one of the key characteristics of a successful teacher. His earlier belief that interacting with students would contribute to a conducive learning environment was further reinforced. He elaborated in interview III that frequent student-instructor interaction would help to make students feel that their teacher was friendly.

*Being friendly.* From his teaching presentation, he also learned that proper way of dealing with students is also important. He explained that maintaining a good relationship with students would make a teacher more approachable, and students would feel more comfortable asking questions in the class. He wrote:

I learned that a teacher needs to know a proper way of dealing with students so that they will feel very comfortable to talk with you without any hesitation when they have any kind of problems in that specific class. It is important to develop very good relation to the students.

He therefore believed that being friendly would make the learning environment more favorable.

### **Passion for Teaching**

He believed that a person needs to be passionate about teaching mathematics, and remain enthusiastic and hard working in order to truly develop as a teacher, he wrote:

...if one considers teaching as something he/she does just for living then there will be less chance of getting improvements in order to be a successful teacher since you always need to work hard and have a great interest in order to progress in anything. One needs to enjoy teaching so that he/she would do better in future in teaching profession.

He therefore implied that one should not take the teaching profession just as a “job”.

### **Language and Culture**

As mentioned earlier, he learned from his teaching presentation that it was crucial to maintain a good relationship with the students, and be approachable so that students would feel comfortable asking questions. He believed that a strong command over language and an understanding of American culture would help a teacher become friendlier with the students. However, being an international student, he realized that it was difficult for him to do so. He wrote: “It is important to develop very good relation to the students. To me, being an international person, in order to develop very good relation with American students is a bit more challenging because of language and cultural difference”. He wrote that having a good understanding of American culture and being fluent in English would help someone become a successful teacher.

Although he mentioned that his first teaching presentation helped him to realize the importance of English proficiency and an understanding of American culture, he did not specify any reasons that led him to develop such a belief. Being an international student and not having English as his native language, he might have faced difficulties delivering a lecture in English in the classroom. Moreover, since most students hesitate to interact with an unfamiliar teacher, he might also have faced difficulty engaging students in the classroom.

### **Preparation**

David’s teaching experience further reinforced his earlier belief that he needed to be prepared before entering the classroom. He had expressed in TPS I that teachers needed good preparation of mathematical content to be successful. In his TPS II, he had written that the amount of

preparation that he thought would be enough was actually not enough, and that he needed to spend more time on preparing teaching materials, and developing “effective teaching techniques”. He added in TPS III that teaching tasks would require even “more exercises”. Without elaborating further, he also wrote that an instructors are more likely to succeed if they are well-organized.

#### **4.1.3.a Summary**

David made only small revisions between TPS I and TPS II, and between TPS II and TPS III. In all three TPSs, he believed that the first and foremost goal of a mathematics instructor was to help students understand mathematical concepts. He also wrote in all three TPSs that he needed to be prepared before entering the classroom. In TPS I, he only discussed content preparation, but in TPS II he shifted his focus to the preparation of teaching material, and developing “effective teaching techniques”. In TPS II, he also realized that the amount of preparation that he thought would be enough in TPS I was actually not enough. This belief was further reinforced in TPS III, where he wrote that he needed even more preparation.

Besides preparation for classroom teaching, he wrote in all three TPSs that teachers should also create a favorable learning environment for the students. To create such an environment, he wrote in TPS I that teachers should create a positive feeling for mathematics, and try to change most students’ mindset that “math is hard”. He added in TPS II that having a caring attitude and interacting with students would also help to create a better learning environment. He also believed that a good sense of humor would be helpful in creating an enjoyable classroom environment; this would also help to keep the students more attentive in the classroom. In TPS III, he added that he needed to become a friendly teacher, and that he also needed to learn to deal with students. He explained that maintaining a good relationship with students would make a

teacher more approachable, so that students would feel more comfortable asking questions in class.

In all three TPSs, he wrote that teachers should have a positive attitude towards teaching, and that they needed to treat students equally. He also believed teachers could be successful or effective if they maintained high expectations for their students, so that students would be encouraged to learn more than just what had been taught in the classroom. He added in TPS II that teachers were more likely to be successful if they were well-organized, explained mathematical concepts clearly, and maintained their authority. He repeated these beliefs in TPS III as well. From his teaching demonstration experience in an actual mathematics classroom he also realized (in TPS III) that he needed to be “serious and careful” while teaching, and that he would also need to know how to implement “effective teaching techniques”. He also realized that teachers should have a passion for teaching mathematics if they really wanted to grow professionally. If one takes the teaching profession just as a “job”, he added that he would not be able to improve his teaching. He also realized that he needed to be able to communicate effectively in English, and that he should also have a strong understanding of the American culture.

From his first teaching demonstration experience, he wrote that he also learned to be more serious and careful while teaching, but he did not elaborate further.

#### **4.1.3. b Factors**

As described earlier, David’s TPS III contained only minor revisions from TPS II. The most influencing factor detected in the TPS III was teaching presentation experience.

David wrote in TPS III that the amount of preparation that he thought for a class period would be enough was actually not enough. He had also written in his TPS II that a teacher needed more time to prepare for a class period. The belief was found to be further reinforced in his TPS III. He

wrote explicitly that his teaching presentation experience made him to realize that he needed to do even more preparation before entering into the classroom.

He added a new belief that he needed to become a friendly teacher, and that he also needed to learn appropriate ways to deal with students. He explained that maintaining a good relationship with students would make a teacher more approachable, which would make students feel more comfortable asking questions. He said that he learned the importance of being friendly and approachable with the students from his teaching presentation experience. Later, he confirmed during the interviews that his teaching experience had taught him to be friendlier with the students while maintaining a professional space with the students. Beside these, he also learned from his teaching experience that he needed to be “serious and careful”, and that he needed to use “effective teaching techniques”. He also learned that improvement in teaching would require a considerable amount of time and effort. He therefore wrote that teachers could improve their teaching only if they had a passion for it.

As mentioned earlier, he learned from his teaching presentation that it was crucial for a teacher to maintain a good relationship with the students, and be approachable so that students would feel comfortable asking questions. He believed that a strong command over language and an understanding of American culture would help a teacher become friendlier with the students. However, being an international student, he realized that it was difficult for him to do so.

Based on his TPS III, it was evident that his teaching philosophy was largely influenced by his teaching presentation experience, and by his own self-reflection after that presentation. As mentioned earlier, MGTAs had to write a self-reflection about their teaching presentation and had to share it with the other MGTAs. The feedback provided by his peers and his mentor could have also affected his teaching philosophy.

#### **4.1.4 Interview I**



The first one-on-one interview lasted 90 minutes, and was conducted on July 2, 2013 during the summer 2013 semester. David taught two recitation sections of business calculus during the spring 2013 semester, and was not teaching any course during the summer 2013 semester.

Coding resulted in the following themes: conceptual understanding, equal treatment of students, experience, high expectation for students, language and culture, learning environment, maintaining teacher authority, multiple teaching methods, preparation, out-of-class support, teaching my way, and technology. Old themes with no changes detected will not be discussed below.

### **Experience**

He had a strong belief that the classroom teaching experience would help a person to grow as a teacher. He expressed that doing something practically is the best way to learn about teaching. About classroom teaching experience, he said: “That will make you experienced you know. Like I think doing something practically is more helpful than just learning from somebody else. If you really work on it, of course, it will be helpful.” He further expressed that public speaking experience would be helpful in building a teacher’s confidence in the classroom. He said that teaching experience also provides opportunities to develop other teaching-related materials such as syllabi and lecture notes.

Being an international student, he found that the way mathematics is taught and learned in the US is different from his home country.

Throughout the interview, he showed that he had strong feelings about the value of classroom experience, which he thought was more valuable than any other professional development activities, including the teaching preparation course.

### **High Expectation for Students**

As he wrote in his teaching philosophy statements, David believed that mathematics instructors should have high expectations for their students. He said that he expected students to learn more than just what he taught in the class and/or from the textbook. When asked what he meant by high expectations, he answered:

What I mean by high expectations means, I want students to learn more than what I taught, do their own kind of study sometime you know. . . . Put some questions at the end of the class, that will force students to do more research on it, and more understanding on it and they will get to the level upper than what I want from my syllabus. I mean in class I will talk to them average understanding, everyone understand that, and at the very end, sometime I drop one or two problems that challenge them, they will do research they will do some kind of thing so they will have better understanding.

While he believed that posing challenging problems in homework and quizzes would encourage students to do more research, he only included problems that would test the fundamental concepts that students needed to learn from the class, and that would be most prevalent on the exams. He said that he did not want to trick students with difficult problems in the tests, and he was not interested in determining which student was the smartest one in the class. He believed that having high expectations would help students who had a genuine interest in mathematics, and who wanted to learn more than just what had been taught in the class.

In his teaching philosophy statements, he had written that his role model high school math teacher used to have high expectation for his students. David's pre-service phase belief in setting high expectations did not seem to have changed by this early stage of the in-service phase.

### **Language and Culture**

David believed that he needed to improve his ability to communicate in English. He said that he wanted to be able to speak English clearly and explain subject matter as precisely as native English speakers. He wanted to improve his accent to sound more native-like. Discussing his future plans, he said: "Since I am an international student, I try to improve my language. Let's be very frank, tell you the first thing, that's what I try to work on."

As he had completed his bachelor's degree in the US, he said that he did not have any cultural issues while teaching. But he said that teaching methods in the US were very different from those in his home country. He believed that he needed to understand the way that mathematics is taught and learned in America:

There are some techniques that are different they learned from high school and the way I learned in high school when I tried to put those over here, and if I don't have the background information like how they learned in high school, they will be like oh..., they won't get it, you know.

Even though mathematics is universal, he found that some mathematical concepts are explained differently here than they were in his home country. In order to help his students understand the concepts, he realized that he needed to learn teaching techniques that are used in the US.

### **Learning Environment**

He believed that a teacher should create a favorable learning environment both in and out of the classroom. Inside the classroom, students should feel like the teacher is talking with and teaching everyone. He believed an instructor can create such an environment by involving everyone in the classroom, and making eye contact with everyone. Teachers should also try to keep students energetic and awake by using humor, and walking around the classroom to make sure that all students are working. Moreover, the teacher should interact with the students and make them feel like their teacher is paying attention to them. While having a conversation about learning environment, he said:

Like, when you are teaching, it's not like you are talking with only one student or some smart students, you should make them feel like you are talking to everybody, so they all need to feel like, hey this teacher is teaching me also. So we are all learning together, it's not like some group of students they are working and some group of students are not, so we have to make everybody working together, make everybody involved in that class, so that kind of environment, something like you gotta walk around in that class, I mean there are different ways to do that, you know, like have eye contact to everybody in that class, something like that, so that kind of thing I think.

David also believed that a teacher should keep his students energetic and awake. Moreover, he said that he should make students feel comfortable interacting with him and asking questions. He believed that this approach would make students feel more open, and more likely to ask questions. According to him, if the instructor jumps directly into the problem or subject matter with no informal opening talk, students might feel like the instructor is not friendly and is not willing to talk with them.

In his earlier teaching philosophy statements, he wrote that teaching could yield “amazing results” if the right ideas and beliefs were implemented in the classroom. When asked what he meant by those right ideas and beliefs, he said that those were the things that would be done to create a welcoming environment for learning in the classroom.

*Caring.* He said that he needed to make his students feel that their teacher cares about them, which he said he learned from the MATH 5902 course:

One most important thing I should not forget, and that’s what I learned from Dr. [instructor of the MATH 5902 course]’s class, is caring, you have to be very caring to the students, if you don’t care, then I don’t think it’s useful, so when I am saying caring, that means, you have to make students make them feel or understand like you really want them to help them to do something better in in that class.

*Equal treatment of students.* He expressed that treating every students equally is a big part of his teaching philosophy. When asked what led him to this belief, he said that this was his philosophy of life, so he had to follow it. He also learned from his tutoring experience that students did not like instructors who did not treat students equally. He also said that he learned about consistency in the preparation course, MATH 5902, especially when grading students’ assignments.

Throughout the interview, he felt strongly about treating students equally. When asked what things he would like to do in the future to improve his teaching, he said, “... try to be very consistent, still I said I wanna be consistent, but I don’t feel like I am hundred percent consistent. So I wanna work more on that, I try to be consistent as much as I could.”

*Humor.* He said that “cracking jokes” occasionally in the class would keep the classroom environment lively, and made students feel more comfortable asking questions.

### **Maintaining Teacher Authority**

David said that undergraduate students are often the same age as many MGTAs, making them more likely to show them less respect than they typically grant to professors. Although students often tried to treat MGTAs as friends, not authority figures, David insisted that he wanted to maintain a professional distance from his students:

Before I used to think I am just a student, you know, now I feel like I am teaching so I have to be like I have some kind of some kind of personality so that makes students feel like hey I mean I am different than you. I am your instructor; I am not like student like you. When you have like similar age, my age and my students that are in the class, they have the same kind of age and they kind of think of you as their friend, you know, I think I have to make some space from the students and try to present them like hey I am you know I am instructing this class and I know more than you, that’s why I am teaching you. You know, that’s kind of space you need to keep off.

He further explained that he wanted to develop a teacher-like personality, and wanted to give his students an impression that he “sounds like a teacher”.

Because many students were his age, he realized that some would treat him more like a friend than an authority figure. As a result, he believed that some students might try to take advantage of him.

Even though David also wrote in his TPS II and III that teachers are more likely to be successful if they have a “great personality” as a teacher, he felt more strongly about maintaining the role of a teacher authority figure at the stage of interview I.

### **Multiple Teaching Methods**

He said he believes in using multiple ways to explain and present materials in the classroom, as verbal explanation alone is not enough for every student. Instead of just using traditional

methods, he said that he would like to use other teaching materials such as graphs, different colors, and different methods to explain to the students. He believed that a teacher should learn as many techniques as possible. He said that he was still learning different methods for explaining college algebra topics by watching videos online, even though he was not teaching during the summer 2013 semester.

### **Organization**

He believed that an instructor should plan ahead on what and how he is going to present materials in the class and how long he should allocate for topics during class. He realized that that he could not be well-organized in the classroom during the spring 2013 semester, but he would like to be more organized in the future.

### **Preparation**

David believed that a teacher should be well-prepared before going to teach in the classroom.

When asked what he meant by being prepared, he said that teachers should prepare the mathematical content they is going to teach, and should also prepare their approach to presenting the content. He also stressed the importance of collecting teaching materials from different resources:

I mean you get to look at the, what you are going to teach on that topic and first look at your syllabus and see like these are the things I need to talk about in class. So you have to make some concepts on that from each topic, from books, from different books or from internet, you know, try to get very short and quick information that will catch the students, so that they can get it in easy way. And some textbook kind of tough to understand, some are easy you know, try to mix them up to make it very informative.

His definition of preparedness had broadened, compared to his teaching philosophy statements from the pre-service phase. He said that it would be beneficial to develop a plan for the lesson by finding materials and examples that draw students' attention, and look at multiple resources such as the internet and different textbooks. He said that he used to think that around fifteen minutes of

preparation time would be enough, but when he actually started to teach, he realized that he needed to spend a significant amount of time for preparation.

David said that an instructor should make a lesson plan before entering into the classroom.

According to him, a carefully crafted lesson plan serves as an effective guide for any instructor.

He said that the lesson plan should include a framework for the whole class period, and should include the material to be presented and its relationship to previously taught concepts. The plan should also allocate time for mathematical topics and class discussion, using carefully chosen examples, and show how things would be organized. When asked to describe more about the lesson plan, he said:

Of course, you need to make a lesson plan. Lesson plan, that means you gotta have idea what you are going to talk, how you are going to relate your previous thing you taught in class to your new topic, think about it, how you gonna relate that, that's the first thing you do in the class, right? And how you gonna start this new topic now, how you gonna describe that to the students, how they will understand? And after that, you will work on the examples, what kind of examples you should give that will cover everything out of that topic from that concept, so try to make, don't try to put lot of examples, just take whole class just putting examples, not like that. You need to have some time to have students to work in that class also, and you need to have some time that you give examples to them also, and you need to have some time to discuss and you need to have some time to give some background information too. So you have to put them all in order, those kind of preparation you need to have before you go to the class. So that's what lesson plan is, tells you from start to end what you gonna do in that class.

In his teaching philosophy II and III, he had also realized the importance of preparation before going to teach. During the interview I, he explicitly mentioned that he would need to prepare the lesson plan.

### **Students**

David stated that the effectiveness of a mathematics class depends not only on the teacher, but also on the students. He said that "if students are not very interactive with their teacher... if there is no learning environment that one gives nothing out of that class I guess...I think it's about mutual understanding between teacher and students". He therefore believed that there is only so

much an instructor can do, and that students themselves should also be responsible for their own learning.

David had heard many negative “rumors” about American students’ mathematical ability and attitude toward learning. However, he said that the students he had in two sections of business calculus were quite good at mathematics. Many students dropped out of these sections, but David said that most of those who dropped were simply unprepared to take the course. He also said that students with good prerequisite knowledge who remained in the class were very good. He implied again that the students who expended enough effort to learn mathematics succeeded in the course.

### **Out-of-class Support**

David said that he liked to help students during his office hours. If needed, he said that he would schedule longer office hours. Moreover, he wanted to be friendly with students in order to make them comfortable speaking with him during the office hours.

### **Teaching My Way**

David said that teaching a course with no autonomy would hinder a teacher’s growth. He said that, based on his own experience, teaching a course with full responsibility was more helpful than teaching a recitation section. He also expressed dissatisfaction about not having the option to choose which course to teach.

He said that teaching a recitation section did not give him much flexibility to do things his way. In other words, he did not have autonomy in his teaching, and he expressed a desire to teach a class with full decision-making ability, and learn from that experience. While conducting a recitation section. He said that whenever students brought up an issue, he would have to direct them to the course coordinator. He even said that if he would be assigned a discussion section to teach again, it would hinder his development as a teacher:



I wanna be fully individual teaching, I don't know how they do it but I mean, rather than having discussion class, I mean I wish I would have real teaching class so I would make syllabus stuff like that so that I will learn totally everything out of it rather than just giving a lecture and grading papers and stuff like that. If I am doing discussion again, I think that will hinder from being real teacher.

Even though he appreciated the support provided by the math department and the course coordinators, he implied that he would like to teach the way he wants to really develop as a teacher.

#### **4.1.4.a Summary**

From his teaching experience, he realized that teaching was more time consuming than he had previously thought. He thought that fifteen minutes would be enough to prepare for a class period, but he realized that he had to spend more time outside the classroom than in the classroom.

When asked what challenges he faced as a GTA, he said that it was sometimes hard to maintain a balance between his teaching responsibilities and his own graduate course work. He said that he had to spend a lot of time for preparation, and grading homework and quizzes. He found that teaching two courses would consume a significant amount of time, and it was difficult for him to find time to study for his own coursework. He therefore started to develop a belief that mathematics instructors, especially MGTAs, needed to work very hard and manage their time very well. Because of the lack of time to spend on his own coursework, he believed that he needed to be very well-organized, both inside and outside the classroom. Inside the classroom, he believed that a math instructor should always develop a lesson plan before going to teach, something he had not explicitly mentioned in his earlier teaching philosophies.

A new belief detected in his teaching philosophy was using multiple teaching methods and techniques to solve problems. He believed that using multiple ways of solving mathematical

problems would enhance student understanding. He said that he had watched online lecture videos in order to know how other professors explain mathematical concepts.

In his TPS II and III, he had described that a teacher should have a “great personality”; he clarified in interview I by saying that the teacher should maintain the role of a teacher authority figure. He had also expressed a belief that a teacher needed to be friendly with students. But during interview I, he changed his tone somewhat, as he had begun to realize that a teacher needed to maintain a professional distance from students. Because of his similar age with the students, he said it was necessary to maintain his authority. Otherwise, the students would treat him as their peer, and would not respect him as much as they respect other professors. He also added that the students would not pay attention to teachers who lacked authority. He was more careful to say this time that although he needed to be approachable to the students, he should try to become more like a professional teacher.

He developed another new belief that the amount of mathematics that students learn depends not only on the teachers, but also on the students themselves. He said that if students do not put enough effort into their own education, or if the students do not have the required prerequisite knowledge, they cannot learn as much as is desired.

Another highly visible change in his teaching philosophy was the development of a belief that a teacher should be given an autonomy in the classroom. He believed that he would not be able to grow as a “real teacher” if he was only allowed to do what he was told by external agents, such as the course coordinator or the mathematics department. From his experience teaching two recitation sections of a business calculus course, he found that he was not allowed to do things the way he wanted, because his course coordinator would not allow him to do so.

David did not mention any classroom technologies until he was asked which technologies he used. He said that it would depend on the course he was teaching. He believed that there was no

need to use a calculator in a college algebra course, but that students might need a calculator to graph functions in a Calculus course. He thought that calculation involving big numbers in statistics would also require a calculator. He further said that there was nothing wrong with letting students use a calculator if they could get the correct answer. His belief that the college algebra teachers would not need graphing calculators might be the result of his lack of teaching experience; calculators are frequently used these days in college algebra courses.

In addition to calculators, David said that he wanted to use an ELMO document camera and a projector in the classroom. He also said that he had seen instructors using online sites such as Blackboard and Desire to Learn (D2L) to communicate with students. But he did not say anything about whether he would use those online tools.

He never said anything about student-centered instruction in his teaching philosophy. When asked to express his opinion about employing student-centered or collaborative learning, he said that he supported the idea of student-centered instruction. But instead of employing fully student-centered or teacher-centered instruction, he would like to implement a mixed model of student-centered and teacher-centered instruction.

David was not fully satisfied with his level of achievement as a teacher, and said that he had a hunger to be a more successful teacher. In order to prepare himself for the fall 2013 semester, he said that he was watching lecture videos posted online by mathematics professors from different universities. He was watching videos during free time in the summer to learn how different instructors were presenting college algebra materials in their lectures. He said he wanted to learn multiple techniques to present materials to help his students understand the mathematical concepts he was going to teach.

#### **4.1.4.b Factors**

The biggest visible factor that influenced David's teaching philosophy was his teaching experience, especially the undergraduate students he taught. Time, his course coordinator, language and cultural knowledge were other factors. He believed that he could not be as approachable as he wanted to because of his foreign accent, and his lack of understanding of American culture.

*Course coordinator.* He said that a course coordinator was needed, especially if someone is teaching for the first time. But although his course coordinator had been very helpful, David felt that the coordinator had also limited his autonomy as an instructor. David believed in implementing his own philosophy, and said that he wanted to learn from his own experience, which he believed would be more effective than learning from somebody else. He even said that his future teaching philosophy might change based on teaching experience. He therefore believed that teaching experience and the self-reflection of teaching would be the most important factor that could change his future teaching philosophy and classroom practices.

*Language and culture.* His teaching philosophy was also influenced by his own perceived lack of understanding of how American students learn mathematics. He said that he noticed some differences in teaching culture between the US and his home country, particularly in how mathematical concepts were explained.

Despite these differences that he had noticed, he said that he was familiar with most of the American styles because he went to an undergraduate school in the US. He said that other cultural differences were not so much of a big issue in his classroom teaching. However, he perceived that his foreign accent limited his ability to reach and interact with students. He described later during interview II that he needed to interact with students and be friendly, because he believed it would make him more approachable, and make students comfortable asking questions. He perceived that students would not want to interact with him because of his accent, even though he believed they

understood him. He said that a cultural differences may have played a role in the students' unwillingness to interact with him.

He implied that an international teacher should understand the American way of teaching, and that speaking with an accent could affect how students respond to the teacher. He said that his first priority would be to improve his English accent.

*Students.* He said that he used to believe that the success of a mathematics class depends only on the teacher. However, he learned from his teaching experience that it depends not only on the teacher but also on the students. He said that there is only so much an instructor can do; students themselves should also become responsible for their own learning.

*Time.* He realized that teaching was very time consuming. He originally thought that fifteen minutes would be enough to prepare for a class, but he found that it required much longer than that. Besides preparing to teach, he said that he had to spend a significant amount of time doing other tasks such as writing exams and grading. He therefore realized that he needed to be well-organized, and needed to manage his time both inside and outside the classroom. He said that explaining everything in a class period was not enough because of the limited time. He therefore had to prepare a good lesson plan before going to teach.

#### **4.1.5 Interview II**

The second interview lasted one hour, and was conducted on October 3, 2014, during the fall 2013 semester, 3 months after the first interview was conducted. During this period, he taught two sections of college algebra, which was his first experience teaching independently. However, this was a coordinated course, with a faculty course coordinator to supervise the teaching of all sections. The following themes were found from coding this interview data: conceptual understanding, experience, high expectation for students, language and culture, learning

environment, multiple teaching methods, out-of-class support, preparation and organization, teaching my way, and technology.

### **Conceptual Understanding**

David stated that helping students understand mathematical concepts was important, as he had done in Interview I. He said that he would not only teach new mathematical concepts, but also explain how they were connected to concepts students had learned in previous class periods.

### **Experience**

David believed that his actual teaching experience helped him to learn more about teaching. When asked what factors contributed to his current teaching philosophy, he said that his teaching experience, especially by observing the students in the class, contributed a lot. He noticed that some students were not enjoying his class. He then realized that he needed to motivate the students to learn mathematics by creating a fun learning environment. After he tried to create such a fun learning environment, he noticed that the students started to show willingness to learn; they were involved more often than before, and gradually started to enjoy the class. He said that his teaching experience was changing his teaching philosophy as well:

But now, I have some additional thing that is adding in my philosophy after I'm having this class, teaching this class, okay. Before, I didn't have student, right? I just believed based on that class. Now, I'm doing the practical. Ok, and what the philosophy I developed, I compare that now. Is that really important when you are really teaching or not? Now I'm doing real teaching job. So now I think – I'm not saying everything that I used to believe is right. Majority of them are right, but still I have some more beliefs that's been added in my teaching philosophy. You see what I mean?

He believed that his teaching experience gave him an opportunity to learn how to approach students and develop a close relationship with them. Teaching experience would give him opportunities to reflect back on his own teaching, which would help him to find out his weaknesses and improve for next time. He said that teaching independent sections is the only “real teaching”, and that he learned a lot about teaching from his teaching experience. He

believed that learning from teaching recitation sections is less effective even though it would consume less time than teaching independent sections. He said that he would prefer to teach independent sections to teach over the recitation sections.

David said that he was still in the beginning phase of his teaching career, and he needed a lot of improvement in his teaching. He believed that teaching experience would provide him opportunities to reflect on his own teaching, and open the door for further improvement. He said that he would like to create a fun learning environment and keep students engaged and active. When asked what specific plans he had to do so, he said, "... from next semester, I might feel, okay, this is not working. So I have to do something else so that kind of change my strategy I think." Even though he did not have any specific plan in mind, he thought that he would learn the things he needed to improve based on his teaching experience, and the self-reflection of his teaching. He had expressed his belief during interview I that teaching experience would help him to develop as a better teacher. He demonstrated an even stronger belief about teaching experience during the interview II.

### **Language and Culture**

David seemed to have held a belief about teaching that he brought from his home country. When asked what aspects of teaching in his home country he would like to bring to American classrooms, he said that students in his home country are more disciplined. Unlike in America, he said that there were strict rules and regulation. He noticed that the students in the US have more freedom; some students do not even pay attention to their teacher, but the teacher cannot do anything about it. His statements implied that it would have been better if the teachers had more authoritative power to force students to work, and maintain a disciplined classroom. He had expressed that he needed to maintain a professional distance between him and his students. One of the reasons he wanted to do so, as he said in interview I, was that the students wouldn't respect

him as a teacher if he approached them as a peer; or at the very least, they wouldn't respect him as much as they respect to other professors. He said that he wanted his students to pay attention to him while teaching and also respect him: "Pay attention and respect me, when I say something, they are supposed to hear me. Stuff like that, I mean you gotta be more commanding you know."

Based on this statement, he believed that teachers and students should have different amounts of power, students should obey their teacher, and teachers should have the authority to impose discipline inside the classroom. As found from earlier research with teaching assistants, many international students have been surprised to see the freedom the American students had; they believed that students should respect them. Unlike in the US, teachers and professors in some countries are treated as respected figures and have far more authority, while students have less freedom. One reason why David wanted to keep a professional distance from students might be his upbringing in an entirely different culture. He might have not been satisfied with the students' freedom and their casual behavior in the classroom.

### **Learning Environment**

David believed that the teacher would need to create an active environment, both inside and outside the classroom. He said that he wanted to see that all the students were learning, or at least they were trying to learn. He further added that he wanted make everyone involved in the learning process. However, he expressed unhappiness that some students would not even try to involve themselves. When asked what things he would like to differently in the following semester, he said that he would try to create a fun environment so that students would be active in the classroom and try to learn. He said that students should be taught in a fun learning environment because students might feel bored sometimes during the class. If students feel bored, he said that teaching and learning would not be effective, regardless of any strategies one applies. He said:



I didn't think teaching should be fun before. Now I add teaching must be fun also. I see students being like bored. Though you care students, though you become consistent to the student, though you motivate, though you create active environment, it's not helpful. It needs to be fun also.

He said that his success as an instructor would depend primarily on whether he could create an active learning environment and engage his students. He said that he developed this belief from the teaching assistant preparation course, MATH 5990.

*Collaborative learning.* He believed that one of the ways to create an active learning environment would be to assign students to work in groups. Discussing how he would create a learning environment, he said:

Like group work, give them group work, like group quiz or something like that. Yeah, like make a group of three or four students sometimes and, and give something they can work in a group, you know. If somebody doesn't know how to solve it, then they can learn that idea from their friends also. So I think that's one thing that's important, make -- is to give the students a group project or a group work, something like that.

Based on his teaching experience, he noticed that some students either hesitate to ask questions in public or they would not want to interrupt the lecture. He believed that if students are given group assignments, they would develop a feeling that they are learning by themselves, and that the teacher is not teaching. In such an environment, he believed that the students would think that it would be okay to ask questions to the instructor because they do not need to interrupt the lecture. Also, when the teacher walks around every corner of the classroom when the students are engaged in a group discussion, there would be an opportunity for the instructor to interact with the students and ask where they are stuck. That would create a welcoming environment.

From this statement, it was evident that he started to realize that fully teacher-centered instruction would not be enough, and that he would need to employ teaching methods other than just lectures. He believed that students would feel more comfortable to ask questions in such an environment.

When asked how often he assigned group work in his teaching that semester, he said that he did so infrequently because he had to use a common syllabus. However, he said that he would employ collaborative learning strategies more often in the future if he had more teaching autonomy.

Even though he had expressed the importance of creating a favorable learning environment in interview I, he had not discussed collaborative learning as a way of achieving that environment. This was an added belief in his teaching philosophy. He said during the member check process and informal discussion with the researcher that he learned the idea of collaborative learning from his mentor and course coordinator.

*Engaging students.* In order to engage students in the classroom, besides employing collaborative learning, he said that he liked to give students some in-class work. He said that students would not learn if they are just seated in the class without doing anything by themselves. He believed, however, that teachers needed to motivate students in order to make them feel engaged.

He had also expressed in interview I that a teacher would need to “crack jokes” sometimes to create a fun environment in the class.

*Interacting with students.* David believed that students become more comfortable asking questions if there is frequent instructor-student interaction. When asked what things he would like to change in his teaching from the following semester, he reflected on his teaching and said that he would like to interact more with his students:

I mean try to interact more with the students, that's what I want to make a change. Right now I feel like I'm teaching them. I mean I'm trying to discuss with them more, but still I feel like that's not enough. So I will be more interactive.

While he expressed his desire to interact more frequently with the students in the future, he said that he was having some difficulties due to his foreign accent. He noticed that students were less likely to interact with a foreign instructor. Although he did not know the reason why students were not willing to interact with him, he suspected that cultural difference might have played a role.

Although he said nothing about interacting with students during interview I, he had written in TPS II and III that instructors are more likely to be successful if they interact with students. He repeated this belief in interview II, which means that his belief had not necessarily changed.

*Caring.* He believed that a teacher's caring nature can make a positive impact on student learning. He said that he learned the idea of showing students that their teacher cares about them and their successes from the instructor of the TA preparation course, MATH 5990.

*Application of mathematics.* In order to keep the students active and engaged, he believed that he needed to motivate the students. He said that one of the ways to motivate students would be to show them how mathematics could be used in other fields, and in their daily lives. He believed that mathematics teaching should be more than just helping students to find an "answer"; students should also learn how to apply mathematical concepts in their respective fields of study, as well as in their real life. When asked what things he does or would like to do to help students learn to apply mathematical concepts in other areas, he said that he would provide examples showing how the related mathematical concepts could be applied.

When asked what things he would like to do differently in the following semesters, he said that he would try to incorporate more applied problems so that the students could see how mathematics could be applied in the real world. He found that teaching in the US is more practically oriented, and this aspect of American teaching is what he would like to take away with him. About teaching in the US, he said that it was

...more applied, more applicable. You can see it. I mean back in my home country, they just teach you the course. I mean just syllabus, start like that. They don't try to give example that it's applicable. I never feel like that. I mean you don't see like you study, study, study and you don't know where you're going to use it. But here, they tried to put more applied examples and that makes sense to the students and they feel good about learning. So that's something I want to take back into my country, home country.

He believed that the students would feel motivated to learn if they see where the mathematical concepts are going to be used. This was an additional belief detected from Interview II. He said that he developed this belief from his students' curiosity on why they should learn the mathematical concepts he was teaching.

### **Multiple Teaching Methods**

David believed that teaching would not be effective if the teacher used only one teaching method, such as a lecture. He expressed that one needed to use various instructional methods to help students understand the mathematical concepts. He believed that he could not develop or implement various teaching methods because of his lack of enough teaching experience. He believed that he would learn to use more teaching methods, and instructional technologies as he becomes more experienced.

### **Preparation and Organization**

David said that it would not be possible to do everything in a short class period. He said that he had learned to make a good lesson plan after he began teaching. He said that a carefully developed lesson plan enabled him to stay organized and present his lessons in a given amount of time. He also said that he learned to prepare lecture notes, and upload those notes online for students to access. He realized that he needed to be more organized inside the classroom. He recalled that sometimes he could not finish his lecture within the class period, while at other times he finished early. He said that he needed to be more careful while preparing lecture notes, and that he needed to become more organized inside the classroom.

There was not a distinguishable change in his belief from TPS I and II regarding the preparation before entering into the classroom. However, he had only pointed out the necessity of developing a lesson plan during interview I. During interview II, he said that he needed to be more careful to develop an “effective lesson plan”.

### **Students**

When asked what things were added in his teaching philosophy since the last interview, David said that students should also have a positive attitude toward learning. He had believed previously that teachers had the only important role in teaching, and that they should be able to make their students learn. But he now said that if the students do not want to learn, the teacher alone cannot do anything. He further said that teacher and students must both contribute in order to create a successful learning environment.

David also realized that even though students should feel responsible for their own education, a teacher can motivate students by creating a favorable learning environment. He also understood from his teaching experience that different students learned differently in different environments. He noticed that some students hesitate to ask questions during class, and that they feel more comfortable to ask questions during small group discussions. Such discussions would allow teachers to interact with the students. Moreover, he learned from his teaching experience that some students were not enjoying his class. He then realized that he needed to motivate the students by creating a fun learning environment. After he tried to create this environment, he noticed that the students started to show a willingness to learn; they were involved more often than before, and gradually started to enjoy the class. His students had therefore influenced his teaching philosophy.

He had expressed that students should also become responsible for learning, and interacting with the teacher was up to their choice. However, he realized that a teacher could create a favorable

environment that would encourage students to interact with the instructor, and also with their peers (such as by assigning group work). He therefore developed a belief that teachers should adjust their instructional style based on the students' responses to instructional styles already in use.

### **Teaching My Way**

During interview II, David's earlier belief that teachers should be given opportunity to teach their way and develop on their own as teachers.

Even though teaching independent sections would allow him more teaching autonomy, he felt that he still did not get as much autonomy as he wanted to have. He said that he had to follow a common syllabus as prepared by the course coordinator:

So that's something I personally don't like, okay. But if I have a chance to make your own syllabus, I mean really become individually teaching, I think that will help you to make something you wanna change in the classroom. That will help you do the way you wanna teach that class. But right now here, everything is already – the framework is already made and I have to be in that framework.

He said that he could not assign as much group work as he wanted to because the common syllabus framework would not allow it. In the future, he said, he would like to assign group work more frequently if he gets opportunity to teach based on his own syllabus. He believed that students would become more active and engaged during collaborative learning. According to him, the common syllabus and the common policy to be followed did not offer him much flexibility. When asked what factors were hindering his learning about teaching, he said that a common policy, the requirement of teaching at a pre-determined common pace across all sections of a coordinated course were hindering his effort to teach his way and develop as a teacher.

Even though he wanted to exercise more teacher autonomy, he said that his supervisor was very helpful. He believed that a supervisor was needed, especially if someone was teaching for the first

time. He wanted to have the supervisor whenever he needed help, but he also wanted to grow as a teacher by himself, and learn from his own experience.

### **Technology**

During interview I, he did not say anything about the use of technology until he was asked.

During interview II, he said unprompted that he had developed skills in using technology for teaching. Also, when asked what aspects of American teaching he would like to take away with him in his home country, he said that he would like to implement the idea of using technology in his home country as well.

He said that he used graphing calculators in almost every class. Moreover, he said that he was using ELMO and a projector, the interactive online site D2L, and also MyMathLab. Even though the use of D2L and MyMathLab was not his own choice, he believed that their use could be beneficial. He said that he would plan to use D2L more often in the future. He believed that the use of MyMathLab saves instructors time, but he had also noticed some technical issues while using the site. He also said that not all students would feel comfortable using technology.

During the interview I, he had said that college algebra instructors would not need to use graphing calculators. During interview II, however, he said that he was using graphing calculators frequently while teaching college algebra.

#### **4.1.5.a Summary**

David's teaching philosophy at this stage was focused primarily on creating a learning environment for students. In order to create such an environment, he believed that he needed to employ different strategies. He thought that employing a single teaching method every day could make students feel bored. So he would like to create a fun learning environment by using various instructional methods, instructional technologies, and some humor as well. He believed that an

important way to create a learning environment would be to motivate students to learn mathematics. In order to do so, he believed that they needed to know how the mathematics they were learning would be used in their own field of study and in their daily lives. He also thought that he would need to make students comfortable asking him questions. In order to do so, he thought that he needed to interact with his students more often. He perceived, however, that he could not become as friendly as he wanted to with the students, and that the students were not so willing to interact with him. He guessed that it might be due to his foreign accent, and that cultural differences might also have played some role.

He said that some students hesitated to ask him questions in class. Therefore, he realized that he needed to encourage students to visit him in the mathematics learning success center (MLSC), or in his office. Office hours would provide students the opportunity to get one-on-one help from the instructor; students would also feel more comfortable asking questions. Moreover, he realized that students hesitated to interrupt the lecture to ask questions, and that students could not be engaged and remain as active as expected. In order to avoid this, he thought that he needed to employ collaborative learning strategies, by assigning group work both inside and outside the classroom. Students might then become more involved, and benefit from group discussion with their peers. If some students are hesitant to ask questions to their instructor, they could ask questions of their peers, he said. He also added that such group assignments offer students opportunities to ask questions because that would not interrupt the lecture. Small group discussion assignments during class also provide an opportunity for teachers to interact with their students, if they walk around the room. The instructor could also answer students' questions, and assess student understanding. He said that although he wanted to help his students learn mathematics by motivating them and keeping them engaged, active, and involved, he did not have any specific plan to do so. He said that he would learn to do so from his teaching experience, and self-reflection on his own teaching. He said, however, that he should be given



more teaching autonomy to implement his plans and policies, and to learn from his own experience.

David believed that he needed to care about the students and their successes. He said that he would try to treat every student equally, and that he would try to be more consistent in the future.

Another aspect of his teaching philosophy was to have high expectations for his students. He wanted his students to learn more than just what had been taught in the class. He wanted to encourage or push them to do additional research, and learn more mathematics by themselves.

He believed that teachers should be prepared before entering into the classroom. Moreover, he realized that he needed to be organized, and learn time management skills. He said that he had limited time because he was both a student and a teacher; he had to split his time between teaching duties and his own graduate coursework. He said that his lesson plans helped to keep him organized inside the classroom. He also felt that he needed to be more organized in the future.

He said that the goal of instructors should be to help students understand mathematical concepts. He used to believe that the success or failure of a class depended solely on the instructor, but he had now developed a belief that students' learning also depends on the students themselves. He believed that teaching is a two-way process, and there is only so much an instructor can do if students do not create an active learning environment, and if they do not put enough effort into their own education.

#### **4.1.5.b Factors**

A number of factors were found to have influenced David's teaching philosophy. The most prominent factor was the teaching experience. Other influential factors were language and culture, other instructors including the course coordinators, SPTCM course, students, and time.

As discussed before, he perceived that he would have been a better instructor if he was more proficient in English, and had a better understanding of American culture.

*Other instructors.* He said that he learned about teaching and learning from the discussion with the course coordinator as well as with other instructors. He said that he had regular meetings with them, where he had opportunities to know what other instructors believe about teaching. He perceived that having a course coordinator was very helpful, especially because he was a beginning instructor. The coordinator used to answer all of his questions, such as how to teach certain things, and how to deal with classroom issues. He also said that he learned the idea of collaborative learning from his faculty mentor, who was also the course coordinator of the course that taught.

*SPTCM course.* He perceived that the math department had provided enough support to the new MGTAs. He said that the pre-service teaching assistant preparation course SPTCM was very helpful for beginning MGTAs, and taught him a lot about teaching and learning mathematics.

He also perceived that he had enough support from the mathematics department, especially the course coordinator. Whenever he had questions or difficulties, he said that he could ask the coordinator for help. However, he also said that he wanted some teacher autonomy, and wanted to develop his own syllabi and implement his own policies. He did not have as much autonomy because he had to use the common syllabus prepared by his course coordinator. For example, he said that he could not assign as many group assignments as he wanted to, because all the instructors had to move at the same pace throughout the semester.

*Teaching experience.* As discussed earlier, he said that teaching experience plays an important role in the growth of a teacher. He attributed changes in his teaching philosophy to his teaching experience. He said that his future teaching philosophy might change because he would learn more as he became more experienced.

*Time.* He said that he did not have enough time to make his teaching more effective, especially since he was also a graduate student. He had to split his time between his own coursework and teaching. As a result, he was not being able to spend the desired amount of time for his studies as well. He believed that he did not face any challenges or difficulties during classroom teaching though.

In summary, he perceived that the department of mathematics had provided enough support, but he expected more teacher autonomy.

#### **4.1.6 Interview III**

The last interview was conducted on January 8, 2014, during the early spring 2014 semester. The interview lasted for little less than an hour. David had taught college algebra course in the fall 2013 semester, and was teaching a trigonometry course during the current semester. He was teaching this course as the instructor of record, was although he was supervised by a course coordinator. The following themes were found from coding the interview III: conceptual understanding, experience, high expectation for students, learning environment, maintaining teacher authority, multiple teaching methods, out-of-class support, preparation and organization, and technology. No changes were detected in his beliefs conceptual understanding, high expectations for students, and maintaining teacher authority.

#### **Experience**

David believed that one needed to experience teaching in order to learn to be an effective teacher. He said that he was at the beginning stage of his teaching career, and was still learning. He believed that thus far, he had been successfully able to transfer his knowledge to the students. He implied that he would become an “effective” teacher in the future based on learning from his own teaching experience.

He said that one of his weaknesses as a math instructor was his lack of teaching experience. When asked what he thinks is the best way to learn about teaching, he said: "I mean definitely, you go teach the class. That will teach you a lot of things." Later, describing the factors that he believed had contributed most to his teaching philosophy, he said that the most influential factor was his teaching experience: "Definitely, my teaching experience and my interaction with other colleagues in this university and my teacher evaluations -- I mean students' evaluations. And, uh, I think I said the main part: experience." Even though he also identified the students' evaluation of his teaching as another influential factor, that learning was still based on his teaching experience, without which he would not have gotten student feedback.

He said that his future instructional development depends the behavior of the students, and on student feedback in his teaching evaluations. Based on his past teaching experience, he said that he learned to make adjustments in his instructional strategies. By observing his student behaviors, he realized the need to reflect back on his teaching, and seek alternative ways to keep the classroom awake.

Based on the interview data, it was evident that his earlier belief that teaching experience was the best way to learn about teaching had only been reinforced. Teaching experience, he believed, would provide him opportunities to learn from student feedback as well as from the self-reflection on his own teaching.

### **Explanation**

David said that a characteristic of successful instructors is their ability to explain things precisely so that students can understand in a short time period. He acknowledged that he was still learning and that he needed to find better ways to explain mathematical concepts to the students. He recognized the lack of enough teaching experience as a challenge for him as a new instructor. He had also expressed the need to explain things clearly in TPS II and III from his pre-service phase.

At the time of interview III, the only change in this belief was that he felt he needed to explain concepts to the level of his students, and that he should not explain them in the way that he himself understood those concepts.

### **Learning environment**

*Application of mathematics.* David said that most students believe that math is hard, and that it is a boring subject. As in the previous interviews, he added that most students do not even see where math is going to be used, which he said could be an obstacle for student learning.

He believed that students should know where the mathematics they learn in class was going to be used in the real life scenarios. He believed that seeing the application of mathematics would motivate students to learn mathematics. Recalling his classroom teaching experience, he said:

I have students raise -- some of the students raise hand and say like, "[Professor], where am I going to use this thing whatever you taught right now? Why we have to learn this math?" Those kinds of questions I have heard from them. And what I stressed to them is like mathematics has a profound impact in our daily lives. You have to use it in daily lives.

Beside all the things described above, he said that a good classroom environment would also include speaking loud enough so that all students could listen. He also said that sharing his passion by being excited sometimes could help students feel the passion their teacher had for mathematics.

As in interview II, he demonstrated his strong belief in creating a welcoming and favorable learning environment. By a favorable environment, he said that he meant to create an interactive, lively, and friendly classroom environment. According to him, creating a favorable learning environment was the most important aspect of his teaching philosophy. Described below are how David thought he would create a conducive learning environment for students.

*Caring.* He said several times during the interview that being caring was an important aspect of his teaching philosophy. He believed that the students should know that their teacher cares about them and their successes. He also said that he would like to understand what students want from him as a teacher.

*Creating a fun environment.* In order to avoid students feeling bored, he said that he needed to create a fun and entertaining environment. By saying so, he implied that an instructor should also use humor to keep students awake and attentive. He also said that he wanted to make mathematics learning more interesting to the students.

*Interactive learning environment.* He said that he would like to create an interactive classroom environment with active student participation. To do so, he said that he needed to encourage students to ask questions by having them get to know each other, which he believed would help them feel comfortable with each other. He would like to encourage students to participate in class by guessing the answers to questions, even if their answers might be wrong. He implied that he wanted to create an environment where students would not feel stupid even if their answers are wrong. He believed that students would be on track to eventually get the right answer by themselves if they do not hesitate to guess.

In order to create an interactive learning environment, he believed that the teacher should also be friendly and approachable to the students, otherwise students would hesitate to interact and ask questions.

While he believed in being friendly with the students, he also advised beginning MGTAs not to be friendlier than needed. Otherwise they would lose respect from their students, and the students would not treat them as their instructor.

During interview II, he said that he would like to employ collaborative learning strategies in class, but he did not say explicitly mention these strategies during interview III. However, he said

repeatedly that he would like to encourage active student participation, and encourage them to ask questions.

His belief in providing a favorable learning environment for students had not changed significantly since interview II. However, he seemed to have reinforced this belief by the time interview III was conducted. The only visible change was that he wanted to have his students guess the answers or solutions of questions he posed in class, and sharing his passion for mathematics with the students. He believed that the habit of guessing answers would eventually lead to the correct solutions or answers.

### **Out-of-class Support**

David said that one characteristic of a successful teacher is to become approachable to students and show willingness to provide out-of-class support. He had also expressed the need to provide out-of-class support during interview II, when he said that he would like to help students during office hours and in the mathematics learning success center (MLSC). During interview III, however, he said that the instructor should also provide support to the students even outside his office hours.

### **Preparation and Organization**

David said that a math teacher should prepare before going to teach in the classroom. When asked what advice he would give to a beginning GTA, he said that he would advise them to be prepared and organized. He realized that he needed to prepare more than he actually thought before.

Discussing the importance of being prepared, he said:

Graduate students need to work on their study, you know. And at the same time they have to prepare for the teaching which is a very challenging thing. So do not take it as something easy or you can do it, you know. It's not. It's a really big deal. You have to spend time. You really need to spend time. Be prepared. Be organized. When you go and teach in the class, you should not sound like some person who doesn't know how to teach. You got to be really a teacher. You should be like a teacher.

It is understood from the above statement that he held a belief that a teacher need to be well-prepared in order to be considered as a “teacher”. Being a graduate student as well as an instructor, he realized that being organized is also equally important. GTAs have their own work to do, such as studying for their own tests. In such cases, he said that they needed to plan ahead and prepare in advance. When asked what beliefs about teaching and learning were reinforced based on his teaching and other experience up to that point, he said that the idea of spending enough time for preparation and organization was reinforced. He said that the more time a teacher spends for preparation, the more ideas he would generate for teaching.

When asked in what ways a novice instructor could grow as a teacher, he said that one would need to prepare the mathematical content, how he or she is going to present or explain the content, and also how to incorporate technology to enhance student understanding. He said that teaching in a traditional way is not enough anymore these days; he believed that one would need to know how to use web-based learning strategies as well. So he was found to have reinforced his belief that an instructor should be well-prepared for classroom teaching, and should be well-organized as well.

By the time the third interview was conducted, he had developed a strong belief that content preparation was necessary, but not sufficient; he said that teachers should also prepare a detailed plan for the lesson they are presenting.

### **Students**

David said that some students wanted to learn more than just what had been taught in the class, and they liked be challenged. For these students, he said that would like to give a few challenging problems at the end of class period. He believed that it was up to the students to be challenged, and willing to learn more; if students give up, he implied that he would not have any regret.

While he said his role model high school math teacher used to have high expectations for



students, he also realized the need to do so from his teaching experience. Based on his statements, his belief on making instructional adjustments depending on the students' behavior was further reinforced at this stage. But no other specific changes were detected.

### **Technology**

When asked how novice instructors could grow as effective teachers, he said that they should learn to incorporate technologies in the classrooms, besides many other things. He said that teaching via traditional lecture-based instruction is not enough these days. He also said that the instructors should learn how to use web-based learning tools such as MyMathLab and WebAssign. Recalling his own experience, he said that beginning instructors could benefit from their interaction with other experienced faculty members who know what technologies are available and which are most effective. He also added that knowing where and when to use technology is more important than just knowing how to use it.

He said that he was using both ELMO and black or white boards in the classrooms. He said that using ELMO did not give as much flexibility, so he was using boards more often than ELMO. When asked why he used ELMO and projector more often in previous semesters, he said it was probably because his course coordinator used ELMO in his classes. But he realized, based on his own experience, that using boards was more comfortable and would give more flexibility to change things.

#### **4.1.6.a Summary and Changes**

The most important aspect of David's teaching philosophy from interview III was his belief in the importance of creating a favorable learning environment for students. He believed that students should have the opportunity to learn in a fun learning environment. Mathematics learning should be interesting to the students, and he would like to keep the students awake and attentive by using

humor. He said that he would like to create an interactive classroom environment, where the students are engaged and are more involved in the learning process.

He said that he wants to encourage students to ask the instructor questions, and to answer his questions. He said that he would also like to encourage them to guess the answers or solutions to mathematical problems. He believed that if the students do not feel stupid for guessing a wrong answer, they will continue guessing and eventually get the correct answer. In order to create an interesting classroom environment and to motivate students, he said that he would like to show more applied examples in class so that students could see where the mathematics they learn would be used.

He believed that he should be friendly and approachable to the students so that students feel comfortable to interact with him and ask questions. He also said that he would like to learn more about American cultures so that it would be easier for him to be more interactive with the students. He said that the students should feel that their teacher cares about them and wants them to succeed in the class. But he said that because of a small age difference between the MGTA instructors and the students, they are likely to treat MGTAs as their peers, and are likely to make noise in the classroom, thereby disrupting the learning environment. Therefore he thought that he needed to maintain his authority so that students would obey and respect him.

He said that instructors need to be well-prepared before entering into the classroom; they should know the material before they could explain the concepts to students. He also said that instructors should develop a plan on how to present the material. Being prepared, he said, would help him become organized in the classroom. He said that content knowledge is necessary for an instructor to succeed, but he also stated that content knowledge is necessary but not sufficient. Otherwise, all people with PhDs in mathematics would have been excellent teachers. He believed that being

well-organized is just as important as being prepared, because instructors, especially MGTAs, have limited time both inside and outside the classroom.

He said that teacher-centered lecture-based instruction is not enough these days, and that he would like to learn and employ various instructional methods. Using only lecture-based instruction, he said, would cause students to feel bored. He would also like to employ different ways to explain mathematical concepts, and to incorporate technology in the classroom more often. In order to be able to clearly explain mathematical concepts and enhance student understanding, he said that he would like to improve his English proficiency, and better understand how American students learn mathematics. Besides all of these, he said that he would like to treat his students equally in all situations. He added that he would have high expectation for his students, and would provide opportunities for them to learn more than what he taught in the classroom. He would also like to offer his students more out-of-class support, even beyond his regular office hours. While he said that he would put as much effort into helping students as he could, he said that there is only so much he could do; students themselves should also expend enough effort into their learning. Therefore the success of a class depends not only on him but also on the students, he said.

David believed that the best way to learn teaching would be to actually have teaching experience. Teaching opportunities would allow instructors to implement their own teaching philosophies in the classroom, and to see if new ideas are worth trying or implementing. Teaching experience, as he said, would also allow instructors to observe students' behavior and responses to their teaching. Self-reflection on their own teaching therefore would allow instructors to adjust their instructional strategies. Moreover, instructors could also learn and improve their teaching based on the students' feedback from teaching evaluations. However, he expressed the opinion that instructors should be given the autonomy to do things as they wished.

He believed that a person should have a passion for both mathematics and teaching, otherwise it would be difficult to make progress. Learning only from one's own experience and students' responses and feedback is not enough; one should also learn from interacting with other instructors.

David added more aspects to his teaching philosophy as he moved from the pre-service phase to the in-service phase. However, some aspects of his teaching philosophy were present in all six stages, three stages during the pre-service, and three stages during the in-service phase. He acknowledged at all stages that teaching is a challenging job. In TPS I, he mostly described the teaching behavior of his role model high school math teacher instead of presenting his own views about teaching and learning mathematics. In his teaching philosophy at other stages, he mostly described the characteristics that he believed a successful math instructor would have instead of writing or saying what he would do in his own classroom. Below is a summary of how his teaching philosophy evolved over time during the in-service, and then during the in-service phase.

The themes detected in his teaching philosophy at all six stages were: conceptual understanding, high expectation for students, learning environment, positive attitude, and preparation. One important aspect of his teaching philosophy from all six stages was to help students understand mathematical concepts. According to him, the goal of teaching was not simply to prepare students for exams by asking them to memorize procedures. He believed that it was necessary for students to understand mathematical concepts regardless of what grade they make in the exams. During interview II, he said that he would not only explain the mathematical concepts but also explain how those concepts were connected to concepts students had learned previously. It was not evident from the interview data how he developed the idea of connecting mathematical concepts. However, he said in interview II that he would like to tell students what they learned in the previous class, what they would be learning in the current class, and what they would be learning

in the following class. It is therefore reasonable to assume that his teaching experience might have had a bigger influence than any other factors. The influence of some reading assignments during the pre-service phase cannot be ruled out, but no evidence was detected in any of his teaching philosophy statements from that phase.

Being prepared was another aspect that was present in all six stages of his teaching philosophy. In TPS I, he felt that teachers who have enough content preparation before entering the classroom would be more confident and would be able to explain concepts clearly to the students. In TPS II, he realized that the instructor should spend more time outside the classroom in order to prepare, and that the preparation of content alone was not enough; he wrote that the instructor should also spend time preparing teaching material and developing effective teaching techniques. In TPS III, he added that based on his teaching presentation experience, teaching would require even “more exercises” outside the class. It is therefore reasonable to assert that he learned from his teaching demonstration experience that the amount of preparation that he thought was adequate earlier was actually not enough. Classroom observations, and the observations of other MGTAs’ teaching demonstrations could have also influenced his teaching philosophy.

During interview I, his definition of being prepared had broadened. In addition to content preparation, he said that instructors need to prepare a lesson plan, and develop an idea of what they are going to present, what order they will present it in, and how they are going to explain the material. They also need to collect materials from a variety of resources, such as the internet and different textbooks. He believed in choosing few examples to present carefully instead of presenting several examples. He also added that the instructor should be prepared in advance in terms of allocating time for classroom discussion and student work. During interview II, he said that a carefully developed lesson plan also helps the instructor to be organized in the classroom. Besides developing a lesson plan and preparing for the content, he realized the need to become organized. In interview III, he said that being organized is equally important to being prepared. In

each of the five stages following TPS I, he reinforced his belief that an instructor should have enough preparation before going to teach in a classroom. He also realized that he needed to spend much more time for preparation than he had previously thought.

Learning environment was another aspect that was detected in his teaching philosophy at all six stages. In TPS I, he demonstrated his belief that the instructor should create a positive feeling for mathematics, because students' negative perception toward mathematics is hindering their learning. Besides trying to change students' mindset that "math is hard", he also believed in being humorous. He expressed that the occasional use of humor could keep the classroom environment more enjoyable and attentive. In TPS II, he added that he should also develop a caring attitude and interact with students. He believed that a caring attitude and interacting with students would help students feel comfortable approaching their teacher and asking questions. In TPS III, he also added that the instructor should learn classroom management skills. He wrote that frequent student-instructor interaction, becoming friendly with students, and appropriately dealing with student issues would make the learning environment more favorable.

During interview I, he added that a good classroom environment can be created by making every student in the classroom engaged and involved. He also said that making eye contact with every student helps them feel that he cares about all of them, not just a few smart students. He also added that the students should feel that their teacher cares about them and their success. During interview II, he emphasized the importance of creating an active learning environment. He said that one of the ways to create such an environment would be to employ collaborative learning strategies in class. Describing the benefit of this approach, he said that students would be able to learn from their friends, and could also develop an ownership of their learning. He also said that students feel more comfortable asking questions if they are working in small groups. He had therefore realized that using only lecture-based instruction was not enough, and that he needed to look for other methods of instruction. Besides assigning group work or projects, he also expressed

the need to engage students by giving them some deskwork. He believed that the instructor should motivate the students in order to engage and involve them in the learning process. In order to motivate students, he believed that the students need to see where the mathematical concepts they learned are going to be used in other fields of study or in their real lives. Therefore, he said that he needed to show more applied problems during class. He also said that he needs to create a fun learning environment in the class. During interview III also, he repeated that the instructor should create a welcoming and favorable environment. He said that an interactive, lively, and friendly classroom environment could contribute to a good learning environment. Besides these, he also added that he would also encourage students to guess the solutions or answers to mathematical problems even if their guesses could be wrong. He believed that students would be able to make such guesses in an environment where they would not feel stupid by guessing the wrong answer, and that the habit of guessing would eventually lead students to find the correct solutions or answers. He also added that the instructor could make students feel his passion for mathematics by occasionally being excited in the class.

It was evident from the written and interview data that David's belief in creating a favorable environment was reinforced throughout following his first teaching philosophy statement. He said that creating a welcoming and favorable learning environment was the most important aspect of his teaching philosophy.

Having high expectations for students was another aspect that was found in his teaching philosophy at all stages. He believed that having high expectations would push students to work harder, and the students would learn more. He said during interview II that he would assign a few challenging problems at the end of each class period. He believed that some students want to be challenged by mathematical problems, and such students would benefit from trying to solve challenging problems. He said that such problems are primarily intended for good students, which would help increase the cognitive level of students. He acknowledged that the students who do

not like to be challenged would not benefit from his high expectations. When asked how he developed this belief, he said that he was impressed with the way his high school math teacher used to have high expectations for his students.

During interview III, he did not say explicitly that having high expectations was an aspect of his teaching philosophy. But when asked, he said that he had not changed that belief. However, the data from interview III suggested that he did not feel as strongly about this belief as he had in earlier stages.

In his teaching philosophies from all stages, David implied that the instructor should have a positive attitude towards teaching in order to succeed. In TPS I, he wrote that one of the characteristics of a good teacher would be to treat students equally in all situations. In his TPS II, he added that the instructor should always be responsible as a teacher. In TPS III, he wrote that instructors should also have a passion for teaching mathematics. He added that if they consider teaching just as a “job” and are teaching just to make a living, they would not be able to succeed as a teacher. He demonstrated a strong belief regarding the equal treatment of students in all three interviews as well.

In addition to the elements that were detected in TPS I, David added three new aspects in TPS II. They were: Organization, Maintaining authority, and Clear explanation. All these aspects were also present in TPS III and all the interviews.

In TPS II and TPS III, David wrote without elaborating any further that mathematics instructors are more likely to be a successful if they are well-organized, both inside and outside of the classroom. He said that a class period has limited time, and so it is hard to cover everything. He believed that the instructor should plan ahead on both what to present and how to present in the class. Moreover, he should also prepare in advance the amount of time he could allocate for each



topic, for classroom discussion, for group and desk work, and to deliver his lecture. He also believed in presenting a few carefully chosen examples instead of giving a lot of examples.

Being a student himself, he said during all three interviews that he had his own coursework and other responsibilities. He, learned, therefore that he had to manage his time very well even outside the classroom. He realized that he needed to spend more time for preparation, and grading exams, homework, and quizzes. In order to balance his time, he said that he had to work hard even during the weekends. By the time interview III was conducted, he said that his previous belief that a teacher, especially an MGTA, needed to be well-organized was reinforced.

Another important aspect that he added in TPS II was Maintaining authority. In TPS II and III, he wrote that a person with a “great personality” would be more likely to be successful as an instructor. When he was asked to elaborate during interview I, he said that instructors should maintain authority so that the students would treat them as an instructor, not as a peer. Otherwise, he believed that the students would not show as much respect as they did to other professors, and would not obey the instructor in class. In order to maintain authority, he said that instructors should keep a professional distance from the students. He also added that keeping this distance would be sufficient to maintain authority; the instructor should also behave in a way that earned students’ respect. He said that students are likely to respect instructors who speak loud enough for everyone to hear, are well-prepared and organized, and also provide a good explanation of the subject matter.

He did not say anything about maintaining authority during interview II. However, he repeated in interview III that doing so was necessary. He said that the undergraduate students would treat MGTA instructors as their peer because of the small age difference between them. As a result, students would not obey MGTAs, which he believed would prevent them from creating an

effective learning environment. This belief, developed during the second stage (TPS II), was reinforced in his teaching philosophies from the later stages.

An aspect of his teaching philosophy that was not detected in TPS I but was detected in TPS II and III was 'Clear explanation'. He believed that instructors should be able to explain mathematical concepts clearly to the students. He wrote that instructors should have good preparation of content in order to be able to explain concepts clearly. Although he did not express this explicitly during any of the interviews, he said that he would have been able to provide precise explanations of the content if he had stronger communication skills in English and more teaching experience.

David added some aspects in his TPS III that were not detected in TPS I and II. They were experience, effective teaching methods, and language and culture. Other themes conceptual understanding, maintaining teacher authority, and positive attitude were also detected in TPS III but they were also present in TPS II, and will not be discussed here.

He expressed in TPS III that he learned a lot from his first teaching demonstration experience. He implied that his teaching experience not only taught him a lot of things, but also developed a belief that an instructors would be more likely to be successful if they had enough teaching experience. He said that he also realized that he needed to become more serious and careful from his first teaching experience. During interview I and interview II, he said that no learning could be better than having the actual teaching experience. He believed that his lack of teaching experience was a serious challenge, and that he would develop as an effective teacher in the future based on his learning from his own teaching experience. During interview II and interview III, he said that instructors would have opportunities to reflect back on their teaching, and to improve their teaching for next time. Moreover, student feedback from their teaching evaluations

would also be helpful to improve one's teaching, he said. This belief was found to be reinforced in his later teaching philosophies.

He wrote in TPS III that instructors should use effective teaching methods. However, he did not write what kind of teaching methods are "effective". During interview I, he said that lecture-based instruction and verbal explanation is not always enough to enhance student understanding. He also said that using multiple instructional methods and technology could be helpful in enhancing student understanding. He expressed similar opinions in interviews II and III as well. He said during interview III that instructors should try to find alternative ways that are quicker to explain, and easier for students to understand.

David acknowledged the role of English language proficiency and an understanding of American culture for the first time in TPS III, but he did not elaborate further. During interview I, he said that an instructor would need to maintain a good relationship with students, which he realized would be difficult unless he had a strong understanding of American culture. As evident from the interview data from all three stages, he perceived that students would not be willing to interact with an instructor with a foreign accent. He therefore realized that he needed to improve his accent. Besides the differences of language and culture, he also said that he realized the differences in how mathematics is taught and learned in the US. Therefore, he pointed out a need to be aware of the American way of teaching, and of how students learned mathematics in high school.

David added a few more beliefs in interview I that were not detected in any of the teaching philosophies from the pre-service phase. They were: Teaching autonomy, Students, and Out of class support.

He believed that mathematics instructors should be provided opportunities to implement their teaching philosophies in the classroom. He said that teaching a course with little autonomy would

hinder a teacher's growth. Even though he realized that the support provided by the course coordinator was helpful, he said that he would need more autonomy to develop as a teacher. During interview II, he said that he had learned more teaching skills from teaching independent sections than teaching recitation sections. He repeated in interview III that he wanted to implement his own philosophy in his classrooms, and that he wanted to learn from his own experience. Therefore, his belief that a teacher needed to have teaching autonomy developed during the initial stage of his in-service phase (interview I) was found to be reinforced in his teaching philosophy at later stages.

During interview I, he said that students should also be responsible for their learning, and that the teaching and learning process is a mutual understanding between teacher and students. He added during interview II that he used to think that teachers had the only significant role in making mathematics learning effective, which by then he realized was not true. He said that the teacher can do only so much if the students do not expend enough effort in their education.

During interview I, he also added that not all students are comfortable interacting with the teacher and their peers in a classroom. He therefore realized that he needed to create a welcoming and conducive environment for students to interact and learn. He said that teachers needed to become friendly with the students. However, he said that he also realized that instructors should keep a professional distance from the students. Otherwise, he said that the students would treat them as their peers, and would not respect and obey them.

During interview III, he said that instructors should adjust their teaching strategies based on the students' responses to the teaching method being employed. Adjustments are necessary because they would help to keep the students awake and attentive, he said.

Providing out of class support to the students was another aspect that he added in interview I. He said that he would be willing to help students during office hours, and that he would schedule

longer office hours if the students needed his help. He realized that some students do not feel comfortable asking questions in the class, and the office hours would be helpful for such students. He expressed similar thoughts during interviews II and III, but he added in interview III that instructors should be willing to help students even outside their office hours. Other than described above, no additional themes were detected from interviews I and II. This chapter will present the results from the data analysis employed to examine the four research questions.

#### **4.1.6.b Factors**

The same factors that influenced David's teaching philosophies from earlier stages were also found to influence his philosophy at the time of the third interview. These factors were: language and culture, other instructors including the course coordinator and fellow MGTAs, students, teaching experience, and teaching they experienced as a student

Among all of these factors, teaching experience was the most influential. He believed that he would learn mostly from his own teaching experience, and that his future teaching philosophy would also depend on his learning from his experience. He said that teaching experience would provide an opportunity for him to learn from undergraduate students' feedback in his teaching evaluations. He added that he had been successful thus far, considering that he was a beginning instructor. However he perceived his lack of teaching experience as a challenge.

When asked to rank the factors that influenced his teaching philosophy, from most to least influential, he ranked them in the order: his teaching experience, the teaching he experienced as a student, past professors or teachers, his undergraduate students, fellow MGTAs and other instructors, and the pre-service preparation program course (SPTCM).

It was interesting to see that he considered the preparation course as the least influential among these factors. He said that the mathematics department had provided enough support to the MGTAs during both the pre-service and the in-service phases. When asked what departmental

support would help him to grow as an instructor, he said he was unable to think of anything. He had previously expressed during interview I that the support from the math department could not be any better. He did not consider the role of professional development opportunities as important.

In addition the factors he ranked in response to the interview question, it was also evident from the interview III data that he had been influenced by differences in language and culture. He said that his lack of understanding of American culture, and his perceived lack of English proficiency were challenges in his efforts to become a successful teacher. He perceived that he could not become more interactive with the students, and hence could not become as friendly as he needed to be. This was because he felt that the students are comfortable asking questions only if the teacher is friendly. He perceived that students were less likely to interact with an international teacher than with domestic teachers. He said that his life would have been so easy if he had to teach in his home country. He therefore started to believe that an instructor should try to understand the American culture as much as he could do.

He also said that his lack of English proficiency also played a role in his teaching. He recalled his teaching experience and said that sometimes he could not explain mathematical concepts effectively, and that the students found it hard to understand no matter how hard he tried to explain. He said that there could be some “American way” of explaining things so that students would understand. He therefore perceived that he would have been a much better teacher if he had a stronger understanding of American culture, and also if he had stronger communication skills in English.

#### **4.2 Case 2: Andrew**

Andrew was a 27-year-old domestic graduate student who was working on a Ph.D. in pure mathematics. He grew up in the southwestern United States. See the Methodology chapter for the complete description of the participant.

#### **4.2.1 Teaching Philosophy Statement I**

Andrew acknowledged that teaching as a graduate teaching assistant would be a highly challenging job. His two and a half page long first teaching philosophy statement (TPS I) was highly influenced by his role model professor from his undergraduate studies. He began his teaching philosophy statement by writing that he took several classes with this professor and enjoyed all of them. He devoted every paragraph of TPS I to describing this professor's teaching behavior, and added very little of his own perspectives on teaching. He ended his statement by writing that he would not follow some aspects of this professor's teaching, even though he would like to emulate him in many aspects: "As for my philosophy on teaching, I think I'd very much like to emulate [professor] in many aspects".

Coding resulted in the following themes from his TPS I: application of mathematics, high expectation for students/tough-love attitude, institutional culture, learning environment, making students think, promoting individual development, and out-of-class support. The following is a description of these themes in alphabetical order.

##### **Application of Mathematics**

Andrew wrote that his professor emphasized that the students should be prepared to apply the mathematical concepts they learned in the classrooms in the real lives when they go to work. Regardless of what major or concentration (pure or applied) they are in, they all have to learn certain things (such as programming skills) in order to be able to work in industry.

##### **High Expectation/Tough-love Attitude**

He wrote that he was impressed by the idea of his role model professor to have very high expectations for his students. In order to push them to work hard, that instructor used to exhibit a tough-love attitude.

[The professor] expected a lot from his students, and this was thoroughly displayed after the midterm exam in the tensor analysis class. [Professor] used a modified GPA to grade assignments, reserving a grade of 5 for work that was flawless. Before giving back the exams he explained to the class that he was very disappointed in the scores. The average score was a 2.3 or so, and he explained that while he was grading he had the desire to fail everyone at that moment. He was very frustrated and didn't understand why the scores were so bad. He then explained that after a day he cooled off and decided not to fail everyone, but that was the only charity he was going to give us. He said, in no uncertain terms, that the grade we received on our tests were the grades we earned. There would be no curve and no extra credit to make up for the loss. He made it very clear that he meant business.

The professor's remark and his poor performance in the first test made Andrew realize that he needed to work very hard to pass the course:

To this day I remember the feeling I had upon hearing this, and later getting my exam back. I had an abysmal score on that exam, and I knew I had to step up my game and do better just to pass this class. Sure it was an elective class, but that fact never entered my mind, I saw a challenge and I had to accept it. I worked so much harder, harder than I ever had before. I made up for the lack of foundation in abstract linear algebra, essentially learning an entirely different class so I could understand the material presented in his class. I ended up pulling out a B in that class, bringing my grade up from a D on that first midterm. He made me want to succeed, and it wasn't until later did I realize that I might have had an easier time succeeding had I sought his council during the quarter.

He wrote that this professor's high expectations and his own fear of failing the class pushed him to work harder. Recalling the time when he was enrolled in the professor's math class, he wrote that the professor was upset by the performances of his students in the class. But instead of being easy, he set the bar even higher for the students.

He believed that assigning hard and challenging homework sets and giving difficult exams would push students to put more effort into their learning. He wrote that this professor made him realize that the success or failure of students depends on the students themselves. Andrew felt very



strongly about being tough with students and having high expectations for them; however, he wrote that he was also willing to support his students whenever they seek his help:

The hand-holding and being too nice doesn't help someone when they really need to use their knowledge. Simply giving answers to students without asking them questions to guide them to the answers doesn't promote thinking and stunts students' growth. Being easy on students doesn't prepare them for the realities of higher education nor industry. These are the aspects I would like to emulate. Having reasonably high expectations of my students yet being available for my students when they seek help.

### **Institutional Culture**

Andrew wrote that he learned from his role model professor's case that an instructor should maintain a balance between his instructional and other responsibilities and shouldn't focus too much on his students. He also learned from the experience of his professor that instructors need to learn to cope with the institutional culture and work to meet its expectations. Universities and departments expect more from instructors than just teaching and helping their students. He wrote:

Although [professor] was an amazing instructor he was not without his flaws. All the effort he put into pushing students, making time for them in his office hours, accommodating every student he could, etc., was ultimately too much to handle. He ended up being burnt out and disenchanted with the system in place at my undergraduate institution. He felt that instructors' focus should be primarily on students and their success and the department believed in a balance between teaching, administrative duties and such. Because of this conflict, which apparently had no resolution, he left his position at the university and landed an instructional position at another university. Last I heard he was much happier in his new position, where he's been for roughly two years, focusing mainly on instructing students.

Learning from the experience of his professor, Andrew wrote that maintaining such a balance among an instructor's teaching and other duties and his personal life is important. He wrote that the need to maintain balance among many responsibilities is more relevant in his case because he needed to focus more on his study. He wrote:

The one thing I would learn from [the professor] is to set boundaries and limitations. There is a need to keep one's sanity and to be able to say no when someone needs help. There comes a time where an instructor needs to focus on themselves and their other duties. This is especially important considering my current position as a graduate student. My studies and work are just as important as my future students. So striking this balance will be one of the areas of teaching that I will be quite focused on. And I'm expecting this

to be difficult for several reasons. It takes considerable time and effort to engage students, let alone creating highly engaging and challenging homework sets, exams and lesson plans. It will be a learning process for sure, but one I am eagerly looking forward to.

He already knew that in order to actually engage students, he needed to spend considerable amount of time to do things such as creating challenging and engaging activities and homework sets.

### **Learning Environment**

Andrew believed in creating a favorable classroom environment for students to learn. He wrote that an engaging classroom environment would contribute to student learning. He understood the importance of engaging students both in and outside of the classroom, but at the same time he also realized that instructors would need to spend a considerable amount of time to be prepared to engage their students. He wrote: “It takes considerable time and effort to engage students, let alone creating highly engaging and challenging homework sets, exams and lesson plans”.

Although he believed that students can be engaged through carefully crafted lesson plans and homework problems, he suspected that he would be able to engage students to the level he wanted to, considering his situation as a graduate student. He wrote that he needed to pay equal attention to his own education.

### **Making Students Think**

One of the reasons for being tough with students and having high expectations for them, according to his TPS I, was to make them think about mathematical ideas. Discussing the way his role model professor used to help students, he wrote:

The most notable aspect of asking [professor] for help wasn't that he'd simply give you an answer. He never gave answers. Rather he would answer your question with another question, leading you to the answer. This method takes even more time than simply saying, ‘Okay this problem is solved by doing this, this and this and you're done’.

He added that “hand-holding” and “being too nice” with students without guiding them to solve mathematical problems would stop students’ growth. In order to promote student thinking, a teacher should not simply answer students’ questions. Instead, he should ask questions to the students in order to guide them to solve mathematical problems and find answers on their own. He believed that assigning hard and challenging homework problems, and giving difficult problems in the exams and quizzes would push students to think more, and learn mathematics.

### **Out-of-class Support**

He wrote that he would keep high expectation for students but at the same time would be available for his students if they need help.

### **Preparation**

As described above, he acknowledged the importance of being prepared for a class. He wrote that carefully crafted lesson plans, and highly challenging homework sets would be helpful to engage students. He also acknowledged that one would need to spend a lot of time to prepare such lesson plans and homework problems besides many other usual teacher responsibilities. Considering his situation as a graduate teaching assistant, he thought that he would not be able to spend as much time as he believes he would need.

#### **4.2.1.a Summary**

In summary, Andrew said very little about his own teaching but described many aspects of his role model professor’s teaching that impressed him. His teaching philosophy statement implied that he would like to set high expectations for his students and employ a tough-love attitude, which he believed would push students to work harder to succeed. He believed that giving challenging problems in the homework and tests would push students to think. Making students think about mathematical ideas is important because they should be able to apply the mathematics

they learned when they go to work. In order to make students further think, instructors should not answer students' questions directly but ask other questions to lead them to their own answer.

Although he believed in having high expectations for students and employing tough-love attitude, he also believed in providing students with out-of-class support whenever they needed it. In his later teaching philosophy statements, and during the interviews, he expressed that he would help his students during his office hours if they seek his help.

Another aspect of his teaching philosophy was to engage students, both inside and outside the class. In order to engage students in the class, he believed that one would need to carefully develop a lesson plan, and also to create engaging and challenging homework sets. He added that he would need to spend a significant amount of time to prepare for the class, although he thought that he would not have enough time to do so.

In addition to the things described above, Andrew also believed that one would need to work coping with the situation in context and the institutional work environment. Good teachers should find a balance among teaching, their other responsibilities, and the mathematics department or university's other expectations of them.

#### **4.2.1.b Factors**

As discussed earlier, Andrew was influenced heavily by his role model undergraduate mathematics professor. In addition, the teaching he had experienced as a student and his own responsibilities as a graduate student helped shape his teaching philosophy. He also discussed how lack of time was a big factor; he acknowledged that it would be very difficult to develop the desired teaching materials that he thought would help engage students and help them learn mathematics. Moreover, he thought that the situation in context, such as departmental cultures, and his professional and personal responsibilities would impact the teaching of a college mathematics instructor.

## **4.2.2 Teaching Philosophy Statement II**

Andrew wrote that he observed classes taught by an experienced faculty member as a part of the course Seminar and Practicum in the Teaching of Collegiate Mathematics (MATH 5902). He also taught two demonstration classes in the actual undergraduate classroom. But he wrote that after observing his mentor's classes, and teaching a few demonstration classes, his philosophy not only did not change, but his views from his earlier teaching philosophy statement had been reinforced. He added only one paragraph to his TPS I to submit his TPS II. The only additional theme detected in TPS II was learning environment.

### **Learning Environment**

Andrew emphasized the importance of creating a learning classroom environment. He believed that an interactive classroom environment would contribute to student learning. According to his TPS II, he realized that the first class he taught was not very interactive. He then made an effort to make other classes more interactive and help the students feel that learning mathematics was a social process: "The two classes I instructed were vastly different. The first was very dry and not very interactive, lots of board work. The second lecture I made a concerted effort to interact with the students and make learning more of a social experience, much like [the role model professor] did with every single one of his classes."

#### **4.2.2.a Summary**

Andrew's teaching philosophy at the stage of TPS II was essentially the same as in his TPS I. The only change detected was that he realized the need to create an active and interactive classroom environment.

#### **4.2.2.b Factors**

Three factors were identified in his TPS II that either helped to develop new beliefs and/or reinforce his existing beliefs: class observation, teaching experience, students. No other factors were detected to have influenced his teaching philosophy, but the feedback his mentor and his fellow TAs provided him after his first teaching demonstration class could have also made some influence.

*Class observation.* By observing his mentor's classes, he wrote that his existing beliefs were reinforced, but not changed: "Through my experience conducting my own lecture and observing [mentor professor's] class I can honestly say that not only have my philosophy not changed from this original document, but that my views have been reinforced". However, he did not provide any further details.

*Students.* The students that he faced in the class seemed to have some impact on his teaching philosophy. After his second class, he wrote that some students approached him and gave some encouraging compliments regarding his teaching style. These comments, according to him, helped to reinforce his existing beliefs from his TPS I. He believed that the students had validated his teaching approach. He also wrote that the first two classes he taught were "vastly" different: students in the first class were not very willing to interact, and he had to put more effort into creating an interactive environment. So the students that he faced in the classroom had made an impact on his teaching philosophy.

*Teaching experience.* He learned from the first teaching demonstration experience that his class was not very interactive; he had to make adjustments to make other classes more interactive. He noticed that his first class was "high and dry", and he spent a great deal of time writing on the board. Learning from this experience, he had to make adjustments to make the other demonstration classes more interactive. He also tried to help his students view learning

mathematics as a social experience. He also recalled that his [role model professor] from undergraduate school used to create this type of interactive environment in every class period.

### **4.2.3 Teaching Philosophy Statement III**

Andrew submitted his third teaching philosophy (TPS III) on December 11, 2012. The following themes were found from coding: conceptual understanding, encouragement/inspiration, experience, high expectation/tough-love attitude, learning environment, making students think, and out-of-class support.

#### **Conceptual Understanding**

Andrew believes that the big picture underlying a mathematical concept is an important thing that every student in every field should understand. He wanted to guide his students to see the “big picture” of a concept by assigning carefully crafted homework problems and connecting mathematics to other fields of science. He believed this last element is generally lacking in mathematics education, which he believed is hindering students’ mathematical understandings. He believed that learning various ways of solving problems would help us grasp the big picture of the concept. He wrote that:

Each branch of mathematics is an added tool in our collective toolbox. Each branch brings with it a unique perspective at looking at a particular problem. These unique perspectives give us the ability to attack problems from several different angles to come to a solution.

He wanted his students to learn mathematical concepts (big picture) as well as the procedures to solve mathematics problems. He wrote that he would plan not to assign a large number of assignments, but only those assignments that would both help students practice the skills learned in the class and also guide them towards understanding the big picture.

#### **Experience**

Andrew wrote that he would like to improve his teaching based on his future teaching experience, and the self-reflection of his own teaching. He wrote:

At the conclusion of any given semester I ask myself, “What impact have I had on my students over the past several months?” If the answer to this question is simply that my students learned some useful mathematical facts and how to manipulate symbols according to some given rules, then I must conclude that I did not perform my duties as an instructor.

His statement implied that teaching experience followed by self-reflection would help him to improve his teaching for next time.

### **High Expectation/Tough-love Attitude**

In order to become a mentor and bring “inspiration and enlightenment”, he wrote that he wants to set high expectations for students, and requires them to work hard and participate in their studies. He therefore wants to create challenging exams and homework assignments in order to make students think. However, instead of assigning a lot of homework problems, wrote that he wants to assign only a few carefully crafted problems that are hard and challenging which will help students understand the big picture and practice the skills learned in the class.

### **Learning Environment**

Andrew repeated in TPS III that creating a favorable learning environment is important. The following are the ways he thought would be helpful to create such an environment.

*Application of mathematics.* He also wrote that he would like to motivate students by showing how mathematics could be applied in other fields of sciences. Being a person with a background in both mathematics and physics, he wrote that he would like to show the application of mathematics to other fields of sciences to create a “sense of wonder”. He wrote that he would like to share his knowledge of how mathematical concepts could be used outside of the mathematical realm, and in physical settings.



*Encouragement/Inspiration.* He wrote that the primary goal of an instructor is to inspire and encourage students to discover things by themselves. He wanted to become a mentor figure who would guide students to develop an ability to do more than just imitate what has been taught in the class.

I believe the main job of an instructor is to inspire one's students and to generate an environment of enthusiasm and discovery. In doing so, students develop more than the ability to regurgitate what has been shown to them. Instead they can discover these facts on their own through the guidance of a mentor. And that is precisely what an instructor should be, a mentor. A person who will bring inspiration, enlightenment and guidance to all of their students. It is this that I strive to achieve as an instructor.

If he becomes a positive figure both in and outside of the classroom, Andrew believed that the students will show willingness to work and participate in their own education.

*Sharing passion.* He wanted to share his passion for mathematics, and show students how it was interconnected with other fields of sciences and could be used to solve problems in those fields.

### **Making Students Think**

Andrew believed that the biggest goal of an instructor was to make his students think, ask questions to themselves, and try to answer those questions on their own. If he could get his students to think about mathematical problems, he believed that he had achieved the goal of being an instructor. He wrote:

I want my students to develop the skill of asking two questions: 'What happens when...?' and 'Why?' These questions are the fundamental tools to opening one's mind and becoming an enlightened individual. If I can impact a number of students to ask these questions in their everyday lives, and further to seek the answers to these questions, then I will have succeeded in being an instructor. These lessons are vital in life and if a student can ask these questions and learn how to find out answers on their own then they will be able to learn anything they set their minds to. This is the ultimate an instructor can hope to achieve.

## **Out-of-class Support**

Andrew wrote that he would encourage his students to seek his help during his office hours since doing everything in class is impossible. He wrote that he would be available for his students to help and provide guidance for their academic ventures, and also to discuss about the topics that students are interested in.

### **4.2.3.a Summary**

An analysis of his teaching philosophies revealed that some of the themes were present in all three teaching philosophy statements: application of mathematics, high expectation for students/tough-love attitude, and making students think. Even though these themes were present in all TPSs, he added more explanation about these themes in TPS III. In TPS I and II, he wrote that his role model professor had employed tough-love attitude and had very high expectation from his students, which in turn, had pushed him to work harder to learn more. But in TPS III, he became more specific about the things he would like to do. He wrote that even though he would like to assign hard and challenging problems to the students, he would not assign too many homework problems. Instead, he would like to assign few “carefully crafted” challenging homework problems “that will both help students practice the skills learned in class but also guide them towards understanding the bigger picture.” He also wrote that he would require students to put in at least as much effort into their own education as he did. By being a constantly positive figure, he believed that students would be willing to participate in their education.

He also felt strongly about teaching students the application of mathematics to other fields of sciences in all three of his TPSs. In TPS I and II, quoting his role model professor from his undergraduate studies, he wrote that students should be prepared to work in industry. He added in TPS III that being a person with a background in both mathematics and physics, he would like to show students how mathematical concepts could be used “outside of the mathematical realm”,

and also in physical settings. One of his goals, he wrote, would be to show the “interconnectivity” of mathematics and other sciences, in order to create an “environment of enthusiasm and discovery”.

In TPS I, he mostly described the teaching behavior of his role model professor. That instructor used to answer students’ questions with other questions, in order to guide them to think further and find their own answer. He also added that “hand holding” and being “too nice” would only stop students’ mathematical growth. In TPS III, he added that he would like his students to develop the skill of asking two questions: “What happens when...?” and “Why?” This implies that he would like to make his students independent thinkers and learners. If he could succeed in having his students ask these questions, and also to seek answers to these questions on their own, he would consider this as an important achievement as a mathematics instructor.

He had opportunities to teach in two different sections of a lower division mathematics course as a part of his practicum experience in the teaching preparation course for MGTAs. He wrote in TPS II that his earlier beliefs did not change, but had been reinforced. However, experiencing actual classroom teaching and self-reflection of his teaching did have some effect on his teaching philosophy. He wrote that the first class he taught was not very interactive; therefore he had to make adjustments to make it more interactive and to make his students feel that learning mathematics was a social process the next time. He also recalled from his undergraduate experience that the classes of his role model undergraduate professor used to be very interactive. He also wrote that encouraging words from some of the students he taught also helped him to reinforce his beliefs that he had expressed in his TPS I:

After the second lecture I had roughly 5 students approach me and ask me further questions, give me words on encouragement, etc. So based on this alone, I feel that a lot of what has been stated above has only been reinforced.

There were very few changes between TPS I and TPS II; however, many changes were visible from TPS II to TPS III. One major change was reflection: he acknowledged that he thinks back to his teaching at the end of each semester and reflects on what impact he has made on his students. If he realizes that the students only learned some mathematical procedures, then he would feel that he had not performed his duty as an instructor. So instead of just teaching procedures to the students, he believed that an instructor should encourage and inspire his students, guide his students to discover mathematical facts. He added that his goal as an instructor was to become “a person who will bring inspiration, enlightenment and guidance to all of their students.”

Another change visible in TPS III was that he wanted to make his students understand and see the ‘big picture’ of mathematical concepts. Showing the interconnectivity of mathematical concepts with other fields of sciences was a way to help students understand the big picture. He wrote:

[Students should develop an] understanding that although each branch of mathematics stands as a pillar on its own, there is a deeper underlying web of connectivity between each branch that gives us a bigger picture. It is this idea of looking beyond just the subject material we are covering in a particular class that I like to incorporate into my classes. Answering how the things we are doing are connected to other fields and other ideas. I believe that this perspective is often lacking in mathematical education and as such our students do not fully grasp the significance of the material they are learning.

Even though he wrote in TPS I, citing his role model professor from undergraduate school, that students should learn certain things such as writing computer programming languages to be able to perform duties when they go to work after graduation; he changed his tone in TPS III. His statement III implied that showing connection and application of mathematics to other fields of sciences could help motivate students to learn mathematics.

He developed a belief in TPS III that he would try to create a good learning environment. In order to create an “environment of enthusiasm and discovery”, he would convey his passion for mathematics and show its interconnectivity with other scientific fields. He wrote that he would also show how mathematics could be used to solve problems in those fields.

He also added an emphasis on equipping students with conceptual understanding, along with procedural knowledge. He wrote that he would plan not to assign large numbers of assignments but only those assignments that would both help students practice the skills learned in the class and also guide them towards understanding the big picture.

He also added the need to encourage students to seek out of class support, such as by asking questions during office hours. He said that:

[Asking questions and learning] need not only be done in the classroom, and I encourage students to approach me with questions or discussions outside of class, particularly during office hours. As an instructor I am here to be there for my students to answer their questions, to help inspire them to expand their minds and to provide guidance in their academic ventures.

Several factors seemed to influence his beginning teaching philosophies during the pre-service phase. The most influential factor was the teaching he had experienced as an undergraduate student; he discussed the teaching of his role model undergraduate professor in all the TPSs. As he moved from TPS I to TPS II, the additional visible factors were classroom observation, teaching presentation experience, and students. The additional factors that were found to influence his TPS III were teaching experience, and the courses taken other than mathematics.

According to his TPS III, he still seemed to be strongly influenced by his undergraduate role model professor. As he discussed in TPS I and II, his professor used to have very high expectations for his students, and used to assign difficult homework and exam problems. In TPS III, he wrote that he would employ a “tough-love attitude” in his classroom, requiring his students to put in as much effort to their own education as he did. He wrote that he would assign hard and challenging problems to the students, as his professor had during his undergraduate studies.

It would be reasonable to assume that he would not have been impressed with his role model professor if had he not been able to learn mathematics from him. He made it clear that his “abysmal” grade on one of the exams, and the professor’s strong determination not to curve their

test grades pushed him to work very hard. Because of his hard work and the way the professor helped him, he ended up with an overall grade of B in the course. Therefore, the kind of teaching he had experienced, and his success as a result of such teaching, had influenced him and his teaching philosophy.

Even though he had taught only two demonstration classes, he wrote that he would improve his future teaching based on the self-reflection of his own teaching experience. There were also some class discussions regarding improving teaching based on the self-reflection of own teaching during seminar sessions of the SPTCM course.

He mentioned in his TPS III that the students themselves should put in enough effort to learn, and that the teacher's effort alone would not be sufficient: "In order for students to truly gain enlightenment they need to work diligently and be participants in their own education. There is a mutually symbiotic relationship between an instructor and their students." So it would not be unreasonable to interpret from his words that there is only so much an instructor can do, and that students' learning also depends on their own attitude and effort.

He was also influenced by courses he had taken other than mathematics. He wrote that he had a background in both mathematics and physics, and that he would provide examples to the students that would show how mathematics could be used in physics and in other scientific fields: "Having a background in both mathematics and physics I love to share my knowledge of how mathematical concepts can be used outside of the mathematical realm and in physical settings."

The factors discussed above were the only clearly detectable factors that had influenced his TPS III. However, it was not clear what factors caused to develop the additional beliefs that appeared in TPS III. It was interesting to observe significant changes in his teaching philosophy as he moved from TPS II to TPS III, even though the changes from TPS I to TPS II was not as significant. It is necessary to be careful while detecting the changes in TPSs and the factors that

possibly caused these changes: what he already knew might not have been expressed in TPS I, and what he wrote in TPS II and III might not have been the cause of what he learned during the pre-service training. It was hard to attribute these changes to the learning from SPTCM course after he wrote TPS II.

#### **4.2.3.b Factors**

The same factors that were detected in Andrew's teaching philosophy at the previous stages were also influential at the stage of TPS III. The only additional factors detected were teaching experience, and the courses taken other than mathematics. He believed that teaching experience would help him to develop as a better teacher. He wrote that courses taken other than mathematics had helped him to see the connection between mathematics and other fields of sciences. He believed that showing this connections to the students would create an environment for enthusiasm and discovery.

#### **4.2.4 Interview I**

The first interview, which lasted for approximately one hour, was conducted on July 5, 2013. Andrew taught two sections of Functions (MATH 1483) in the spring 2013, and was teaching a section of Business Calculus during the summer 2013 semester, when the first interview was conducted. Coding resulted in the following themes: compassion, experience, high expectation/tough-love attitude, learning environment, making students think, multiple teaching methods, other instructors, out-of-class support, preparation, students, and teaching my way. No additional changes were detected in the themes application of mathematics, and making students think, and therefore they will not be discussed here.

#### **Compassion**

Andrew believed that the instructors should show compassion for the students and their difficulties. He said that he did not agree with how they were taught to handle academic integrity issues in the pre-service preparation course 'MATH 5902'; they were taught to be less compassionate with the students. Some of his comments about the preparation course implied that instructors should also help their students to correct their mistakes before taking any actions against them. He said:

You still will be able to gather information, say okay well great! Academic integrity violation, it's very important, it's very serious given the technicalities of the situation, I mean it's your choice as an instructor whether you want to proceed by being conflicted with that particular situation. I was able to come to realization. It's the, at the discretion of the instructor. If you see something it doesn't necessarily that you have to act on it. You can take your student, pull him aside and say, hey I found a discrepancy, okay, I want to give you one warning, don't do it again, kind of the idea. These are the consequences, dah, dah, dah but you don't have to pursue academic integrity at that point, right?

### **Experience**

Andrew believed that he would develop as a teacher based on the learning from his teaching experience. He said that the actual teaching experience had helped him to gain more confidence and learn about teaching. He said that he learned not being fearful of getting something wrong in the classroom because that could also contribute to alleviating students' math anxiety. He believed that students would see that it is okay to make mistakes while learning. When asked how he felt after the first semester of teaching, he said:

A lot more confident. I can do this. I know what I'm talking about. I thought that first semester of teaching was very enlightening and very – it settles the nerves. I mean there's a little anxiety but once you started it felt natural, it felt familiar. So that was what took a couple of weeks.

He expressed that learning from experience and developing as a teacher is more effective than learning from an external agent. Even though he would like to feel that there is someone to help



him whenever he needed, he said that he would like to learn from his own experience, and wanted to be who he is.

When asked if the activities that he participated in during the pre-service preparation program (MATH 5902) were helpful, he said: "I'm not sure so much about the teaching and the teaching style". He described that he learned about some teaching "procedures" such as dealing with students, and handling academic integrity violations. However, he said that he did not agree with all the things he was told by the instructor of the course.

In summary, Andrew was found to hold a strong belief that learning and developing from his own teaching experience is more effective than learning from somebody or something else. He implied that any professional development activities would have only minimal impact in his teaching style.

### **High Expectation/Tough-love Attitude**

As he had written in his teaching philosophies from the pre-service phase, Andrew again expressed that he would like to have high expectation from students. He said that he treats his students as adults and wants them to behave as adults. He said that he would expect his students to feel their responsibility by themselves but he would not baby them:

I treat them like adults. ... My philosophy of teaching especially in the university is I'm not here to quarrel, I'm not here to baby, I'm not here to baby sit. You're over eighteen, you're an adult. Act like it and that's kind of the philosophy I've always had.

He said that the students from one of the two classes he taught did suffer the consequences of not behaving as adults and wanting to be babied. Those student who acted as adults understood their responsibilities very well and were more successful.

He felt strongly about treating his students as adults and having high expectations for them. He said that he did not want to compromise on this:

So again this is me challenging my students. Ummm I wasn't going to be sneaky about it I was very forthright, honest. I said whatever you had difficulty with on the first three exams, expect those problems to be on the final and you're going to do them. And again there were only a handful of people who complained about it and that's fine they can complain, but it was still going to be on the final and I'm going to treat you like an adult and I'm going to expect you to do your work because once you graduate the same thing is going to happen to you in the real world, you're going to be expected to perform whether you like it or not. And that's what I try to emulate.

In his earlier teaching philosophy statements, he wrote that he would employ a tough-love attitude in his classrooms. When asked to clarify why he wanted to do so, he said:

A tough-love attitude I think is very important. Because, and this kinda leads to a bigger debate or conversation, but I think if you kind of coddle or if you're too soft, there's an expectation of that comes in your students' minds where they don't feel like they necessarily have to work as hard, they don't need to learn stuff as much as they need to, they actually need to, they become lazy is what it comes down to. When you have a tough love attitude and you expect -- you have expectations and I'm not going to give you easy questions. I expect you to work and there's a reward for your work. It may not necessarily -- you may not get the grade that you want that's not the reward. The reward is bigger. The ability to be able to think and in our society as a whole there is a lack of that ability to think and no one wants to work for it. And that being able to work hard for something whatever it is will make you more successful I find.

He said that the tough-love attitude applies not only to his classroom, it applies everywhere and it forces people to work harder:

So I mean the tough love attitude is not just for my class. That tough love attitude applies kind of -- if you have that mentally and that go get there kind of idea or attitude, I think you're more inclined to be successful as opposed to wanting everything and expecting people to give you, to hand out whatever -- easy exam, no you have to work because I'm like, the American dream right? You got to work your tail off to get somewhere and I think somewhere along the way we've kind of lost that.

His belief about having high expectations for his students came from his undergraduate learning experience, especially from his role model mathematics professor. He said that that professor's

expectations made him realize how far behind he was, and that pushed him to work a lot harder than before.

His belief from his earlier teaching philosophies from the pre-service phase on having high expectation for students and employing tough-love attitude had been reinforced at the stage of interview I.

### **Learning Environment**

Andrew believed that student learning is also a function of the kind of learning environment that one can create. He said that the first thing he would like do is to change students' mindset that mathematics is hard. He said that he would also like to engage his students, and promote classroom interaction in order to create a conducive classroom environment.

*Creating positive feeling for mathematics.* He said that most students have a negative attitude towards mathematics and its learning, and that instructors should try to create a positive feeling towards mathematics in order to alleviate their math anxiety. He said that he would try to tell his students that math is just like a different language and that anyone can learn, just like his role model mathematics professor did when he was taking his classes. He said:

A lot of this stuff is like Chinese, I have no idea what it is but the symbols, I mean, and I try to emulate or talk to them and say hey, it's like any other language. Once you understand what the symbols mean, you can understand what the language is saying. Um, and I guess in that regard it's – again it's just that same professor. He always brought it down to a simple level of this is what was going on. If you're able to understand in the most basic form then you truly understand what's going on and that's really what I try to instill.

He said that making some mistakes in the classroom could prove to be an even more “enlightening situation”. He expressed that when students see and point instructor's mistakes out, that is helpful for them to alleviate their math anxiety; they would see that even the people with graduate degrees in mathematics make mistakes, and that it is okay to make mistakes while learning.

Andrew therefore implied that instructors should not worry much about making mistakes in the class, as doing so would create a positive learning experience for the students. In addition to assuring students that it is not so hard to learn mathematics, he said that demonstrating passion for the subject could also help students to change their attitude towards mathematics. He said that instructors need to show their passion for the subject as well as their compassion for the students, in order to create a positive feeling for the subject. He believed that if teaching, passion, and compassion are not attached together, an instructor would not be able to create a positive learning experience for the students.

Creating positive feeling for mathematics to alleviate students' math anxiety was an additional aspect of his teaching philosophy detected in interview I, which had not been evident in his earlier teaching philosophies.

*Engaging students/interacting with students.* Andrew believed that student engagement is an important part of teaching. He implied that if instructors just deliver a lecture but do not engage their students, students would feel bored and would not want to attend the class. He said

Whenever I, I do a problem on a board the one thing I write up the problem on the board and I say okay what do we do? I don't even start the first step, I ask them what the first step is every single time because if I just go up there and do all the work and the – one it's boring. Math is, for the general public, math is a very boring subject to be. So if you're just up there writing on the board and not engaging your students and not getting it, they're going to be bored out of their mind especially on the lower classes like functions, because the students hate it, they hate this class. They're forced to take this class and they don't want to be there.

He further said that he would not like to be the only person talking in the class, and would not want to make his students feel bored. He said that he would like to engage his students by promoting active classroom discussions, and forcing them to think. He would also like to ask students questions such as how they got what they got, which he believed would force students to think.

In order to engage them in a thinking process, he always asks them questions that prompt them to justify their argument. He said:

I don't really write a ton on the board. What I'll do is I'll have a rough outline of what I want to talk about and most of it kind of to that one and I ask them why these things happen? Why would you expect we have a new kind of concept? How do we solve this sort of equation for example? And I ask them, how would you think, how would you handle this? Being in a conversation but I have bullet points of what I want to hit. So that once I get through all my bullet points who had a nice dialogue, I write on the board and I get them whatever they need as far as being written down on their notes then we end up going to the book and doing problems out of the book. They kind of emulate how their homework would be like to give them the kind of an idea what to expect from their homework.

Recalling the classes taught by his role model undergraduate professor, he said that he used to engage students by not answering a question with an answer; instead, he used to answer students' questions with another question to get them think. He said that he would like to emulate the professor's idea in his teaching.

He also said that he doesn't want to be a person who would just tell facts and asks students to memorize them. He believes that such instructional strategy would fuel students' negative perception towards mathematics and its learning. Instead, he said that he would like to interact with them, engage and involve them in the learning process.

In summary, he implied that engaging students was an important aspect of his teaching. Engaging students would create a positive learning experience, and would also encourage them to think about mathematical ideas. He believed that an engaging classroom environment could be created by interacting with the students, and asking them questions.

### **Multiple Teaching Methods**

Andrew said that different students learn in different environments and in different ways. He wants to understand students' thinking and learn the kinds of learning environment or teaching

styles that best help students learn. He said that he wanted to employ multiple techniques to address all kinds of learning habits and encompass all kinds of students:

Being able to relate to them in a better way. Being able to really kind of get intake of what they're thinking and being able to explain whatever I'm trying to lecture is effective for that person or those people, the students that came in that class. What sort of activities work for – because I mean if you go, just go on board and put all your material out there that works for certain students. Going into groups, that work for others, making them work on their own and then going over it later. I mean there's so many different ways to do these things to teach, and there's so many students, each one have different way they learn most effectively and being able to kind of hit most of those and what ways I could kind of emulate that to my teaching to be able to be as encompassing as possible.

He said that instructors should understand the type of students they have in class and understand their mindset as well. Based on the students' level of mathematical ability, they should make instructional adjustments or find alternative ways to explain that match the level of students' understanding.

### **Other Instructors**

Andrew said that teachers can improve by learning from their interactions with other instructors. He believed that such interactions would provide opportunities for instructors to understand different perspectives about teaching and dealing with issues. He said that he benefitted from having his fellow graduate students around him when he had some issues with teaching. He said that the discussion with other graduate students was helpful because they brought perspectives that were different from his own:

They bring a different perspective that you don't have, playing a different perspective that you don't have, maybe it's not always helpful but it's always useful to understand that maybe there's another way to approach a particular problem. Even now in my teaching some, or I have a situation I'm not sure exactly how I'm going to do this. I'm still kind of planning on how I'm going to do in a particular lecture. I'm going to do or handle a particular situation that's coming up, but I'm not exactly sure and then someone will say, well how about this idea? How about what could you do this instead and that's always been helpful. My colleagues have been very helpful in that area.

He also said that he also benefitted from discussions with his mentor, who also became his course coordinator during the spring 2013 semester. He expressed that such discussions led him to

realize that there were more convincing perspectives about teaching and learning mathematics than the ones he already had.

### **Preparation**

Andrew had written in his previous teaching philosophies that a teacher should prepare before entering into the classroom. He said that he used to think previously that he would not need to spend too long outside the classroom. After he started to teach, he realized that it was not true. He said that he had to spend a significant amount of time doing things such as writing exams and preparing for class:

The amount of effort you actually have to put in um for creating an exam on your own, the creativity you have to have to be able to do something like that and to be able to make it so that way your students actually have a fighting chance of being able to do it well. I think those things I didn't consider um before. Um lecturing was kind of something that set a little bit time to actually get used to, but I don't think my philosophy changed on that so much because it's still a conversation to me, perhaps I don't make a conversation more time to others, but it's still a conversation, but definitely the prep work and the time outside of classroom that is dedicated to teaching and dedicated to creating your lesson plan. Um so that more than anything has changed as far as after my first semester is concerned.

He also realized that teaching takes creativity. He said that one should try to study students' minds, as well as research teaching techniques or ways to explain mathematical ideas that are within the reach of students in the class. He implied that the instructor should be well-prepared to alter the teaching methods if needed, and provide any kind of explanation that students find easier to grasp.

### **Out-of-class Support**

He said that students should also be given some out of class support, especially if they approach him for help. Giving an example, he said that he had offered an extra hour-long problem solving session for his students to help them prepare for an upcoming exam.

### **Students**

Andrew said that the students' learning and their successes depends not only on the teacher but mostly on students' personalities, such as their attitude and their personal nature. He said that students from one of his sections performed better than the other, and when asked why that might have happened, he said:

The lectures were perfectly the same so I think the personalities of students, their work ethic, because in my first class, like I said ever the first game I challenged them and I said you guys have to bust your butt and get the stuff done to learn and they did ummm and my second class, they ended up feeling like you know this is going to be an easy course sort of missing a lot of classes, even when their second exam came in and that was terrible for them. People gave up, they didn't start they still didn't come to class so they didn't put in the work ethic, and you know it was, I think it was more along the lines of the personalities than anything else.

While discussing how the students' successes depended on their own attitudes and hard work, he said:

Well it worked for one section, it worked very well, because, well truth be told they did terribly. The first section did really terribly on the first exam and it scared them and I pretty much told them buck up it's going to be harder. The second section, they did really well on the first exam and I told them you know maintain the course, good job, keep going. They ended up slacking off um to the most part. So it was really hard to engage even when it comes to class and that most hands after the first exam I saw attendance drop off 50 percent sometimes and it was consistently around 50 percent uh attendance so um but the people who were there and who did their homework and were active participate uh participants it worked for the most part. Um so if they were in class and engaging it worked for them um but if they ended up slacking off or not wanting to participate then it was not as successful not like that.

He said that the learning outcome is mostly a function of students' personalities and their attitude towards learning. Giving examples of students from his two sections, he said that the learning outcome varied even though the teacher variable remained constant. In order to create an interactive learning environment, for example, he said that he tried to be friendly with his students, but it didn't work well in one of the sections:

Well in the fall I had a very interesting experience because the two classes that I taught, I thought functions um, they were very drastic and behavior personalities of the classes. Um on the one hand I had one class who was very timid and wasn't very expressive and um, another class was very expressive and very vocal. ... Like you know it's frustrating for certain students because you know certain students will say well, who cares why this is the right answer and that goes back to my I'm not trying to give these kids just facts



and tell them what to do and why to do it or get them what to do at a particular situation, but I want them to understand why they're doing what they're doing.

He said that he wanted to help his students understand the concept. But some students did not like him because they were just looking for a procedure to solve the problem and find an answer.

Although he expressed that students' learning depends mostly on themselves, he also acknowledged that their feedback is important to identify the instructors' weaknesses, and to figure out where and how to improve their teaching. He believed that it was students' responsibility to point out the instructors' weaknesses.

Overall, he believed that students' success depends largely on students themselves. He said that things such as class attendance, classroom participation, and asking questions are their own responsibilities. Their attitude towards working and learning largely determines their successes. He also mentioned that teaching is a mutual understanding between an instructor and his students and that they both should understand their responsibilities.

### **Teaching My Way**

Andrew said that he wanted to learn from his own teaching experience and develop as a teacher.

He added that he wants to be who he is, but and does not want to be someone else. He said:

So me being able to be myself and being an instructor and having an advisor that was there if I needed him, and not necessarily there all the time and like looking over my shoulder, I think that benefits me more than if I were to have somebody constantly like asking me what I'm doing, constantly trying to critique what I was doing, because it wouldn't allow me to be who I wanted to be as an instructor.

He said that his mentor from the pre-service preparation program course (SPTCM) allowed him to develop himself as a teacher. However, he learned from his fellow teaching assistants that the courses they were teaching during the semester the interview was conducted were coordinated courses, and that the course coordinators had pre-determined schedules that all sections had to follow, and the instructors had to meet with the course coordinator every week. He said that that

such coordinated courses sometimes would “take away” his style, and would not let him develop on his own. When asked what kind of support he would like the math department to provide him, he said:

Well, I wasn't sure because I know you have different advisors, each one has their own style of advising. Um, my advisor in particular is very hands off which I appreciate because it let me develop into the teacher or the instructor I wanted to be. Um, and he let me basically just gave me guidelines, this is what you need to do. These are the things you need to cover, and I appreciate it. That was really cool because then I was able to come up with some creativity and try to – and if I fell behind that's okay, I could catch up. There wasn't that stress. Right now other classes, let's say they have a set schedule that you have to follow and you're always meeting with your advisor what your that I feel kind of takes away from the style that I have.

He implied that he wanted to learn and develop as an instructor from his own teaching experience, and would not like interference from an external agent. He said that he wanted to have someone to help whenever he needed though.

#### **4.2.4.a Summary**

The most important aspect of Andrew's teaching philosophy was having high expectations for students and employing a tough-love attitude. Doing so, he believed, would push students to work harder. He believed that not employing a tough-love attitude could make students lazy, and they could feel that they do not need to learn as much as they actually need to. He said that the students' learning and their successes depend not only on the teacher but mostly on students themselves. He said that college students are adults, and he would treat them as adults. He also added that he was not there to “babysit” them. Teaching is done as a mutual understanding between an instructor and his students, and both sides should be equally responsible, he said. He explained that things such as class attendance, classroom participation, approaching him for help, and asking questions are students' responsibilities. Based on his teaching experience during the spring 2013 semester, he found that the two sections of a math course he taught performed

differently. He said that their attitude towards working and learning largely determined their successes. However, he also said that instructors should show some compassion to their students.

Even though he strongly believed that student learning depends, for the most part, on students themselves, he also believed that student learning is also a function of the learning environment that the instructors can create. He believed that instructors should try to change students' mindset that mathematics is hard, which he believed might hinder their mathematics learning. He said that engaging students, and promoting classroom interaction would contribute to a conducive learning environment in the class. He also believed that instructors should be available to students whenever they needed help, both inside and outside of the classroom. He also said that different students learn in different environments and in different ways. He believed that the instructors should understand students' thinking and learn to employ the instructional methods that best help students to learn. He said that he wanted to employ multiple instructional methods to address all kinds of learning habits and encompass all kinds of students.

He believed that teaching takes creativity and is time consuming; one should spend a significant amount of time to prepare for class before teaching. He said that instructors should create engaging and challenging homework and exam problems, and should also be prepared for using different kinds of teaching methods.

He believed in pushing students develop their critical thinking skills so that they would be able to solve problems on their own. He said that he would encourage students to ask questions of themselves, and try to answer those questions on their own. He believed that giving answers to students' questions directly could stop them from thinking; instructors should answer students' questions with other questions, in order to push them to think about mathematical ideas, and to lead them to find their own solutions. Asking questions such as how they know what they know would also promote student thinking, he said. He said that promoting thinking skills in students

would make them independent problem solvers, and prepare them for applying their mathematical knowledge when they go to work.

Andrew was found to hold a strong belief that learning from his own teaching experience is more effective than learning from somebody or something else. He implied that participating in professional development activities would have only minimal impact in his teaching style. He said that he wanted to employ his own teaching philosophy in his classrooms, and wanted to exercise full teaching autonomy. He believed that continuously critique from an outside source and “looking over his shoulder” wouldn’t allow him to be who he wanted to be as an instructor. Although he would like to have someone to help him whenever he needed, he said that continuous intervention from the course coordinator or the department would “take away” his style. However, he also realized that instructors can benefit from interacting with other instructors, which would provide them opportunities to understand other people’s perspectives.

There were only a few changes detected in his teaching philosophy. One of the changes detected was that he developed a belief that the success of a class depends mostly on students. He said that students should also feel the responsibility of putting enough effort into their learning, and that there is only so much an instructor can do. He said that the undergraduate students are adults, and he would treat them as adults. He said that they should change their attitude towards learning, and it is up to them to decide how much effort to expend and how much to learn. Based on his teaching experience the previous semester, he said that the two sections of a math course he taught performed differently. He also observed that some students were expending more effort than others, which led him to believe that learning depends mostly on students. He had written in his earlier teaching philosophy statements that he would have high expectation for students, and employ a tough-love attitude to the students. In interview I, however, he said that the instructors should show compassion to the students’ difficulties.

In earlier teaching philosophies, he said that students in the class could be engaged by carefully crafted homework sets, and exam problems. During interview I, he added that it can be done so also by regularly asking them questions. An additional belief displayed in interview I that was previously undetected in his TPS statements was in creating a positive feeling for mathematics to alleviate students' math anxiety.

Another important aspect of his teaching philosophy that was detected in interview I but not detected in his pre-service teaching philosophies was teaching autonomy. He believed that if teachers are not allowed to implement their beliefs and styles in their classrooms, they would not be able to develop naturally, and would not become who they wanted to become as an instructor. In addition to these changes, below are the descriptions of some of the things detected from interview I data which are worth noting here.

Andrew did not say anything about employing collaborative learning and technology. When asked, he said that he had not used technology very often, although he said that using technology would be a good idea. He said that he wanted to display something on the projector one day, but he could not do so because the required software was not installed on the computer in the classroom.

Andrew did not mention explicitly about using collaborative learning in his teaching philosophy. When asked to tell his opinion about collaborative learning, he said that the effectiveness of such learning depends on the nature or the attitude of the students. He said that group work was not very common in his class; he had tried it only a couple of times throughout the semester, and students did not find it as helpful. He further expressed that even though he doesn't let students work in small groups very often, he always tries to engage and involve the entire class in problem solving activities. He said that making everyone in the class involved together is more time efficient, instead of having them work in small groups:

I kind of make the entire group out of the class. I guess if you want to put in those terms, but I don't do like you groups of four, you guys work together. I do like a whole brainstorm of the entire class together because there might be one person who has an idea that will help, somebody else will be in entirely different group so um, I try keep it kind of all together and we work on, and I find it to be more efficient that way. I mean consider the time we could work out – work through more problems and we have more ideas.

He said that the challenges he faced during the first few weeks of the semester were not necessarily public speaking but a feeling of responsibility and being comfortable with that responsibility. He had a feeling of how he would manage to do things right and be able to effectively explain concepts to his students. He said:

You're going to mold these kids' minds for 16 weeks, 16 and/or 17 weeks. That's a big responsibility and being able to be comfortable with that responsibility, it took a little bit of time. I mean it wasn't necessarily public speaking it was the fact that, oh my God! I better be able to do this stuff right and be able to explain it to them so that they understand it so they can't actually do well in this class because if I'm a crappy teacher, they're not going to succeed.

When he was asked to make a self-assessment of himself as an instructor, he said that he was only moderately successful. He said that the lack of success in one section nullified the success in the other section. He said that the subject he taught was “crappy,” but a majority of his students learned a lot and appreciated his teaching style. The students gave him encouraging comments in the teaching evaluation. He did not know the reason for the low attendance in one of the sections he taught, but he said that he might have not done enough to engage his students. He also acknowledged that he still had plenty of room for improvement.

He taught a course called Mathematical Functions, which he characterized as a ‘crappy’ course. He did not know what to expect from his students when he started to teach the course, and he did not make assumptions about their prerequisite mathematical background. He also said that he did

not expect his students to have any prior knowledge in the Business Calculus course he was teaching during the summer 2013 semester.

He said that he benefited a lot from the support provided by the mathematics department. He said that he was not so sure about whether he learned or adopted the teaching styles from the preparation course, but he learned a lot about dealing with student issues. Before he joined the current graduate program, he did not even know that he would be assigned to a course coordinator to help him.

When asked in what ways the course coordinator was helpful in supporting him, he said that the coordinator did not intervene in his daily teaching activities but let him learn and develop on his own. He said he did not have to see his course coordinator very often. He had to meet him in certain situations such as getting his exams approved, discussing the exam results, and dealing with some student issues. He said that because of the relationship he developed with the course coordinator and the conversations with him, he was able to understand that not all of his perspectives were right.

His statements during the conversation implied that he wanted to learn from his own experience, have decision making ability, and exercise teaching autonomy, instead of just learning from somebody else. He said that he also learned by observing his course coordinator's class.

Despite his positive perception of the support he got from the mathematics department and the teaching preparation class, he mentioned that there were some situations when he had to disagree with the way he and the other MGTAs were taught to deal with students in the preparation course. For example, he disagreed with how GTAs were taught to handle academic integrity cases.

#### **4.2.4.b Factors**

The following factors were found to influence his views about teaching and learning mathematics: other instructors, SPTCM course, teaching experience, and teaching experienced as a student.

*Other instructors.* Andrew said that he learned by interacting with other mathematics instructors, including his fellow teaching assistants, and his mentor and course coordinator. He said that he learned mostly by observing his mentor's classes and the discussions following those classes. He expressed that such discussions allowed him to see where he was in terms of his beliefs regarding teaching mathematics.

He also found that he could benefit from having his fellow graduate students and other instructors around him. He said that when he had some issues with teaching, the discussions with them were very helpful because they brought different perspectives from his own.

*SPTCM course.* He said that he was not sure whether he learned or adopted the teaching styles from the preparation course. He had to disagree on how they were taught to deal with some student issues, but he said that he learned a lot from the course.

*Students.* He said that he realized from his teaching experience that students' learning depended not only on the teacher, but mostly on students' own personalities and attitudes. Giving examples of students from his two sections, he said that their learning outcomes varied even though the teacher variable remained constant. In order to create an interactive learning environment, for example, he said that he tried to be friendly with his students, but it didn't work well in one of the sections. He also added that he wanted to help his students understand concepts and used to answer their questions with other questions, but some students did not like this approach because they were just looking for a procedure to solve the problem and find an answer. He implied that those students just wanted to get things done, but did not want to understand the mathematical



concepts. Therefore, he developed a belief that learning outcomes are mostly a function of students' personalities and their attitudes towards learning.

Although he expressed that student learning depends mostly on the students themselves, he also acknowledged that their feedback is important to identify instructors' weaknesses, and to figure out where and how to improve their teaching.

*Teaching experience.* Andrew said that the actual teaching experience helped him to gain more confidence and learn about teaching. He said that he learned not to be fearful of getting something wrong in the classroom, because occasional mistakes could also help alleviate students' math anxiety. He believed that students would see that it is okay to make mistakes while learning because they will see that even a person with a graduate degree in mathematics sometimes makes mistakes. When asked how he felt after the first semester of teaching, he said that he felt a lot more comfortable. His teaching experience helped him to realize that he should not worry too much about making mistakes in the class.

*Teaching experienced as a student.* As in his previous teaching philosophy statements from the pre-service phase, his teaching philosophy at the stage of interview I was also highly influenced by the teaching he had experienced that contributed most to his mathematics learning. He was especially influenced by his role model undergraduate mathematics professor's teaching. He said, "When you come in as being student and instructed your entire life, you kind of try to invoke kind of the teaching styles the teachers that works best for you."

He said that he would like to emulate his role model professor in many aspects such as having high expectations for students, employing a tough-love attitude, and showing passion for mathematics to the class. According to him, his role model professor used to employ tough-love attitude in his classrooms and did not curve students' grades. He also said that he had a great passion for his profession and the subject he was teaching.

Other than his role model professor, he was also influenced by his father, who worked in the US Navy for several years. His father was very hard-working and believed that people should work hard to fulfill their American dream. It is important to note that Andrew was home schooled for the last three years of his high school education.

#### **4.2.5 Interview II**

The second interview with Andrew was conducted on October 7, 2013, during the fall semester. He taught two sections of business calculus during the summer 2013 semester, and was teaching two sections of calculus I during the fall 2013 semester.

When asked to describe his overall experience in his graduate program, he said that he experienced some cultural shock in moving from a big city to a small college town. He said that the location and surroundings were not familiar to him. He said that the place was not ideal, and that he felt like he was not at home. Coming from a city of five million people to a small college town of fifty thousand people, he said that it was a “giant challenge” and a “huge adjustment. However, he said that he did not have any complaints about the mathematics department.

Later, when he was asked to describe his experience as an MGTA, he said that he had both positive and negative experiences. He said that he did not think that his teaching philosophy had changed a lot; actually being involved in teaching and going through its rigors every day had changed some of his viewpoint about teaching. Because of the amount of work outside of class, he realized that he would not pursue teaching as a career. He said:

I realized that maybe you know teaching is something that I won't do for a living simply because I love being in front of the classroom. I love the lecture type of thing, but all that is involved that is being a teacher is not something I guess I anticipated. Perhaps that just comes with the territory of being a TA but yeah, it's something that I probably don't want to do for a career.

Coding resulted in the following themes from this interview II data: conceptual

understanding/making students think, high expectation for students/tough-love attitude, in-class

work, maintaining teacher authority, out-of-class support, passion and compassion, preparation, students, and technology. There was no changes in the theme out-of-class support as compared to the previous teaching philosophy statements, and will not be discussed here.

### **Conceptual Understanding/Making Students Think**

Andrew had a philosophy that mathematics instructors should help students understand mathematical concepts. In order to help students understand concepts, he said that he would try his best to explain things as clearly as possible. Moreover, he said that he would never solve a problem by himself without involving students, and he made students think by asking them questions, such as what they think is right, and why they think so. He said:

I've never really done a problem and said not just how we do it, but why do these work. I mean, the 'why' is just as important as the 'how' for me, and being able to explain these things. Like we went over a couple of theorems today, and for section 4.2, and you know, I asked, 'Why does this make sense?' I don't even prove it there myself. I said, 'Why would this make sense? Why would this be true?'

He said that just doing the work and giving him the correct answer is not enough, and that he would like his students to justify their decisions and the procedures they used to solve the problems.

*Explanation.* Andrew believed that instructors are expected to have some content expertise in order to be able to teach in a mathematics classroom. In addition to knowing the content, he believed that they should also know how to explain mathematical concepts by breaking down complex mathematical ideas in simpler terms that students can understand.

In order to explain mathematics to the students, he also said that he keeps asking students questions, such as 'Why does this make sense?', 'Why would this be true?', and many other 'what' and 'how' questions. He believed that this approach would involve students in thinking about mathematical processes, and help them to understand mathematical concepts. When asked what characteristics make an instructor effective, he cited the ability to explain:

If you could convey that and you can instill that in the student, not only how to do it but why to do it, why it works, and the interpretation and seeing the connection – the subtle connections – I would label that professor an excellent professor.

When explaining mathematical concepts and their connections and applications, he said that he usually keeps average and weaker students in mind. He added that he would not mind taking the whole class period to explain a concept, even when all but one student has understood it.

Moreover, he said that instructors should know alternative ways to explain concepts if they notice that students are not grasping them.

In summary, Andrew believed that knowing the content was not enough, and that instructors should also be able to explain mathematical concepts clearly.

### **High Expectation/Tough-love Attitude**

Andrew said that his philosophy from the earlier stages had not changed, but had been reinforced.

He implied that he would not be easy with his students, especially if they keep complaining all the time, because they are seeking excuses when they have to work hard. He said:

Last time we talked, I talked about having a tough guy, you know, a tough-love kind of mentality. I wouldn't say that I've necessarily softened up, if anything I've hardened since then. Especially teaching this semester where I'm the type of person if you complain all the time, I'm going to be to the point where one umm, I'm going to say real tough and then I'll pop and make your life a little bit harder simply because they can always be harder.

He said that his philosophy was that the students should do things as they are told by their instructors. He felt very strongly about employing a tough-love attitude; he said that he would become even tougher on them if they refuse to do as they were told and keep complaining.

From his teaching experience, he found that a lot of students had a lazy attitude, and would blame on their instructor or his teaching styles for their own poor performance. He perceived that students still did not have the feeling of being in college, where they would need to work much harder. Discussing his students' attitude, he said:

You can see laziness attitudes. I mean, and then they'll blame you or they'll say anything about your teaching style and say it's you. It's your fault. Well, you know, when I see you and you say certain things like, hey, this teacher sucks. There's that other thing maybe, but then you have to complain about having to study over the weekend. You're in college. That's what you're supposed to do. You want to pass. Especially if they're maybe engineering students, there are going to be times where you're not going to have a weekend for a month.

Andrew saw a contradiction between students' career choices and their attitude toward working hard. In order to give them a feeling of how hard college life, and the life after graduation would be, he said that he became even tougher on his students:

I told my kids several times especially, you know. They would complain about something, and I said, "Welcome, college." That's my response. You know, tough. You know, life gets a little bit tough for you, especially if you're going to be engineers or scientists. And that coupled with the fact that these kids want to be engineers and scientists, I'm going to hold that to a higher standard.

He said that if the students want to get into the college of sciences or engineering, they have to know that the life would be much tougher than what they had currently. He implied that if they cannot perform as expected and keep complaining about minor things, they would not be able to achieve whatever they thought they would. He continued saying that he would expect even more from such students. He believed that people who want to be scientists or engineers should not seek excuses to avoid working hard, and he expected even more from such students. To remind students how some instructors and colleges act intentionally to get rid of weak students, he said that he gave them a tough quiz and said:

I gave them a quiz and it was kind of loaded quiz. I kind of did it on purpose. Basically, it's one definition and one limit problem. And the average was maybe about 5 out of 10, and I got on the case and I said, this is probably going to be the easiest math class you take here. You're going to be a scientist or engineer. ... Just imagine on how tough your life is going to be when you take your engineering classes, especially we have classes because those are meant for you to fail. They actually intend for their students to fail to get rid of the weaker students. So if I'm trying – if I'm molding and I'm teaching math to people who are going to be engineers or physicists or scientists or mathematicians and what not, oh, yeah, I'm going to be harder on them. I'm going to expect more out of them because they have big shoes to fill.

When asked what his rationale for being hard on students was, and how he learned to be tougher on them, he said that if the students want to be scientists or engineers, they should live up to the

expectation of the profession they are going to choose, and that his philosophy was that they have to work hard in order to meet that expectation.

He further explained that he grew up and was schooled in an environment where he was expected to perform at a particular, and he did as he was told, and worked to fulfil that expectation. When asked if he would have the same attitude towards his students, he said:

Yeah. It's about my attitude about most they did. You have to do something – if you want to accomplish anything you gotta bust your butt. You gotta put the hard work. Don't complain about everything. Do it. And that's the way I am, and that's the way I've always been and that's the kind of what I kind of expect out of the people I suppose.

When asked how employing a tough-love attitude had helped students in their learning, he said that it was yet to be seen because students were still adjusting to having a tough instructor. But he said that some students' attitudes had improved, but other students' attitudes had gotten worse. He realized that students had become a little bit more responsible than they were when he just started to teach. For example, he said that students have stopped asking for a makeup if they missed homework or quizzes without any reason, or without letting him know.

When asked if his philosophy of having high expectations for students and employing a tough-love attitude would change once he began teaching a new course, he said that he would employ a tough-love attitude in any course he taught, at any level. However, he said that he expect somewhat less from students in remedial courses.

In summary, Andrew had a strong belief in setting high expectations and employing a tough-love attitude. At the time of Interview II, he said that this earlier philosophy had not changed, but had been reinforced.

### **In-class Work**

Andrew said that after going over a section and solving a few example problems, he would assign many problems for students to work on in class. He would then walk around the class and answer

any questions the students had. He said that he preferred assigning classwork and correcting students' mistakes in class, instead of assigning homework problems, because that approach often led to students getting wrong answers and not understanding what they had done wrong.

When asked if he assigns individual or group work, he said that he did assign group work, but he found that students tended to work alone. He said that he expected them to be actively involved in discussions with their peers, but this rarely occurred. He said that some students gradually started to socialize, but he was surprised to see that most of them did not even try. When asked why he thought students hesitated to interact, he said that he did not believe that they do not like to interact; his class used to be "rowdy" when he entered the classroom. But he was surprised to see that they did not like to interact when they actually had to work on math problems.

When asked how his teaching behaviors had changed since his first semester as an instructor, he said that he had begun to assign more classwork. He said that he had to change his style because he found that his students were just doing their homework but not any extra work. He further said that he had a lot of complaints from students that they could not do math problems on their own when they were doing homework problems. He also found that his students had lack of foundation, and that they were not practicing math problems on their own. In order to combat those complaints and have his students work, he decided to assign classwork for them, and help them whenever they needed. Later, he found that students were reading their textbooks in order to be able to solve the problems, which encouraged him to assign even more problems for students to work on in class.

In summary, Andrew believed that assigning in-class work and monitoring students' progress was better than assigning homework problems, for which students would have no one to point out their mistakes while they worked. He said that he was not sure whether group work was effective, because he found that students tend to work alone instead of working with their peers. Engaging

students in problem solving activities in class was a belief that was not detected in his teaching philosophies from earlier stages.

### **Maintaining Teacher Authority**

Andrew said that being tough on students was a philosophy that he learned when he grew up, and also during his schooling. He was home schooled during the last three years of high school, and his father had a kind of mentality that one should work hard, and do as told. When he went to college, his role model undergraduate math professor also pushed students to work hard, and to do so, he was tough on students and set high standards for them. Later, when Andrew started to teach, he said that students' attitudes towards learning further reinforced his belief in being tough with them. Moreover, he said that some of his students started to treat him like a peer, but that being tougher let them know that he was not their friend. He said:

The interaction of the students, the complicated relationship that can be developed, um because I guess from a younger person's standpoint, because some of my kids are 23 or 28, and they see me as being as, you know, a kind of a peer.

When asked what would happen if they treat him like a peer, he implied that the students would not obey him, and would make noise in the classroom, disrupting the whole classroom environment. He implied that he wanted to interact with the students, involve them in the discussion and learning process, and teach them to be respectful. But some of his students' classroom behavior led him to realize that he needed to maintain authority.

In summary, Andrew realized that he needed to maintain authority because some students treated him like a peer. He believed that being tougher would show students the distinction between their status as students, and his status as the instructor. The aspect of maintaining authority was not present in his teaching philosophy from interview I.



## **Patience and Compassion**

Andrew believed that mathematics instructors need to be patient, because sometimes it would be hard for them to make students understand mathematical concepts, and also they could encounter a lot of situations that they had not expected before. He realized that some students did not understand mathematical concepts that he had explained to them several times, thereby forcing him to explain the concept again, without becoming angry. He said that he learned to be patient from his teaching experience:

And having that patience you just say, 'Okay.' And you start from scratch again and again and again and they would say, 'Can you do that?' Okay. That's one. Having a lot more patience or not just saying, "Do you get it?" And then have them – have that expectation of them saying, "Yes," but they're not. But being able to read someone's face and say, "Really, do you get it? I have no problems sitting here." And then making them feel more at ease and say, "No, I really don't." I mean, okay, it stays that back, wait for a moment, for a second, and then explain in a different way. And I find that to be very important because it involves even the weakest students. It helps that pick along. So I guess that would be something that I can improve on, having that patience and being able to reach students when they are kind of struggling. But I can help with the biggest ones.

When asked to describe the characteristics of good instructors, he mentioned patience, willingness to work with even the weakest students, taking the time to explain concepts, and showing compassion to students who worked hard despite their struggles. Being patient and showing compassion were new beliefs detected in interview II, which had not been present during Interview I or his pre-service TPSs.

## **Preparation**

Andrew did not say anything about being prepared while discussing his teaching philosophy. But when asked to describe the features that would contribute to a conducive learning environment, he cited the teacher's preparation. When asked what out-of-class activities he does before teaching a lesson, he said that he does not think that a lesson plan is necessary if he already has enough content knowledge to teach the class.

He said that some people give in-class activities to the students, but he had never done so, because he did not have enough time for preparation. He said that the only thing necessary to be able to teach a class is:

Knowing what you're going to be talking about and being able to explain what you're talking about. Yes, that is necessary. It's very necessary. Perhaps, if you want to – I know certain people like having activities. That takes more preparation. I've never been the type of person that did activities and necessarily have the time for it, so like prepare for it which is kind of unfortunate. But outside of class, I'll be honest and say that I don't prepare that much. I go to class. I know what I'm talking about. I'm confident enough to just say 'Okay, this is what we're talking about today. We'll talk about it.' And I feel that, you know, being that kind of – there's a little of expertise that's expected. And I review the material to make sure that I know what I'm talking about. But once I do know what I'm talking about, then okay. I like to let things come out naturally instead of already pretty planned, and I think for the most part I have had success in doing that.

He therefore believed strongly that knowing what he is teaching and being able to explain is all that he needs to teach a class. He also said that required expertise is already expected from an instructor. Although he said that he reviews the material before he is going to talk about that in class, he does not do any other kind of preparation. When asked what changes he would expect in his teaching style in the following semesters, he said that he did not expect to change his style anytime soon, because he thought that he had been successful on what he was doing, and that it had matched his personality.

## **Students**

Andrew believed that students' learning depends mostly on them, and there is only so much an instructor can do. He said that how much students accomplish depends on their attitude towards learning, and how much effort they expend.

He recalled a few of his students who came to ask for extra help, and said that he was happy to see those students' attitudes and effort. He said that he was glad to provide support to those students, who, he said, succeeded as a result of their hard work. Later, when he was asked to describe things that would contribute to a conducive classroom learning environment, he

mentioned students' willingness to work and learn. He believed that these qualities would not only benefit the students, but would also motivate their instructors. He said that both students and instructors should understand their responsibilities in order to succeed. However, he strongly believed that the success of a class depends primarily on students' willingness to participate, work and learn; instructors' roles are much smaller.

### **Technology**

Andrew did not say anything about using technology when he was asked to describe his teaching philosophy. Later, when he was asked to describe what instructional tools he had used or would like to use, he said that he did not use any technology most of the time, other than just using a computer and a projector to pull up WebAssign online homework. He said that he uses the chalkboard most of the time to solve problems and draw diagrams or graphs.

However, he said that use of technology sometimes helps provide a visual explanation to students. He noticed that his classrooms were equipped with technology, but he only used it a few times. He said that the technology was useful to show students the exact graphs of some functions, which he said was a lot better than drawing a "bad" graph on the board. He said that he had been a "big fan" of using the available technology since the first time he used it, because he found it very useful and effective. But he also admitted that he only used that technology occasionally. From his statements, it was evident that using technology was not an important aspect of his teaching philosophy, even though he had started to realize that technology could help to enhance student understanding.

#### **4.2.5.a Summary**

Andrew believed that the primary goal of mathematics instructor is to help students understand mathematical concepts. In order to do so, he said that instructors need to be able to know the content they will be teaching, and how to explain it effectively to the students. He believed that

instructors should review their material before teaching, but did not necessarily need to prepare and follow a lesson plan. However, they should be able to explain mathematical concepts in different ways, as some students would not be able to understand from only one method of explanation. Although he said that he did not use technology frequently, he said that the use of technology could be helpful to enhance student understanding.

Andrew said that he would like to engage students in class by assigning mathematical problems to work on. He said that in-class problem solving activities provide opportunities for students to ask the instructor questions if they get stuck, and for instructors to monitor students' understanding. He realized that when students solve homework problems, sometimes they end up with the wrong solutions without knowing where they had made mistakes. But when students are engaged in in-class problem solving sessions, the instructors can immediately correct students' mistakes.

He believed that students' learning and their successes depend primarily on how much effort they expend. He believed that students should understand their responsibility and work hard if they want to succeed. The biggest aspect of Andrew's teaching philosophy, therefore, was to have high expectations for his students, and employ a tough-love attitude. He believed that this approach would help students understand their responsibility and push them to work harder. A tough-love attitude, he believed, would also discourage students from complaining about their instructors and treating them as peers.

He realized that instructors sometimes encounter unexpected issues, such as strange student behaviors. Moreover, some students do not understand mathematical concepts, even if the instructor has tried hard to explain them. In such cases, he said that instructors needed to be patient. He said that some students struggle to understand mathematical concepts, but they show positive attitude to work and learn. In such cases, he believed that instructors should show

compassion. He also believed in providing out-of-class support to students, but he added that the students should approach the instructors to seek their help.

While he did not explicitly mention creating a good learning environment, as he had in Interview I, he did say that he would like to engage students by asking frequent questions, answering their questions, and by correcting student mistakes during in-class problem solving sessions. He said that he also asked students to work in groups, but he found that they still tended to work individually.

In addition to the above things, there are few more things that are worth noting here. Andrew said that he had to face a lot of challenges as a mathematics GTA. One of the biggest was the lack of time. In addition to teaching in class, he said that he had to review the material he was going to teach, grade student work, take graduate classes, and conduct his own research.

Another challenge he faced was feeling like he had not fulfilled his responsibilities as an instructor. Overall, he described students' behavior as his most significant challenge. Specifically, he mentioned their lack of effort and attempts to treat him as a peer:

One is being able to not be bitter and too angry at people and say, you know, your kids are going to mess up and that's out of your control. Grading those first exams, grading other things, and it's just like you sit there and you think to yourself, man, I must be a really crappy instructor if my kids are doing this poorly. And it's really not necessarily you as an instructor. And that's been a challenge to just having to let go that, you know, all I can do is the best that can at explaining things. The other major percentage of that is the student's effort. So that's been a major challenge. Being able to deal with the kids that tend to probably make things a little too "buddy-buddy," that's been another challenge ... dealing with human behavior, that's been probably the biggest challenge.

His challenges were mostly similar to those faced by most of the first year teachers. He faced a challenge of students treating him like their peers because some of them were of his age. This was a similar challenge also experienced by David.

#### **4.2.5.b Factors**

A number of factors were identified from the Interview II data that had influenced his teaching philosophy. They were courses taught, students, teaching experienced as a student, and time. The most influential among these factors was the students he taught.

*Course taught.* Even though he said that he would like to continue his strategy of employing a tough-love attitude in every course, he said that he would expect less from students enrolled in lower division or remedial courses. In upper division courses, he said that he set higher expectations in order to prepare students to cope with their chosen professions in science and engineering. He said:

I guess it will depend on what I'll be teaching. I don't know if I would be stern if I wasn't teaching Calculus I. But then again, if I was teaching something like differential equations maybe I will still be. . . . So if I'm trying -- if I'm molding and I'm teaching math to people who are going to be engineers or physicists or scientists or mathematicians and what not, oh, yeah, I'm going to be harder on them. I'm going to expect more out of them because they have big shoes to fill.

*Students.* As described above, Andrew believed that student learning depends mostly on their own effort. He found that many of his students seemed lazy, even though most of them wanted to become engineers or scientists. He said that if the students want to become scientists or engineers, they should live up to the high expectations of those professions, and that his philosophy was that they have to work hard to do so. Many students complained about his expectations, and resisted taking more responsibility for their own learning. But he said that their complaints, as well as their unwillingness to work and learn, contradicted their expectation to become engineers. He said these students attitudes reinforced his belief in setting high expectations, and made him become even tougher with his students.

Andrew found that students who were willing to work and learn did approach him for help. All of these students tended to succeed in his classes, even the ones who at first struggled with the course material. He therefore realized that student learning depends mostly on students. Therefore, he said that being tougher on them would force them to work harder, and learn more.

As discussed earlier, he found that some of his students started to treat him as a peer, because they were of his age. As a result, he said that they did not obey him, and used to disrupt the class by being noisy. But he successfully maintained his authority by being tougher on them and preventing them from disrupting class.

Andrew came to realize that teaching involves a large amount of work, as well as many complications and complaints, such as failing students who blamed the instructor for their lack of success. This issue was one of many unforeseen problems that led Andrew to conclude that he would not pursue a career in teaching. However, he also found the positive attitude of other students helped motivate him to “keep going”. His hardworking students made him realize that instead of always being tough, he needed to show more compassion.

In summary, his teaching philosophy was highly influenced by his teaching experience, primarily by the behaviors of his students. Although students had also influenced his teaching philosophy in his previous interviews and TPSs, their influence became even stronger as he gained more teaching experience.

*Teaching experienced as a student.* A number of past experiences were found to have influenced his teaching philosophy. They were the teaching he experienced as a student, his role model professor, and his family background.

Andrew said that he first learned to have high expectations and employ a tough-love attitude from his role model undergraduate professor. This belief was then further reinforced from his own teaching experience. Moreover, he said that he was raised to be a responsible person and do what he was told, and he still believed that these traits were vitally important.

Recalling his undergraduate classroom experience, he said that Engineering and other disciplines intentionally give challenging tests in order to get rid of weaker students. He said that he would like to have high expectations for his students to let them feel how hard their life was going to be.

His pre-service teaching philosophy was found to be reinforced by his teaching experience.

*Time.* His statements implied that he was not assigning classroom activities because he knew these would take him a lot of time to prepare. He said that he does not do lesson plans because he thinks that they are not really necessary. But he also said that he reviews the material before class, because he thinks that it is really necessary. He said that his style of not doing lesson plans and being able to say what comes naturally has matched his personality. He said that he did not think he would change his style anytime soon.

He also explained that he could not finish some routine instructional tasks on time, because he had a lot of other things to do. Instead of making up excuses with his students, he said that he was honest with them about why he had not been able to finish such tasks.

Considering his situation as a graduate student with a lot of coursework and research, the lack of time seemed to influence his teaching philosophy regarding being prepared for class.

#### **4.2.6 Interview III**

The third interview was conducted on March 25, 2014, during the spring 2014 semester. He was teaching two sections of calculus I course during this semester, and had taught the same course in the fall 2013 semester as well. Coding resulted in the following themes: experience, high expectations for students/tough-love attitude, learning environment, maintaining teacher authority, making students think, out-of-class support, preparation, and students.

#### **Experience**

He said that the best way to become a better teacher is gain more teaching experience. He believed all instructors develop differently, based on their own personalities, and that he should not deviate from his own style. Below is an excerpt from interview III:



*Interviewer:* What is the best way to learn about teaching mathematics?

*Andrew:* To teach.

*Interviewer:* To teach?

*Andrew:* To teach, to fail, and to gain that experience, to know what to do and what not to do, gain your own style, figure out who you are as an instructor, and then don't deviate from that.

When asked if he thinks participating in professional development activities would help someone grow as a better teacher, he said that it might work for some, but possibly not for him. He believed that students find it difficult to understand some of mathematical concepts because they are difficult. He said that students should expend more effort to understand those concepts, and that “pampering students” cannot substitute for the hard work that is necessary to succeed. He said:

I feel like a lot of the plans that go into it are flawed initially because at its core I feel a lot of it – you know, you look at students and yes, some of the concepts are going to be difficult and some of the concepts are going to be difficult because they are difficult, and you just have to work through it. And I think we're trying to replace hard work with pampering students. Just have them sit down, stop being lazy, open a book and read. I mean I polled my students, none of them read. So I don't know. I tend to have this more staunch, I guess viewpoint of just put some hard work in and you're going to get it. Some kids are going to have to put a hell of a lot more of work than others. But you know what? If you want to pass a class, that's the requirement.

He therefore implied that teachers learn mostly from teaching experience and that he sees little value in professional development activities. He also believed that the math department and the students should have modest expectations for new GTAs, and implied that GTAs would become more effective as they garnered more teaching experience.

### **High Expectation for Students/Tough-love Attitude**

As he mentioned in his previous interview, Andrew said that student learning is directly related to the amount of effort that students expend. He said that he expected students to work, and he employed a tough-love attitude to prompt them to work even more. He said that he would let students know that their other classes were going to be much harder, and that they needed to

accept the challenge. He said that he wanted his students from the previous semester to feel how hard their other classes were going to be by giving “ridiculously hard” problems in a quiz, although he did not expect his students to solve the problems. He said that he even scared them by sharing his undergraduate experience and how some departments intentionally tried to get rid of weaker students by giving hard exams in the pre-requisite classes. He repeated again in interview III that he did not like to hear students’ complaints, and that he would become even tougher if they kept complaining, in order to discourage further complaints.

In summary, he believed that having high expectations for them and employing a tough-love attitude would force them to work harder in order to succeed. He also said that students should develop a positive attitude towards working.

### **In-class Work**

Andrew said that he had had begun to have students solve more problems during class. He said that this was his course coordinator’s idea, but he liked it because he started to realize that having them solve problems in class wakes them up and keeps them engaged. Moreover, he said that this practice enabled him to correct students’ mistakes while they were working on the problems, which was impossible to do with homework. He also found that having them solve problems in class had changed their attitude to have him solve all the problems instead of trying on their own.

### **Learning Environment**

Andrew believed in creating a favorable learning environment, both in and out of class. When asked to identify his strengths, he said that taking teaching not too seriously, being social with students, and creating a fun learning environment. He believed that teaching is a serious job, but he said that he would advise new GTAs to take it easy, and not be afraid to make mistakes. He believed that letting students know that anyone can make mistakes would help to make them feel that it is okay to make mistakes. He believed that taking a less serious approach would make

students feel comfortable, engaged, and willing to participate. Moreover, he said that he wanted to create an environment where students do not feel embarrassed to ask questions, do not feel ashamed that they do not know something, and do not feel like they are going to be judged.

*Caring.* Andrew believed that he could develop a healthy relationship with his students that extended outside the classroom because of his caring attitude. He said, for example, that when he ran into them on campus, they often exchanged greetings and chatted with each other. He believed that he had become more than just a teacher to his students. In summary, he believed that creating a conducive environment was crucial to student learning.

*Humor.* He said that he realized from his teaching experience that use of humor could also play an important role in creating a conducive and comfortable learning environment. Recalling one of the classes he taught during the previous semester, he said:

I mean it was a back and forth banter between the two of us, or not just the two of us, Tom and I, but the entire class. And we would laugh and it was – I felt in a way kind of felt like a standup comedian teaching calculus because whenever I would say a joke, it could have been this stupid joke, they would laugh and it was a very good environment. It was a very enjoyable environment.

*Interaction with students.* He believed that interacting with students would make it easier to involve and engage students in the class. Instead of focusing too much on lecturing, he said that in order to create a welcoming environment, he would like to engage in conversation with the students, and he encourages them to answer his questions and ask their own. He wanted students to let him know what they are thinking.

*Passion and compassion.* When asked what he thought were the key characteristics of a successful mathematics instructor, he cited passion for the subject and compassion for students' struggles. He said that students might not share their instructor's passion, but it would inspire them to be more engaged, and make them want to avoid disappointing the instructor.

Furthermore, he said that showing compassion for students' struggles would make them feel more comfortable approaching the instructor for help when needed.

### **Making Students Think**

Andrew said that having students think about mathematical ideas was an important aspect of his teaching philosophy. He said that in the current educational system and culture, students are being taught not to ask questions, but only to do as told. As a result, he added that students do not know how to think on their own. He said that even future mathematics instructors are growing up learning this teaching culture, and he believes that it should change.

He believed that his philosophy was to teach students to think on their own and become independent learners. He believed that answering student questions with questions of his own, as opposed to providing them with answers, would promote student thinking. He believed that students should also try to learn how to think on their own instead of just seeking an "answer" to a mathematical problem. He said that his philosophy was not to provide answers to students' questions, and he was not teaching to talk at "blank faces". He said that he was there to engage students and teach them how to think.

He believed that students' lack of motivation to think on their own is not completely their fault; it was the fault of the system and teaching culture. When asked what things he would like to change in his future teaching, he said:

The way we teach kids in elementary, middle school and high school to prepare them for college. They don't know how to think on their own. They've been told not to ask the question why. They've been told to just do and I hate that. And that's part of my frustration as being a teacher is that students, they don't have that motivation to ask and inquire and then the curiosity has been squashed essentially. And not only that, a lot of students, they hate math because of that very reason that their math teacher is growing up. They didn't know the answers to their questions and this teacher's instinct is to tell them to shut up and stop asking questions and just do it. So that more than anything is changed.

In summary, he believed that students should be taught how to think on their own instead of just teaching them procedures to solve mathematical problems.

### **Maintaining Teacher Authority**

In addition to being social, friendly, and humorous, Andrew believed that instructors, especially GTAs, should also maintain authority. From his experience, he realized that mathematics GTAs should avoid being friendlier than needed with their students, who might treat them as peers because of their similar ages. As a result, he described in interview II how some students would not obey, and could disrupt the classroom by making noise. However, he did not explicitly refer to this in interview III. He believed that mathematics graduate teaching assistant instructors should know when to be firm and when to be gentle, depending on the situation.

### **Out-of-class Support**

He said that he would like to provide out-of-class support, but only to students who showed a willingness to work hard. However, if students came to office hours just to ask for the “answers”, he said that he would not work with them.

### **Preparation**

Andrew believed that instructors should have confidence in the material they will be teaching, and implied that they should have good knowledge of the content. He said that he does not prepare for class except by reviewing the material hand. He believed that being able to talk about things that are not already written down, and to bring in examples “on the fly” has some advantages. He thought that if instructors have already prepared how to solve a problem, they would simply follow the procedure, and that students would just copy that procedure. He said that seeing their instructors struggling to solve a problem would help them feel that even their instructors struggle sometimes, and that it is okay to make mistakes. He said that not following a

procedure to solve a problem, but finding solutions in their own way would help students to figure out their own solutions:

I don't plan my lectures. I just go. And sometimes coming up with examples on the fly, you make mistakes or you might hit a situation where you're kind of unprepared which is great because those are great teaching moments I think. They will give you a really good opportunity to say, "Hey, this is how I figured out this problem." And your students are going to be in the same boat where they're going to look at a problem fresh and not know exactly where to go. And seeing you struggle, one, it makes it seem like, okay, everyone struggles with this; two, you struggle through it and get to the end of the answer, or get to the answer at the end will show them how to do it on their own instead of having it just, this is what it's going to be, a copy-paste kind of procedure. But that's not how math is done.

When asked how novice instructors could grow as teachers, he said that it varies by person. He said that he does not prepare for classes, just reviews the material five to ten minutes beforehand, which he thought might be a result of his own arrogance. He said that he has seen other instructors who have laid out every single detail before they go to the class, but he does not find that necessary. He implied that professional growth depends on a person's individual philosophy.

## **Students**

Andrew said that the main part of his teaching philosophy was to tell students to do their work.

He said that the point of going to college is to work and earn a degree:

[My] teaching philosophy is get your sh\*t done. I give you a task, you work your a\*\* off to get it. It may be really hard but that's the whole point of learning. That's the whole point of going to college, to challenge yourself.

He believed that learning depends mostly on students, and that teachers and curricula have a less significant role. He said that he does not know about mathematics education studies, but he considers these and the professional development of teachers as an excuse for students not to work hard. He had a strong belief that a college degree is not guaranteed but students should earn it.

He said that he understood even during his undergraduate years that making a higher grade in the course was his responsibility. But he acknowledged that the instructors do have an impact in making students want to work harder for their classes. However, he said that he developed a new belief that instructors can only be held responsible for so much of students' success, including their grades. He realized from his teaching experience that student effort played a more important role than the instructor in student success.

When asked if his philosophy from the previous stage had changed, he said that he still believed that it was students' responsibility to work hard and put the required effort. However, he had become less emotionally invested in students' efforts; if they were unwilling to put in the work, it did not bother him:

I still require 'Do your work'. So I mean nowadays I don't harp on it as much. I mean I just say, 'Hey, if you guys are going to mess up, then that's on you. That's not on me. Now get your stuff done.' But I don't take it to heart as much as anymore. If people don't want to take responsibility for their own grade, then it's not my problem.

He went on to say that if a class of students did not put in the required effort, he put less effort into teaching the course. When asked to identify his weakness, he said that it was the lack of motivation to work; it was hard to find the motivation to keep on going when students do not try to work themselves. He also admitted that his lack of motivation to teach might have negatively impacted some hard working students.

Therefore, he had developed a belief that if students did not expend the required effort and did not succeed, it was their problem. He said that his philosophy high expectations and tough love students worked very well in one of the sections he taught. He said that the students' entire attitude changed; they became more engaged and hard-working. But in his other section, students did not perform as well, because he believed that not respond as favorably to his approach.

When asked if any of his beliefs from earlier stages were reinforced, he said that his belief that students should work had definitely strengthened. He stated that some of his students who

struggled through and worked really hard to understand the material succeeded in his class. He also said that they sought his help by regularly visiting him during his office hours and in the mathematics learning success center. When these students succeeded as a result of their own efforts, his belief in the importance of student persistence was strengthened. However, he expressed dissatisfaction that his philosophy had not been received well by many students. He believed that most students just want “answers” but they do not show willingness to learn.

In summary, Andrew strongly believed that student success depends primarily on students, and that they should understand their responsibility and work very hard in order to succeed.

#### **4.2.6.a Summary of Changes**

There were almost no changes in his teaching philosophy between Interview II and Interview III. However, the strength of some beliefs had clearly diminished. For example, he said that it used to be difficult for him to see students not putting as much effort as he had expected, and not changing their attitude towards learning. However, he said that by now he was fed up and less emotionally invested in students’ level of effort.

He believed that he would continue to set high expectations and display a tough-love attitude, and that he would not change his style just because some students kept complaining. However, he did think that his convictions in this area had become less intense:

I feel sometimes it’s a lost cause, so I don’t bother so much, but I definitely have a tough love attitude. And at this point I’ve gotten to the point where I want to be me. And if somebody doesn’t like the fact that I like to push people’s buttons and give you guys hard problems and make it impossible for you to do something, well that’s your problem because I’m going to do it anyway. So I’m doing it less about the students and more about what I like now, simply because some students are just bitching on about everything and anything. So I’m not going to just be there and kiss my students’ asses essentially.



He said that the variation in student performances among different sections he taught posed difficulties for him. He said that one section did well because his personality might have matched with the students' personalities, so they might have responded well to his approach.

Andrew also realized that his approach to dealing with students had room for improvement. It was his personality to be direct and honest with students, but sometimes he felt that he could go too far, which could cause problems with some students:

Last semester I had a kid who had no idea about pre-calculus, and I said, "This is stuff that you should already know." And I guess he thought I would make him feel stupid, but I mean, that's a prerequisite for this class. And he didn't like it very much, and he stormed off of my office hours that moment and I never saw him in the office ever again. So perhaps – I don't know. I wasn't – maybe I could have been a little bit nicer about it but you got to be direct sometimes. You just can't sugar coat it. You got to know that you have to know this stuff. So there had been – some people just don't respond to it and that's fine, but that's just my personality. I mean I've had teachers where their personality doesn't mesh with mine and as a student I had to deal with it. So at the same time I mean I don't impose on them and make them do – I mean I'm not too much of a jerk I don't think, but I'm not going to change who I am because of select few people can't handle it.

Andrew said that he would advise new MGTAs not to take teaching too seriously, and not to be afraid to make mistakes. He believed that failing to solve a mathematical problem in class and trying it in a different way is a great teaching moment, because he believed that students would see that anyone can make mistakes, and that it is okay to make mistakes while learning.

Even though he said during Interview II that he used to assign in-class work to students, he said in Interview III that he had started to do so more frequently during the current semester (spring 2014). He said that assigning in-class problem solving had been the idea of his course coordinator, who had observed his class and gave some feedback. He found that this approach was more effective than assigning a lot of homework problems, because it would be difficult to correct students' mistakes when they solve their homework problems.

Regarding out-of-class support, Andrew said that if he finds that students are putting effort into their own learning, he would put as much effort into his teaching. Otherwise, he said that he

would not “waste his breath” for those who just come to seek “answers” to their problems, but are unwilling to put effort into their own learning.

#### **4.2.6.b Factors**

As in the previous teaching philosophy statements from earlier stages, his teaching philosophy was influenced by a number of factors. They were teaching experience, experience as a student, other instructors, and time.

*Students.* He said that the next most influential factor in shaping his philosophy was the behavior of the students he taught. He said:

Number two would definitely probably be my students and how they either fortified my belief or made me modify certain things by experiencing things with some of my students, how their disdain or displeasure with certain things or the fact that they enjoyed or really, really wanted me to continue doing certain aspects of my teaching. But other than that I don't think any of the other things here really – I mean again, the students and your teaching experience here or elsewhere, I think those kind of go hand in hand because clearly if you're teaching, your students are part of that. So I would say number one, with my experience as a student combined with past professors, and number two would be my students and teaching experience. And then the others, I don't think they really contributed at all.

He said that he taught two sections of the same course during the fall 2013 semester, and one of the sections performed very well but the other did not perform as well because the students did not work as hard. He said that the students were even worse during the spring 2014 semester, when he found it difficult to accept how little effort students were putting into their own learning. This led him to believe that student success depends mostly on students, and much less on the instructor. He said that he had gotten to the point where he was far less emotionally invested in

students' efforts and outcomes. When asked if he had done anything to address this challenge, he said:

I mean you could try. But if the student is not going to try, they're not going to do anything. It's not going to change. I mean the best you can do is let them know that you're there for them, and be a positive influence and just enjoy what you're doing. But if students don't want to try, they're not going to. It doesn't matter how – like the old saying, you can lead a horse to the water but you can't make it drink. ... So you could preach all day long and for the majority of them it's just going to go in one ear and out the other. So at this point I don't waste my breath. I say a little couple of things and see if whoever responds, if somebody responds, then great, I'll help them out. But more often than not, no one responds or there's a little response.

He therefore implied that he gave up caring about those who did not want to work, and he developed a belief that one can do only so much to motivate adult students. However, he said that if students put effort into their learning, he would put at least as much effort into teaching them.

He had said during earlier interviews that he would not pursue teaching as a career. When asked if he still felt the same way, he said that he had reconsidered the idea of teaching, particularly because of a positive experience with a class he taught in the fall 2013 semester. But he later realized that the class was just an exception. He said that teaching is a thankless job and that its benefits do not outweigh the cons.

In summary, the attitude and the behavior of his students had a strong influence on Andrew, and his teaching philosophy.

*Teaching experienced as a student.* Andrew said that his teaching philosophy was largely influenced by the teaching he experienced as a student, mostly by his role model undergraduate mathematics professor. He said:

The philosophy that I kind of adopted from [the professor] was being stern, having high expectations for my students, but at the same time being there for the students who want the help, who are willing to ask for help, and constantly engaging with my students. So a lot of that came

from [the professor] because of what I saw he did in his students and myself particularly. I wanted to do that to my students as well.

He said that his experience as a student had the strongest influence in his teaching philosophy. His experience as a student would also include his experience with the role model professor.

It was interesting to observe that he did not think his teaching philosophy was influenced by any factors other than his own teaching experience, and his experience as a student.

*Time.* He implied that lack of time plays a big role in the life of an MGTA. He said that sometimes he had to create an exam for the classes he was teaching when he had his own exams to take. But he said that he had less stress during the spring 2014 semester, because his course coordinator did almost everything for them.

Andrew said that he never prepares for a class, except for briefly reviewing the material he was going to teach. Although he said that this lack of preparation was a matter of his own personal style, it might also have been caused by the lack of time that he had mentioned in interview II.

### **4.3 Case 3: Rebecca**

Rebecca was a 23 years old masters' student in applied mathematics and did not have a plan to pursue her Ph.D. She completed her undergraduate degree in mathematics and information technology at a small Catholic University in the mid-western United States. See the Methodology chapter for the complete description of the participant.

#### **4.3.1 Teaching Philosophy Statement I**

Almost all of Rebecca's opinions about teaching and learning were based on the teaching she had experienced as an undergraduate student, and how that experience contributed to her learning.

She was heavily influenced by the teaching of her role model undergraduate professor, and also

by the teaching of other instructors who she perceived were not effective. Coding resulted in the following themes: conceptual understanding, high expectations for students, learning environment, and out-of-class support.

### **Conceptual Understanding**

Rebecca believed that the instructors should encourage or even push students to understand mathematical concepts, not just the procedures. In order to help her students understand concepts, her role model professor used to make challenging tests, encourage students to ask questions, provide examples of applications of mathematics to the real world, and employ collaborative learning and whole class discussion.

### **High Expectations for Students**

In order to push her students learn and understand the material, her role model professor used to create challenging tests which would assess how much his students had understood the concept.

### **Learning Environment**

She wrote that it would be necessary for instructors to create a learning environment for students. Below are some of the things that she thought that teachers should do to create a learning environment.

*Application of the concept.* She wrote that she learned from her role model professor to motivate students by providing examples of applications of the mathematical concepts taught in the classroom to the outside world.

*Caring/being inspiring and encouraging.* She wrote that students need to know that their teacher cares about them and their successes. In order to make them feel so, she believed that teachers should encourage or inspire their students, both in and outside the classroom. She wrote that the

caring nature of her role model teachers from her undergraduate studies had a positive impact in her learning. She felt more comfortable seeking support from those professors who cared about her success. She wrote:

When these teachers showed me that they cared about my success, they opened a new door to my learning ability. I trusted these teachers, and I knew that if I ever needed help, I could always turn to them. Many of these teachers have made me the student I am today. Their encouraging words have helped me to discover my true passions.

She said that she would have not discovered her passion for mathematics if she had not had her role model professor as an undergraduate.

*Collaborative learning.* She perceived that using teaching methods other than just lectures would contribute to a good learning environment. She wrote that her role model professor understood the importance and effectiveness of classroom discussion and collaborative learning. She wrote:

I never once saw him stop a discussion between students unless he absolutely had to because of time constraints. This teacher understood the importance of collaboration and saw clearly how effective it was in giving students an even better understanding of the material than just lectures could ever do.

Although collaborative learning is beneficial to student understanding, she noticed that it is not time efficient. Her role model teacher used to allow class discussion but he had to interrupt such discussions because of limited time.

*Engaging students.* She believed that teachers who keep their students engaged and active in the classroom are more likely to be successful. Recalling her past undergraduate experience, she wrote:

Although I have seen many good examples of effective teaching in my lifetime, I have also seen examples of ineffective teaching. In my experience, teachers who have had difficulty in keeping students engaged and active in the classroom have been less effective than those who do not. Many of my classmates did not put much effort into their work for the class. Students did not care about the teacher, the material, or the class in

general. It was very difficult for these teachers to get students to do homework and pay attention in class. The material the teacher had tried to teach his students did not have the impact that effective teaching techniques would have.

She recalled her role model professor from her undergraduate experience, and said he used to engage students by asking questions and also encouraged them to do so.

*Passion/enthusiasm.* She felt that the passion of some professors for the subject they taught made the subject very interesting and that she felt wanting to learn more about the subject. She found that the teachers who had passion for the subject they taught cared about the students and their successes, and they offered their students out-of-class support. Based on that impression, she believed that a teacher should convey the passion for the subject and teaching in order to impress the students and make them learn.

*Promotion of individual learning and research.* Based on her experience as a student, she wrote that engaging students outside of class by assigning projects is very effective. She wrote that such projects promote individual research and help students become independent learners.

[Some] teachers I have had in the past have also shown methods toward effective teaching. A few of my teachers have assigned projects that have encouraged individual research. Instead of learning from lectures or other classroom activities, these teachers would require their students to find sources such as books or websites to solve problems. This was very effective in my perspective. It forced students to use their own initiative to find relevant sources and to actually learn from these sources. These projects revealed to the students that it was possible to learn outside of the classroom. As my classes got harder, this skill was definitely valuable. If I did not understand a topic in class or just needed to refresh my memory about a topic I had already been taught, I knew how to find a relevant source and learn from it.

### **Out-of-class Support**

Rebecca wrote that instructors should be available to answer students' questions when they need help. Her professors in the undergraduate program offered their students out-of-class support, especially those professors who conveyed their passion for the subjects they taught. Recalling her role model professor, she wrote that he was very approachable to the students, and was very helpful whenever students needed his help.

#### **4.3.1.a Summary**

Rebecca's TPS I was mostly influenced by the teaching of her "effective" professors from her undergraduate university. Based on that experience, she believed that instructors should help students understand mathematical concepts, not just the procedures to solve problems. In order to do so, she believed that they should create a good learning environment for the students, both inside and outside the classroom. In order to create such an environment, she believed that instructors should show their passion for mathematics to the students. She added that they should engage students, employ collaborative learning, promote individual research, and motivate students by showing the application of mathematical concepts. She wrote that instructors should have high expectations for their students by giving challenging problems on exams and in other assignments. In addition to having high expectations for them, instructors should also demonstrate to the students that they care about them and their successes, and also provide out-of-class support whenever the students need.

#### **4.3.1.b Factors**

The only factor that influenced her TPS I was her past experience as a student, especially the role model teacher from her undergraduate school.

#### **4.3.2 Teaching Philosophy Statement II**

Her second teaching philosophy statement (TPS II) was just a minor revision of her TPS I. The only two additional themes found from TPS II were positive attitude, and preparation and organization.

##### **Positive Attitude**

Without elaborating further, she wrote that the instructors should have a positive attitude. When she was asked to clarify what she meant by positive attitude of the instructors, she said that they



need to be responsible persons. Giving an example, she said that the instructors should be in their offices during their designated office hours.

### **Preparation and Organization**

Based on the observations of the undergraduate classes taught by her mentor, she noticed that being prepared makes a big difference in teaching. She observed that developing and posting lecture notes, and preparing the material they are going to teach develops instructors' confidence. In addition to being prepared, she believed that instructors should also organize themselves in the classroom. Moreover, she wrote that being well-prepared and organized makes a huge difference in how the students respond to the instructor; they are not afraid to ask the instructor questions.

#### **4.3.2.a Summary**

Rebecca's teaching philosophy at this stage was essentially the same as her teaching philosophy in TPS I. She added only two things in her TPS I: instructors should have a positive attitude, and that they need to be prepared for a class, and should be organized inside the classroom.

#### **4.3.2.b Factors**

In addition to the factors discussed in TPS I, her teaching philosophy was influenced by the observations of classes taught by her mentor.

### **4.3.3 Teaching Philosophy Statement III**

Rebecca's third teaching philosophy (TPS III) did not produce any new themes. She felt stronger about creating a conducive classroom environment where students will feel happy, and willing to learn. She wrote that the confidence the students will gain through such an environment will help her to continue to become a successful instructor.

#### **4.3.3.a Summary**

Rebecca's TPS II and TPS III contained only minor revisions to her TPS I. She added only one aspect in TPS II that she learned from observing her mentor's classes: being prepared and organized. In TPS III, she focused more on creating a welcoming classroom environment for students. Her past experience as a student was the most influential factor in all three TPSs, especially the teaching of her role model instructors, and some other instructors who she believed were not effective. Observations of the undergraduate classes taught by her mentor during the in-service phase had some influence in her TPS II and TPS III. It was interesting to see that no other activities such as reading assignments, seminar discussions, and her teaching demonstration experience were detected to influence her teaching philosophies.

#### **4.3.3.b Factors**

No additional factors were detected in TPS III.

#### **4.3.4 Interview I**

The first interview was conducted during the summer 2013 semester. She had taught two sections of college algebra during the spring 2013 semester, and was also teaching the same course in the summer 2013 semester. Coding resulted in the following themes: experience, high expectation for students, learning environment, maintaining teacher authority, making students think, multiple techniques, organization, preparation, students, and teaching my way.

#### **Teaching Experience**

Rebecca said that classroom teaching experience is very helpful for learning about teaching and gaining more confidence. During her first few weeks of teaching, she said that she was not feeling confident because of her lack of teaching experience; but her classroom presentation experience in the pre-service preparation program course helped her to gain some confidence.

She learned a lot from her first semester teaching experience, even though it was a little intimidating at first. Describing her learning from her first semester teaching, she said:

I have learned how to relate to students, I've learned how to be professional with them, but still like create that atmosphere that they can come to me when they need questions they had. So if they ever stuck with something, they knew that they can come see me, and so it's kind of building, learning how to build that professional relationship, but a friendly relationship at the same time. So I have learned a lot about that. I have learned a lot about public speaking, like being up in front of people and making sure my words come out right, it's really tough some days. As I have learned, it's okay to make a mistake on the board, my mental math is not very good, so every now and then you know my students look at me and say, hey I don't think that adds up right, and that helps me. And having that repertoire with your students, it's really helpful. It makes me lot more comfortable when they are more friendly with me, and so that really helps, so I feel like that I have really learned a lot from teaching.

She said that she knew how to handle students, present things in different ways so that students understand better, and also understood the importance of a good exam. She said that her tutoring experience helped her to assess students' mathematical background and also how to teach students with mathematics learning deficiency.

When asked what factors contributed to her teaching philosophy, she also said that she learned a lot from tutoring undergraduate students when she was also an undergraduate student. She said that she is still making adjustments in her teaching and believes that she will get better after having more teaching experience.

### **High Expectation for Students**

She did not feel as strongly about having high expectations as she had in her earlier teaching philosophy statements. But she said that she still wants to make her tests a little challenging by including some difficult problems, because she wants students to think about and learn the material. At the same time, she also said that she does not want to make tests too difficult and wants to include some easy problems to address all kind of students.

### **Learning Environment**

Rebecca said that the most important aspect of her teaching philosophy was to create a welcoming environment for her students in and outside the classroom. When she was asked what she meant by a welcoming environment, she explained:

That's just the comfortable. That the students are okay with asking the teachers questions, they are okay, they are not afraid to say you know hey I don't understand this, can you explain this. And say it in class it's different if a student approaches you after class. But if a student is okay with saying that during class, there might be other students that have the same question. So it's better if the classroom feels welcoming, not just the professor but the whole class, so that they feel like ok I can ask this during class. It's okay like nobody is gonna make fun of me, that's kind of the idea. So I really feel like that a welcoming classroom is just, it's that comfortable, you know I can be myself, I can ask questions if I need to.

She said that she wants to become approachable with the students by being friendly and encouraging them to talk, have a dialogue with her, and ask questions. She said:

I also kind of wanna be a friend in a way, I want them to feel in a way that they can approach me with questions, I don't want them to be afraid to ask me things. I feel like the best way to learn is to ask questions, so if you get stuck on something, you need to see me, you need to ask me questions. Even if you don't know how to phrase your question, kind of guide me to your question, and I can help you out, so I wanna be that person they feel comfortable asking with. I don't want them to feel like something is a stupid question – there is no such thing as a stupid question, just ask it and I will talk you through it.

Speaking about some of her undergraduate professors, she said that they gave her a feeling that it is okay to need help and there are no stupid questions. She said that they handled her questions very well without embarrassing her. Because of their teaching behaviors, she said that she felt more encouraged to approach them and ask questions.

*Application of mathematics.* She said that one of the ways to motivate and encourage students to learn mathematics would be to show them how mathematics can be applied to solve real world problems.

*Caring.* She repeated that her role model professors had a caring attitude, and that she also cares about her students and their success. In order to encourage students to seek help from their

instructors, she said that the students need to know that their teacher cares about them and their successes.

*Collaborative learning.* As she wrote in her previous teaching philosophies, Rebecca believed that employing collaborative learning strategy would contribute to a learning environment. In collaborative learning environment, she said that students get to know their peers and become more comfortable with each other. She said:

I really feel like if you can make students comfortable with each other, they are gonna be more comfortable all around. So if they are comfortable with these, these little groups, maybe if you can switch these groups up, maybe they just feel comfortable, a lot more welcoming. So just getting to know the whole class, getting to know everybody as a whole, I think it's really helpful.

However, she realized that the effectiveness of student collaboration or student-centered instruction depends on the level of the course and the attitude of the students. She realized that instructors should be careful and pay attention to every group to make sure that they all are involved in the discussion. She believed that teacher-centered instruction may prove to be more effective in lower division courses, because some students are taking courses just to fulfill their degree requirements, and therefore are not motivated to do things and learn on their own.

From her teaching experience, she found that many students appreciated the group work idea because collaborative learning gave students a good break from listening to her all the time.

Moreover, she noticed that students can retain their knowledge for a longer period of time if they have learned concepts from student-centered instruction, such as collaborative learning.

*Creating positive feelings for mathematics.* She said that she wants to change students' mindset that math is a terrible subject. She said that that type of math anxiety hinders student outcomes because it decreases motivation to learn. She said:

They think that math is such a terrible subject, and I really feel that that hinders how they learn. Cause if someone thinks that something is way too hard, it's way too over their head, they hate it, they are not gonna take the time to learn it, they are not gonna, it's

gonna be harder for them to find a motivation to actually learn it, and being it's like trying to do it, and so I wanna kind of try to change that mind, and that's one thing that I want to do it as a teacher, it's change that mindset.

*Engaging students.* She said that she engages her students by involving students in the problem-solving process, and asking them questions. She said that she wants to make sure that the students are answering her questions, and writing the lecture notes that she has posted online for them to have access to. From her teaching experience, she said that it was difficult at first to engage students who had come back to school after a long time, but eventually she got better at it.

*Sharing passion.* By seeing the passion of her role model undergraduate professor, she said that teachers should have the passion for the subject and they should share their passion to the students. She believed that the students will be motivated to learn if they feel the passion of their instructors. When asked how she would try to make her students feel the same passion she had, she said:

Maybe bringing out some outside things, so like you said with the mathematical software that I've never done, but I mean bringing something outside, something that might be above that they are learning now, but something kind of cool. So maybe an application of something they are doing, I think that kind of shows passion that shows that oh, that's really cool. Because you can get it here, you can use the same idea and this is, they have done and things like that, like going out of like what to say out of the book because you know you teach out of the book but if you know set out of that book look for something that ahh like relatable to them, they see that you went out of your way to help them, they see that you know you think this is really cool so some sort of application that's really needs. So maybe like something like NASA, you know some sort of math they did, maybe they did it with matrices or something above, matrices you know, they use matrices to do this, and I think they see that that's really cool. So that kind of gives them that passion and that shows that you went out of your way to help them.

### **Maintaining Teacher Authority**

After Rebecca had actual classroom teaching experience, she realized that she needs to be a little tougher with her students. She said that she was trying to develop a professional relationship with her students but she realized that it was difficult to do so because there was not a significant age gap between her and the students. She realized that she needs to maintain the role of an authority figure because some of her students treated her as their peer. She said:

I did see that sometimes I need to be a little more strict. Since I do accept late homework every now and then, but I need to be a little more strict on that, so I am still trying to build that professional relationship with the students. So I still need to be a leader over them, and not so much a friend, and sometimes it's difficult because I am of their age, so that makes – but for the most part I still feel the same about my teaching philosophy.

She said that she likes to be friendly, but also a person whom the students look up to and respect.

Maintaining an authority figure role was an added belief in her teaching philosophy.

### **Making Students Think**

Rebecca said that she wants to make her students think about mathematical ideas. In order to do so, she said that she does answer students' questions but guides them to find their own answers.

She said:

I also don't wanna be a teacher that ... kind of carries you to the answer. I want to be, I want them to be independent thinkers, I want them to... okay here is my problem, how do I get to the answer like, I want them to get out on their own, does that make sense, do you know, I want them to have those thought processes, so I want to try to develop a thought process.

She recalled her undergraduate role model math professor who used to make them think by giving only the basic ideas; they had to put those ideas together to solve problems.

### **Multiple Techniques**

Rebecca said that she employs multiple techniques to enhance student understanding. Giving an example of her classroom teaching, she said that she used colored chalk to draw original graphs and transformed graphs with different colors when she taught transformation of functions.

### **Organization**

Rebecca said that being a graduate student and a teaching assistant at the same time, it was difficult to find a balance. So she realized that she has to be very organized.

You have to be very organized, you have to organize your time very well, you have to satisfy certain times. Okay I am gonna dedicate this amount of time on this day, okay to my own class, I dedicate this amount of time to teaching, especially exams day, some

days I will have an exam but I will have to be creating an exam for another of my classes that I am teaching, and so that can be really hectic. You kinda have to, you know, balance your studying with, you know with the class, and it's it just takes a lot of organization, you have to be prepared, you have to be motivated to do it, you can't procrastinate.

In her TPSs II and III, she wrote that instructors need to be organized inside the class. She felt more strongly about being organized both inside and outside the classroom.

### **Preparation**

Rebecca believes that the instructors themselves need to understand the content they are going to teach, see if the examples they are going to present work out okay, and prepare the answers to possible student questions. When asked what preparation the instructors should do, she said:

Making sure that you understand the material. So like when I taught trig, I had to learn all the stuff, cause I learned that in high school a long time ago. So like, making sure that you understand the material, working through examples like if you are gonna present examples in class, make sure that works out okay. You don't wanna stand up there be like, why isn't this working out I don't understand? You know, you wanna work through all of that. Be prepared to take the questions they might be asked. Like if us, if you know something trouble students a lot, so based on the experience, may be you've taught before, you've seen a lot of these questions being asked about this particular topic. You might be prepared to answer the questions. Or answer them in your lecture, so kind of anticipating what questions might come, that definitely is helpful. So I think yeah, just having your lecture prepared, to knowing what you are gonna talk about, knowing what kind of examples you wanna go through, how those examples work out, those kind of things.

She had also written in her earlier teaching philosophies that instructors needed to be prepared.

Based on her first semester teaching experience, she realized that teaching is time consuming and that instructors need to spend a significant amount of time to prepare for class.

### **Students**

Rebecca developed a belief from her first semester teaching experience that students should also be responsible for their own learning, and they need to expend the required effort on their learning. She said that she was successful in contributing to the learning of those students who were willing to learn:



The students that I had in the spring, I have been told that that was not a good class, because they didn't come to class, things like that. So it's just, it's kinda hard to tell but I feel like the students that came to class and that worked hard, they learned the material, they started to see that I enjoy math, they kind of had that feeling kinda changed, they didn't hate math as much. And so I feel like because of that I feel like I was very successful.

### **Teaching My Way**

Rebecca implied that MGTAs should be given teaching autonomy in order for them to develop as effective instructors. She said that although graduate students need backup support to help them when issues come up, she said that learning from their own experience and mistakes is the best way to learn about teaching.

She said that she had expected to have some kind of support from the mathematics department, and she especially wanted someone to answer questions if she had them. However, she believes that learning from her own experience and mistakes is the best way to learn. When she was asked what kind of support she had expected from the mathematics department regarding her teaching, she said:

They have to be supportive but still like kind of back up, like they have to like do things on your own, learn from your own mistakes things like that cause that's the best way to learn, so I wanted them to be supportive but still encouraging, still pushing me to be better, things like that, so I really appreciated the fact that I had a mentor, that really helped. My course coordinator for the first, first class I took, I really appreciate that she was very helpful.

#### **4.3.4.a Summary**

At the stage of interview I, Rebecca added a few things to her previous teaching philosophy. She added that teaching experience is important for learning to become a better mathematics teacher, and to gain confidence in teaching. In order for novices to develop into effective instructors, however, she said that they should be able to exercise teacher autonomy. She said that learning from one's own mistakes and experience is the best way to learn about teaching.

She realized from her experience that preparing for a class is very time consuming, and in order for MGTAs to maintain a balance between teaching and their own coursework, they need to be very well-organized, both inside and outside the classroom. She learned the instructors, especially teaching assistants, need to maintain an authority figure role because some students would attempt to treat them as a peer.

She added that in order to create a learning environment and to motivate students, instructors need to create a positive feeling for mathematics. Students' negative attitude towards mathematics might be hindering their mathematics learning, she said. Even though collaborative learning is beneficial to student learning, instructors should be careful to make sure that all the students are participating while they are working in groups. She found that some groups were dependent on the smartest member of the group. Moreover, she perceived that teacher-centered instruction may prove to be more effective in lower division mathematics courses than collaborative learning, because most of the students are not motivated to learn on their own, but are taking the course just to fulfill their degree requirement. She also added that students should also understand the responsibility of putting effort into their learning, as a teacher can do only so much for their students' learning. She felt less strongly about having high expectations for her students, although she said that she would still like to challenge her students with difficult problems.

Rebecca said that instructors should employ different methods to explain mathematical concepts to the students. She added that students should be taught to think on their own, and she wanted to guide them to find their own solutions instead of giving "answers" to students' questions.

She did not say anything about using technology before she was asked to tell her opinion. She said that she uses ELMO and a projector to display her lecture notes to the class. She writes on the board only if the ELMO or projector is not working for some reason. She uses a calculator

mainly for graphing but does not like her students to use a calculator for simple arithmetic, such as adding, subtracting, and fractions. She believes that students should be able to do so by hand. She usually types her lecture notes and posts them on D2L for her students to access online and bring the printout to class. Sometimes she prefers to use colored chalk to write on the board, to aid students visually.

Rebecca thought, by looking at her students' course evaluations, and considering that it was her first time teaching the course, that she did a good job. She admitted that she was still adjusting to classroom teaching, and that she had a lot of room for improvement. She said:

Overall I feel like I have great reviews. There were one or two little comments that were a little strange, but I kind of expected that. There were a couple of students there that I think they didn't like me. And I think that was part of it, I think they just, I don't know. But overall I think that was like one, maybe two responses that there was like a little strange. Out of 26 responses or you know, that was one question or one student, the rest of them sounded, I mean I feel like I did my job. I feel like I did really well, I had a lot of students comment on how passionate I was. And so that made me feel really good, and how much I cared about teaching and their success. So hearing that made me feel like, okay, I am getting this idea across, that I want that I cared about them and that I want them to succeed and that math was not terrible. I'm getting that idea across.

She further explained that it's hard to tell how successful she was because there is no way to actually measure the success. She said she still needs to make improvements to become a better teacher, and that it takes time and experience.

#### **4.3.4.b Factors**

The factors that were detected to influence Rebecca's teaching philosophy in interview I were her own experience as a student, other instructors, SPTCM course, and teaching experience.

*Experience as a student.* Rebecca was found to be influenced strongly by her own experience as a student. She said that she was influenced mostly by some of her undergraduate professors. She invoked the teaching of those professors several times during the interview.

*Other instructors.* She was able to go and ask questions to any experienced teaching assistant, and professors in the department even if they were not her course coordinator. She also felt comfortable to have her fellow TAs around who were also undergoing through the same learning process as she was. She said that she usually asks questions of her peers, the course coordinator, or other professors in the department to deal with some of the issues that she is not sure about. Being around other instructors and fellow TAs helped her to know the perspectives of other people. She said that listening to their perspectives sometimes changed how she used to view certain things about teaching. She said that she usually seeks other peoples' opinions on some of the issues that she doesn't know how to handle; she then weighs those options, thinks back on how she should have handled that situation, and makes an appropriate decision.

She said that she wouldn't have done any group work if she had not gotten that idea and support from her course coordinator.

*SPTCM course.* Not having to teach in the first semester but having preparation class was very helpful to adjust her to a new environment and graduate school. When asked what she feels about the support she got from the mathematics department, she said:

A lot of students might disagree, but I really think that it was really helpful for me personally, because I was really nervous coming in. And I had to adjust to being a graduate student, do more difficult classes and things like that, and being out of a completely different school because I have never been far from home, so adjusting to school far from home was a big adjustment too. And that, so it's really nice to just have that leeway in there instead of just being thrown in. So I kind of had a semester to adjust and I was thrown in teaching. So I really appreciate that about the school.

Class observation of mentors and classroom discussion in the seminar was very helpful. Class discussion helped her to learn the perspectives of other people and deal with several student issues. She said:

We had to grade. So he gave us some problems that students had worked out, and we had to grade them and we had to discuss why we graded on that way and anything like that, so we had to talk about how grading is subjective, so because just one teacher grades in one way or another teacher grades it in another way doesn't make it wrong, you just need

to back up your answer, so that was really helpful. We also got to ask questions, so like when we were observing we wrote down a list of questions and we then used to discuss them in class and that was helpful too. Cause then there were some things that showed up in other classes but that didn't show up in mine, that were really good to know and things like that.

She also had some classroom presentation opportunities in which she had to present a lecture in the class. She added that being able to stand in front of the class and getting feedback about her teaching from her colleagues was also helpful to become more confident. When asked in what ways the activities they did in the preparation class were helpful, she said:

Definitely the activities where we presented a lecture in class, so I sat in on a class and I really appreciated the fact that I got to sit in on the class. But then I actually had to present one lecture in that class. So that kind of helped with the nerves, and like it was nice to be able to stand up there and, you know get experienced. But it helped with the nerves a lot, cause I was so nervous that day and I was still nervous to do my own class. But now I kind of felt how that works, so actually got to teach one section for that college algebra class. Umm, what else? Talking about the teaching philosophy made me think about how I wanted to teach, like what kind of teacher I wanted to be, how I wanted to come across to my students. And so I think that was really helpful too. So those are the two big ones.

She was a little worried about not knowing the institutional culture, but the preparation course helped to alleviate her anxiety:

I was really nervous to start teaching, cause as I said I have never taught before. So I was really scared about that, but like I said, having that prep class was really nice because I have never taken any classes at Oklahoma State before my graduate level, so I didn't know how things worked here. I mean I knew kind of how they worked at my undergrad, but I didn't how they worked here. So like the academic integrity part, I didn't know about that and things like that. So it's nice to have that class, is kind of calmed my nerves a little bit because it's really scary being in front of the classroom teaching people and not knowing how the school works. So that was really scary, and not having taught before, it was really scary too cause I had never experienced that.

She was able to ask questions of any experienced TA or professor in the department, even the ones who were not her course coordinator. She also felt comfortable to have her fellow TAs

around who were undergoing the same learning process as she was. She said she had support from the graduate college as well. The graduate college had organized a graduate teaching assistant seminar in which she learned many things about teaching and learning.

*Teaching experience.* Rebecca said that she was a beginning instructor, and that she was still making adjustments in her teaching. She implied that she is learning from her teaching experience.

*Time.* She said that she employed collaborative learning strategies twice a week during the regular semester, but she could not do so during the summer 2013 semester because of time constraints. If she had enough time, she said that she would employ it more often because she felt that students learn and retain mathematical knowledge better if they discover or do things by themselves.

#### **4.3.5 Interview II**

The second interview with Rebecca was conducted during the fall 2013 semester. She was teaching two sections of calculus I during that semester. She had taught a section of college algebra during the summer 2013 semester and a section of precalculus during the spring 2013 semester. The following themes were detected from coding: experience, explanation, high expectations, learning environment, maintaining teacher authority, organization, out-of-class support, preparation, students, teacher authority, and technology.

#### **Experience**

She said that she was nervous during her first semester teaching, but she had gained more confidence in teaching as well as in the subject matter. She said that she had changed her student assessment strategy; she had started to give more quizzes than she did in previous semesters. She realized that students' performances in those quizzes reflects how they are going to do in the

exams. She found from her teaching experience that some students may not be good test takers, but they will feel more comfortable for the exams if they are given more quizzes in class.

She implied that teaching different courses as a beginning instructor had hindered her effort to improve her teaching. When asked what differences she would expect in her teaching behavior in the future, she said:

After two to three years, I'd be a lot more comfortable with it, especially if I was teaching the same subject. I've noticed that having to switch subjects every semester has made me really uncomfortable. So I'm really ready to take those lesson plans that I did for one semester and improve on them. I can't do that when I'm teaching different courses every year. I feel like if I was teaching the same course for two or three years, I feel I would be a lot more confident. I'd be able to expand on how I teach different things and get different ideas of how I can present this section a little better. I can do something hands-on that might make more sense to the students. I feel like I'd be a lot more confident in that and I'd be able to just – I feel like I'd really be able to teach it a lot better. And I feel right now I can improve on that but that comes with teaching different classes every semester. So yeah, two to three years down the road, I feel like I would be a pretty good teacher. I'm pretty confident in that.

She said that she would have grown to a better instructor if she were given the same course to teach continuously over the period of two to three years. She said that she would self-reflect on her teaching, assess what did not go as expected, and figure out ways to improve for next time.

### **Explanation**

Rebecca said that the instructors need to be able to clearly explain mathematical concepts to the students. She said that she would like to find out and learn how to explain mathematical concepts in different ways, and explain at a level that average students will understand. Reflecting on her classroom teaching experience, she said:

I noticed that there was one example that I gave that a lot of students didn't understand. Maybe I can figure out a better way to explain it or choose a different example and things that would make more sense. Just being to adjust my lesson plan a little to make it more understandable for the students.

She said that she would be able to find alternative ways to explain things to help students understand if she is given the same course to teach continuously for a few years. She implied that

she had not been able to become as effective as she would have liked, because she had had to teach three different courses in three semesters.

### **High Expectation for Students**

Rebecca said that she would like to have high expectation for her students. She said that one of her role model undergraduate professors used to give very hard exams, which motivated and pushed her to work harder in order to succeed in his class. However, she felt less strongly about having high expectation from the students at the interview II stage than before. She said that she does not like to intimidate her students by giving very challenging problems at first. She wants to first assign them a few easy and doable problems, then slowly build up their confidence before having them solve more challenging problems.

### **Learning Environment**

Rebecca said that instructors need to create a friendly classroom environment where students do not feel embarrassed to speak up if they have questions, and do not feel that they are being judged. Instead of scaring her students, she said that she wants to create a calm and relaxed atmosphere. Speaking about creating a conducive learning environment, she said:

I try to keep it friendly because I want – like don't want people to be embarrassed to speak up if they're stuck on something. I try to keep it really relaxed. And I don't want people to be afraid to say something and be wrong. I make sure that there's no judging going on like, "Oh, you got the wrong answer," and things like that. So I try to make sure it's a very friendly yet professional atmosphere. I don't want them to be scared. I want them to relax. I feel like you learn better that way too. So that is what I try to keep is just a really calm and relaxed atmosphere.

The following are the ways she wanted to create a good learning environment for students:

*Application of mathematics.* Rebecca said that she provides more examples of application problems than she used to do, because she believed that the students will see how mathematics can be applied to solving real life problems.



*Caring.* She said that she makes her students feel that she cares about them and their successes. She believed that students are more likely to interact with and approach their instructors if they know that they care about their successes.

*Collaborative learning.* As she described in her previous teaching philosophies, she said that she would like to encourage students to talk about math with each other, instead of just doing homework on their own. She said that she employs collaborative learning strategies in class, and grades their group work to encourage them to work. She believed that students benefit by working with each other if they are working in groups.

*Creating positive feeling for mathematics.* Rebecca said again that the first thing she would like to do was to change students' attitude towards mathematics and learning mathematics. She wanted to help students feel that mathematics is not hard, but it is a fun subject if they get past their negative attitude. From her tutoring experience while she was an undergraduate student, she realized that being encouraging and creating a positive feeling towards mathematics learning makes a difference in students' attitude. She said:

I've noticed that some of the students are actually really good at it. They don't give themselves enough credit. And so I worked with a couple of students quite a lot. Like I had two students that would meet with me at least once a week for a whole semester. Towards the end of the semester, they were finally like, I'm getting this stuff. This stuff isn't as bad, you know, isn't as bad. That was because I would encourage them and I would tell them, you can do it. This isn't something that – it's not rocket science. You can handle it. That really kind of made me want to be more encouraging and to change those attitudes, because it makes me sad to see people so negative about the subject that I love.

*Encouragement.* She said that she wants to encourage and push her students to put effort into their learning. She feels that being encouraging makes students more willing to put in the effort to really succeed. She also said that she tells her students not to give up, and encourages them to try to solve problems on their own. She believed that they will feel accomplished and also feel the ownership of their learning if they can solve problems by themselves. She said that she does not

want to intimidate her students by giving difficult problems. She said that she will encourage them to do easy problems first, and if they can solve those easy problems on their own, she believed that they will find the motivation to solve more difficult problems. She found that some of the students were actually good in mathematics, but they did not give themselves enough credit for their own ability.

*Humor.* She said that she uses some humor to create a fun learning environment. She said that she tells some math jokes to her students every now and then in the class:

I told them a math joke the first day of class. Some of them were just like, oh, that's so cheesy, and things like that. But – so the next day, I did another one. I kept doing them all week long and every now and then I throw them another math joke. . . . They realized how goofy I am and so it makes them a lot more, you know, this girl's real, you know. She's easy to talk to.

She believed that using humor would make an instructor more approachable to the students, and make the students feel more comfortable asking questions.

*Sharing passion with students.* She said that she wants to share her passion for mathematics with students. She believed that if she can show that she enjoys mathematics, and that this subject is fun, it will be helpful to change students' negative attitude towards mathematics. In order to share her passion with students, she said that occasionally, she deliberately becomes excited when she finishes solving some problems.

### **Maintaining Teacher Authority**

She believed that instructors, especially graduate teaching assistants, need to maintain an authority figure role. She said that she has become a little stricter this semester because she realized that the students will keep asking her for favors all the time if she agrees to fulfil their demands once.

### **Organization**

Rebecca believed that instructors needed to be well-organized. Based on her teaching experience while being a graduate student, she realized that she needed to be even more organized, both inside and outside of the classroom. She said that she had gotten better at being organized than before. She said that she used to jump from one topic to another, but she has worked on transitioning between different topics so that students understand better. When asked what improvement she would like to make the following semesters, she said that she would like to be even more organized. She felt more strongly about being organized by the stage of interview II; she expressed the need to be organized several times during the interview.

### **Out-of-class Support**

Rebecca said that she always makes sure that she is approachable and available to her students whenever students need her support. She said that she encourages her students to visit her office and would like to help them during her office hours. Also, she said that she tries to respond to her students' emails as soon as she can.

### **Preparation**

Rebecca said that she would spend a significant amount of time to make sure that she is prepared for class and makes sure that she is ready to answer students' questions. She tries to anticipate any questions that she thinks students might ask during the class, and any possible errors they might make while solving problems. When asked what specific things she would do to prepare for her class, she said:

That includes the lesson plans and making sure I know what's being taught that day before that day comes, and making sure I have example problems, making sure I anticipate any common mistakes that students might make especially when dealing with Algebra – a lot of common Algebra mistakes so I'm ready to handle those. If the student says, "oh, let's cancel out those x's, but you can't cancel out those x's". I need to be prepared to explain why we can't do that. Looking over their homework assignments that I've assigned so I know how to do all of those problems to make sure that if they have questions over those, I can answer them easily, and make sure it's in an organized manner.

She had also expressed during interview I that being prepared for a class was important. By the stage of interview II, she realized that she needed to prepare even more; she added that she would also like to develop a detailed plan before going in for classroom teaching:

It makes me realize like between the first time I started teaching and now, I know I need to be a lot more prepared for class because there were days I'm like, oh, I know this stuff. I don't usually spend a lot of time preparing. And then I realize some of those student questions were really good, and I'm just like, I don't know how to answer that question, so I'd have to figure out how to answer those questions. So I'm a lot more prepared now. I can anticipate student questions a little better because I've seen those students. I know the common questions that come up. I'm starting to see questions that repeat every class. It's getting a lot easier to be more prepared.

She emphasized the importance of being prepared more often than anything else during this interview.

### **Students**

Rebecca said that some of the students used to visit her office hours regularly. Those students were average students who wanted to do better, and knew that they need to work hard to succeed. She said that many of the students did not show up in her office for help, but they used to come only before the test. She implied that students should also act responsibly and need to expend the required effort for their learning.

### **Teaching My Way**

Rebecca said that even though she understands the purpose of having an experienced professor coordinate a course, she believed that she could not do some of the things that she would like to do. She said that she could not grade her students' exam, since each instructor would grade only one problem for all sections. She said that some instructors had emphasized something that she had not, and her students lost points in the tests. She implied that even though she appreciated the support from the department, she wanted some kind of teacher autonomy. When asked how the lack of decision-making ability was affecting her teaching, she said:

It makes it tough because then you have to be careful – okay, if I make this decision for this situation, is that going to affect how other classes go? You have to be careful about that – I don't know. I feel like – and then the time constraints that come with that too, because we have so many meetings throughout the week, especially when the exams came up, we had four meetings that week. So that's more time out of my schedule that I'm already busy for. I don't really like that because then I can ... like if I was just teaching a class all on my own, you know, I can do it whenever I have time. But if we have meetings all the time, we have to do it together if there's only this specific time that I can work on this. So that makes it tough.

### **Technology**

She realized that she would like to use technology in her classroom. She believed that using visual aids such as projecting graphs on the projector, and pulling out some of the things from the computer would be a good idea to enhance student understanding. She added that she also uses the smart board to write things, in addition to using the computer, the ELMO, and a projector. She found that she can save what she writes on the smart board, which she can send to her students if they have missed a class for some reason. However, she said that she had started to use the chalkboard in the classroom more often, and the ELMO and projector less often than before. She said that she had not been able to use technology as frequently as she thought she should, because she did not have enough time to set those up during the class, and prepare things to put up and project on the screen for students to see. She said, however, that technology should be used when it is appropriate, and overuse of it could hinder student learning ability. Moreover, she said that she used graphing calculators more than any other technology.

In Interview I, she had not mentioned anything about using technology until she was asked. So her emphasis on technology in Interview II was a definite change. She said that she used ELMO and a projector most of the time in her last semester of classroom teaching, but had started to use chalkboard more because she found that it gave her more flexibility.

#### **4.3.5.a Summary**

Rebecca's teaching philosophy at the stage of Interview II was only slightly different from her previous teaching philosophy at the Interview I stage. She still believed strongly in creating a conducive and comfortable learning environment for students. She added that the use of humor could be helpful in creating a fun learning environment in the class.

She added that she would like to be encouraging, and wants to encourage her students to put more effort into mathematics learning. She said that she would encourage her students by saying that mathematics is a doable thing, and if the students try, they will be able to do it. She believed that the students will feel more accomplished and become more confident if they can solve some problems by themselves.

She said that the use of technology in the classroom would be helpful to enhance student understanding. She expressed a desire to participate in some professional development activities, to learn about using technology in the classroom teaching. She realized that the use of the chalkboard gives more flexibility than using an ELMO and a projector.

She had also realized the need to be prepared and well-organized in her previous teaching philosophies. However, she felt more strongly about these at the interview II stage, expressing it several times. She also added that instructors need to prepare a detailed plan before going in for classroom teaching.

In her previous teaching philosophies, she expressed a belief in having high expectations for students. She believed that having such high expectations would encourage students to work harder. However, she felt less strongly about this at the Interview II stage. She said that she does not like to intimidate her students by giving very challenging problems. She wants to begin with a few easy problems, and slowly build up their confidence before working with more challenging problems. This was the biggest change detected in her teaching philosophy at the Interview II stage.

She added a belief that instructors should be able to explain mathematical concepts clearly to the students. She said that she wants to learn how mathematical concepts can be explained in different ways to enhance student understanding.

The same external factors detected in teaching philosophies from previous stages were found to influence Rebecca, and her teaching philosophy. She said that the lack of time was hindering her from preparing for teaching and providing out-of-class support to her students.

#### **4.3.5.b Factors**

The same external factors that influenced Rebecca's teaching philosophies from earlier stages were found to influence her teaching philosophy at the Interview II stage. Below is a brief description of these factors.

*Other instructors.* She said that she was still surprised by some of the requests that students make. If she is not sure about what to do, she takes advice from other instructors. When asked what factors are helping her to learn about teaching, she said:

The support that I have here, so like my course coordinator, I can go to her if I have any trouble. Since I am teaching Calculus, I've got like a bunch of colleagues that are also teaching the same course. We're all in the same section, so I can go and talk to them if I need to. Fellow TAs, students that are also struggling with the time constraint and things like that, I can talk to them if I ever need anybody. Old professors and old course coordinators. I always – there are two of them that I go back and talk to all the time, and I'm just like, "What would you do in this situation?" And things like that. Definitely, the support here really helps with my teaching ability.

*SPTCM course.* She said that she did not learn much from the preparation class. The only thing she said she learned was to become a professional, and maintain the role of a teacher authority figure. She said that she also learned how to deal with students in a professional manner. She said that her overall philosophy had not changed as a result of the preparation course.

*Teaching experience.* Her teaching experience, especially the students she taught, was a big factor in shaping her teaching philosophy. She said that she learned that students have negative attitudes

towards mathematics from her tutoring of undergraduate students. She said that being encouraging and creating a positive feeling towards mathematics learning made a difference in her students' attitudes. She found that many of her students had changed their attitude towards mathematics. She also said that many students do not give enough credit to their ability. However, she said that nothing had really changed in her teaching philosophy based on her teaching experience as a GTA. She said that she only "tweaked a few things" in how she practices her teaching philosophies, but it had remained essentially the same.

*Teaching experienced as a student.* Rebecca and her teaching philosophy were influenced by the teaching she had experienced as an undergraduate student. She learned from her past undergraduate professors to be encouraging, to have high expectations for students, share her passion with them, create a fun environment in the class, make students work, and provide out-of-class support. She also said that some of those professors took an interest in her life outside of school and showed that they got to know her not just as a student in the class. As a result, she said that she felt more encouraged to seek their support and learn.

*Time.* She said that she did not have enough time to prepare because of her own coursework and her teaching responsibilities. She said:

I haven't had a whole lot of time to prepare to put up a graph on the board and things like that. It's been kind of tough... We meet four days a week. It's mostly my time consumption because with taking two classes and teaching two sections that are eight hours – well, total eight hours. It gets to be a lot during the week. And so sometimes it's hard to be able to plan ahead that far to make sure I am able to do that.

She said that the biggest challenge that was hindering her teaching was the lack of time. She said that if she had more time, she would have been a much more confident instructor, and would have made herself more available to the students.

*Course taught.* She found that the students in the lower division courses are less motivated to learn mathematics. She found that the students in the upper division courses are more likely to put



in the required effort when they are assigned group work. She said that the level of students definitely made a difference on how the group work went.

When she was asked which course she would like to teach, college algebra or calculus, she said that she liked the material of college algebra, but she preferred the students in Calculus because most of them were more motivated to learn mathematics.

#### **4.3.6 Interview III**

The third interview with Rebecca was conducted on January 4, 2014 during the spring semester. She was teaching two sections of calculus I during the semester, and had taught the same course in the fall 2013 semester.

#### **Conceptual Understanding**

Rebecca believed that mathematics instructors should help students understand mathematical concepts. She said that she gives examples of math problems to the students that require more than just procedural knowledge to solve. She said she assesses students' conceptual understanding by also asking them questions.

#### **Experience**

She believed that the best way for novices to learn to teach is to experience teaching, reflect on their own teaching, and ask questions of experienced instructors. She said that novices can grow into better instructors by being exposed to students and classroom situations. When asked how one can learn best about teaching mathematics, she said:

Just experience it. So, actually being in front of students and having students ask you questions. The only way to be prepared for student questions is to hear them and to be like, you know, you can say okay, students might ask me about this, this, and this, but there are still going to be questions that are unexpected. And the only way that you're going to be prepared to handle those or confident in being able to answer those is if you've actually experienced it.

As she became more experienced, she felt more strongly that one can grow to a better teacher only by teaching.

### **Explanation**

As she expressed in her teaching philosophies from previous stages, she believed that instructors need to be able to clearly explain mathematical concepts to the students. As she becomes more experienced, she said that she can figure out better ways to explain concepts by reflecting on her own teaching experience.

### **High Expectation for Students**

There was no change in her belief in having high expectations for students. She reiterated that it would be a good idea to give some easy problems at first to boost their confidence, before assigning challenging problems. However, she said that she might still be a little too nice with her students, and so she needs to become a little tougher with them by giving challenging problems to solve in her quizzes.

### **Learning Environment**

She said that she does not just want to teach by delivering teacher-centered lectures, with students listening and taking notes. She said that she would like to interact with students, involve them in problem-solving processes, and also encourage them to engage in conversation with each other. She believed that the students should be kept active by doing non-traditional things to get them out of the everyday mundane experience. Being informal and interacting with students would be helpful to create a good learning environment. As she also done during the interview II, she said that creating a successful learning environment depended on creating a positive feeling for mathematics, employing collaborative learning, sharing one's passion for mathematics, caring for

students, encouraging them, using humor, showing the application of mathematics to real world problems, and encouraging students by saying that anyone can learn mathematics.

Although she had previously mentioned the importance of engaging students and creating an interactive classroom environment, she emphasized these much more during interview III. In order to engage students, she asks them questions all the time, and encourages them to express their ideas to solve problems:

I make them answer questions in class all the time and I'll write up a problem on the board and say, okay how do we do this? So I make them go through it instead of me just teaching them. ... I mostly lecture, but I do ask questions so I try to make it more engaging. So even though I'm teaching them like vocabulary and showing them proof, I still make sure that they're involved. So I'm constantly asking questions even if it's the simple, what's  $1 + 1$ , like simplifying things. I always ask them, okay what does [this] simplify to and things like that, and so I'll try to ask them even conceptual questions. So if this is true does that mean that this is always true? Things like that. So I always make sure that they're with me.

She said that she would like to create an interactive learning environment by talking to the students, asking them questions, and encouraging them to talk with each other and debated each other's ideas.

### **Maintaining Teacher Authority**

By the time the interview III was conducted, Rebecca felt even more strongly that MGTA instructors need to maintain the role of a teacher authority figure. As in interview II, she said that if the instructors agree to fulfil student requests once, students will keep making more requests.

When asked what advice she would give to beginning teaching assistants, she said:

I would warn them about students, like doing grades now. I've got at least two students asking can we do extra credit? So don't always listen to them, you know, kind of stay your ground. You have to learn to stay in your ground.

She said that one of her self-perceived weakness was not being tough enough with her students. She realized that she needed to become tougher with them, be able to say “no”, and push them to work harder instead of always being nice with them. She believed that employing a tough-love attitude would help her to maintain the role of a teacher authority figure. This was an added belief in her teaching philosophy.

### **Making Students Think**

Instead of giving answers to the students’ questions, Rebecca believed that instructors should let them struggle, and work to come to their own conclusions. She said that instructors should encourage them to think for a while, and help them only when they need it.

### **Patience**

Rebecca realized that she needed a lot of patience while teaching, and she termed being patient as one of the characteristics of a successful teacher. This was an added belief in her teaching philosophy, which had not been present at previous stages. She recalled her experience and said that instructors need to be patient even if they need to sit with the students and spend a long time to let them solve the problems and get their own answers. When asked what advice she would give to a beginning teaching assistant, she said: “Patience, patience is a big one. You know, waiting for students to answer the questions and not just giving them the answers. Then if a student is struggling with something, you know, keep working with them. Don’t give up on them.”

### **Preparation**

As she gained more teaching experience, she seemed to have reinforced her belief that instructors needed to be well-prepared to teach. When asked to identify her weaknesses in teaching, she

recalled that she had to teach some mathematical content that she herself did not have confidence. Therefore, she realized that she needed to plan ahead and prepare the content in advance.

### **Students**

As in interview II, she believed that students should put effort into their learning, and that teachers can only push a student too far.

#### **4.3.6.a Summary of Changes**

Her teaching philosophy at the stage of Interview III was essentially the same as her philosophy from Interview II stage. The only additional things detected in Interview III were being patient and employing a tough-love attitude. She believed that instructors need to be patient; instead of giving answers to students' questions, she said they should let students struggle for a while and let them come to their own solutions. She added that they should provide support only when students cannot figure problems out by themselves.

She reinforced her earlier belief that instructors, especially MGTAs, need to maintain the role of a teacher authority figure. She believed that employing a tough-love attitude would help her to maintain that role.

Her belief regarding the preparation for classroom teaching had been reinforced. She said several times that instructors should have confidence in the material they are going to teach, and therefore they should prepare in advance. She said that instructors should fulfil their responsibilities, such as knowing the content they are going to teach, being in the office for designated office hours, and being on time for class meetings.

She said that she started to use the chalkboard more often than before, because she realized that using the ELMO did not offer as much flexibility to move around and be engaged with students. Rebecca admitted that she was just a beginner, and her teaching still needs a lot of improvement.

Rebecca's teaching philosophy changed slowly over time as she moved through six different stages: three stages in each of the pre-service and the in-service phases. Some of her beliefs from the first stage did not change, but were reinforced throughout. The biggest part of her teaching philosophy across all these stages was creating a favorable learning environment for students. She wrote in all three TPSs from the pre-service phase that a good learning environment can be created by showing the application of mathematics to real world examples, being caring, employing collaborative learning, engaging students, sharing one's passion for mathematics with the students, and promoting individual learning and research. At the stage of Interview I, she added that creating a positive feeling for mathematics can also contribute to making a favorable learning environment. In Interview II, she added that the use of humor could also help students feel more comfortable, and more willing to approach their instructors for help. During interview III, she felt even more strongly about this, and said that she would try to create an active and interactive classroom environment.

She felt strongly in all six stages that the instructors should have high expectation for students by assigning challenging problems. She believed that having high expectations would push students to work harder and learn. However, she felt less strongly about this during the later stages of her in-service phase, when she said that she does not like to intimidate her students by giving very challenging problems at first. Instead, she wanted to assign them a few easy and doable problems, then slowly build up their confidence before assigning more challenging problems. Similarly, providing out-of-class support to students was detected in her teaching philosophies from all six stages.

In her TPS II and III, she added that instructors should have a positive attitude, and also expressed the importance of being prepared and organized. She wrote that she learned to be prepared and organized by observing the teaching behaviors of her faculty mentor in undergraduate classrooms. During the in-service phase, she realized that she needed even more

preparation before going in for classroom teaching. Moreover, she said that preparing the mathematical content and being organized is even more important. Her belief was reinforced during Interviews II and III. No additional themes were detected in her TPS III.

When she entered the in-service phase, she realized that she needed to maintain the role of a teacher authority figure because some of her students treated her as their peer. In her teaching philosophies at the Interview II and III stages, she also repeated that she needed to build a professional relationship with the students, acting more as a leader than as a friend.

She added in Interview I, and repeated in Interviews II and III that instructors should not just provide answers to the students. Instead, she said that they should let them struggle and think for a while, and then guide them to find their own answers. During Interview III, she added that instructors should be patient; they should wait until the students come to their own conclusions, and provide help only when they need.

Rebecca said in Interview I that novice instructors will develop as they become more experienced. She said that she learned a lot of things from her first semester of teaching, such as the importance of creating a good learning atmosphere. She believed that instructors can reflect on their own teaching, ask questions of experienced instructors, and improve for next time. She repeated in other interviews that the best way to learn about teaching is to teach. In addition to this, she believed that instructors should also be given teaching autonomy to implement their own philosophies, and learn from their own experience and mistakes.

From her teaching experience, she found that instructors can only do so much for the learning of the students. The students should understand their own responsibilities and expend the required effort into their learning. In Interview I, she said that the instructors should employ multiple techniques to explain mathematical concepts. She also repeated in Interviews II and III that they should be able to clearly explain the mathematical concepts to the students. She also found from

her experience that student understanding can be enhanced by using some kind of visual aids or technology. During Interview I, she said that she used the ELMO and a projector, but she later said that she had begun to use the chalkboard more often, because it allowed her more flexibility to move around and engage with the students.

Rebecca's initial teaching philosophies during the pre-service phase were mostly influenced by the teaching she experienced as an undergraduate student, both from her role model professors and from professors whom she thought were ineffective. During the later stages of her pre-service phase, she was influenced by observing the undergraduate classes taught by her faculty mentor. She had also learned from the instructor of the preparation course how to maintain a professional relationship with her students. As she entered the in-service phase, the most influential factors were her teaching experience and her students. However, fellow GTAs and other experienced instructors also played a role in shaping her teaching philosophies.

#### **4.3.6.b Factors**

The same external factors that were detected in her earlier teaching philosophies were found to influence her teaching philosophy at the stage of interview III. The only additional factor detected was the lack of enough mathematical content knowledge. The most dominant factor was her teaching experience and the students she taught. She said that the foundation of her teaching philosophy was inspired by her past professors, but she said that the beliefs in her initial teaching philosophy were changed or reinforced primarily from her own teaching experience. Other influences included her own experience as a student, past professors, other instructors' opinions, observing other instructors' classes, lack of time, and the TA preparation course.

#### **4.4 Case 4: Jennifer**



Jennifer was a 30-year-old international student who completed her high school, undergraduate, and masters' degrees in a north-east Asian country. See the Methodology chapter for the complete description of the participant.

#### **4.4.1 Teaching Philosophy Statement I**

Jennifer submitted her first teaching philosophy statement (TPS I) on August 28, 2012. She opened her first paragraph by writing that the definition of a good teacher varies from person to person depending on their backgrounds, experiences, and personal nature. Some of the things that she wrote in TPS I were not related to mathematics teaching and learning. She believed that a teacher has a broader role than just transmitting content knowledge to the students. For example, she wrote that effective teachers need not have a good physical appearance, and should be able to guide their students in dealing with personal issues. Coding resulted in the following themes from her teaching philosophy: content knowledge, learning environment, and out-of-class support.

##### **Content Knowledge**

Without elaborating further, Jennifer wrote that effective instructors should have a good knowledge of subject matter.

##### **Learning Environment**

Jennifer believed that instructors should have a positive attitude and create a comfortable environment for students to learn. Based on her experience with her role model high school math tutor, she learned that teachers should not judge their students exclusively by their exam grades, but need to focus on their overall development. She wrote that she used to show willingness to help her students at any time they needed. The following are the ways in which she thought that one can create such a favorable environment:

*Application of mathematics.* She believed that the instructors should motivate their students to learn mathematics by showing the application of mathematics in other fields. She recalled the teaching of her high school math tutor, who had used this approach to make mathematics learning interesting:

I remember she shows me to use scores of mathematical knowledge, such as inequalities, sequences and functions, in analyzing, researching and solving some simple physical and biological problems which I fail to acquire in my school class. I admit these methods not only enrich my knowledge but also make me believe that mathematics is such an interesting course as well as a helpful tool in our lives.

*Care and compassion.* With no further elaboration, she wrote that instructors should show compassion for students' difficulties, encourage students to overcome them, and share the joy of students' successes. Influenced by her role model math teacher from high school, she developed a belief that teachers should understand their students and make them feel that they care about their successes.

*Equal treatment of students.* Based on her experience with one of her teachers from high school, she developed a belief that teachers should treat their students equally. That teacher's negative attitude toward weaker students was counterproductive to student learning, in that it discouraged her to ask him questions and seek his help:

My physics teacher is such an ineffective one. He only concerns those who perform well in physics course and praises them frequently. In addition to this, He also encourages and instructs them to get involved in learning some advanced physics knowledge actively. For me, unfortunately, physics is a tough course. I am confused about the content and fail to figure those exercises out often, not mention to exams. So I have to seek advice from him. However, every time he just considers my problems as insignificant ones, so he either asks me to work them out by myself or explains roughly. As a result, I still could not clear these physics issues and my performance in physics is getting worse and worse. Then this teacher begins to despise me and, at last, neglect me wholly, no longer caring my problems in both academy as well as life, which hurts me deeply and makes me give up this class finally. From then on, physics becomes the course that I dislike most.

*Friendliness.* Jennifer wrote that instructors should be good friends with their students, interact with them frequently, and accept their feedback to improve teaching. She wrote that she was highly impressed with her role model high school teacher's friendly behavior. Jennifer's informal

conversations with that teacher outside the classroom helped her to feel more comfortable, because the teacher used to listen to and respect other peoples' viewpoints. Discussing the teacher's friendly behavior, Jennifer wrote:

She teaches me to respect others first, including those who have different ideas from me – treating them friendly instead of despising or being hostile to them in that everyone has his/her own view to the same issue, and then I can win others' respects.

Moreover, she added that the instructors should help students to deal with personal issues, in addition to academic issues. Giving an example, she wrote that this teacher knew that the students must “own the ability to tackle issues from other aspects, such as communicating with others actively, being able to overcome some difficulties independently and dealing with finance successfully, so that they are able to survive after entering into the society”.

*Patience.* Jennifer learned from her experience with the role model teacher that instructors should be patient. Recalling her high school experience, she wrote that the teacher never blamed her even if she did poorly in the tests. She helped Jennifer to figure out her problems, and encouraged her to do better for next time, made Jennifer feel more comfortable.

In summary, Jennifer believed that the instructors should create a welcoming environment for students to learn. She wrote that instructors' unfriendly and hostile behaviors could negatively impact student learning.

### **Out-of-class Support**

Her TPS I showed that the instructors should show willingness to provide out-of-class support. She wrote that she was disappointed with her physics teacher's behavior because he refused to provide help or answer her questions, because she did not do as well as other students in her

physics class. She implied that she could have succeeded in the course if she had gotten his support, but she eventually gave up on the class.

#### **4.4.1.a Summary**

Jennifer's TPS I was mostly about her philosophy of teaching in general, and without being particularly specific about mathematics teaching. She wrote that mathematics instructors should help students with personal issues, in addition to helping them learn mathematics. Only three themes were detected in her teaching philosophy: content knowledge, learning environment, and out-of-class support. She believed that effective instructors should have sound knowledge of mathematical content.

She believed that people who have a good mathematical content knowledge are more likely to succeed as mathematics instructors. The biggest aspect of her teaching philosophy was to create a favorable learning environment for students. She wrote that instructors should not judge students by their exam grades or the questions they ask. They should encourage students to learn, and show willingness to help them all the time. She believed that showing the application of mathematics to other fields, being caring, showing compassion, treating students equally, being friendly with them, and being patient can contribute to favorable learning environment. Moreover, she said that the instructors should also provide out-of-class support to students anytime they needed.

Her beginning teaching philosophy was influenced by her own experience as a student in the past, specifically by a role model high school math tutor, and an "ineffective" physics teacher.

#### **4.4.1.b Factors**

The only factor that influenced her TPS I was her own experience as a student. Her beginning teaching philosophy was influenced mostly by the teaching of her role model high school math

tutor. It was also influenced by the teaching of another high school teacher who she described as “ineffective”, because he only cared about the students who had high grades on exams.

#### **4.4.2 Teaching Philosophy Statement II**

Jennifer submitted her second teaching philosophy statement (TPS II) on October 31, 2012. It was just a minor revision of her TPS I. She wrote that she wanted to mention two additional things that she had not mentioned previously: treating everyone equally, and smiling at her students. She wrote:

In the earlier time, I described an effective teacher as a person who is knowledgeable, friendly, helpful. Now, after experiencing the practicum in my mentor’s class and my own classes, I feel that, except the characteristics I mentioned above, an effective teacher should also smile to his/her students often and treat each one fairly.

Even though she said that she would like to add those two things in her TPS II, equal treatment of students was already present in her TPS I. She only seemed to have reinforced her earlier belief in creating a favorable learning environment for students. From her own experience as a graduate student, and by observing the undergraduate classes taught by her faculty mentor, she found that instructors should also smile at their students in order to create a welcoming and comfortable environment. Moreover, she wrote that she also learned to respect students and their confidential information such as their exam scores. She wrote that the teachers in their home country used to announce students’ grades in the classroom in front of all their peers, but she realized that it could have a negative impact on poor-performing students.

But other than these elements, no additional changes were detected in her TPS II. She did observe some general differences in teaching culture between her home country and in the United States, but did not describe any changes specific to mathematics teaching.

##### **4.4.2.a Summary**

Jennifer's teaching philosophy at this stage was essentially the same as in the stage of TPS I. She said that she only learned to smile at her students, and to respect their confidential information such as exam scores.

#### **4.4.2.b Factors**

The only additional factors detected were her own experience as a graduate student, and her observation of the undergraduate classes taught by her faculty mentor.

#### **4.4.3 Teaching Philosophy Statement III**

Jennifer submitted her third teaching philosophy statement (TPS III) toward the end of the fall 2012 semester. Her teaching philosophy again contained only minor revisions of her earlier teaching philosophies. The only changes detected in her TPS III were making eye contacts with the students, and being prepared.

#### **Eye Contact**

Jennifer wrote that effective teachers should keep eye contact with their students while teaching, in order to make sure that students understand the content, and show students that the instructor cares about all of them, which would help ensure that they all paid attention. She recalled her observation of an undergraduate class taught by her faculty mentor, and wrote that the mentor instructor quickly discovered that the students had actually not understood the content by looking at their facial expressions. The instructor then explained the content again in more detail.

#### **Preparation**

Jennifer realized that she needs to be well-prepared before going in for classroom teaching. This realization had come about based on her international teaching assistant (ITA) test, which all international GTAs had to take in order to be eligible to teach in undergraduate classrooms. They

have to give a short teaching presentation over content of their choice, in front of a mixed audience of English language specialists, content specialists, and undergraduate students.

Although Jennifer passed the test, she realized that she was not adequately prepared, as she felt nervous during her presentation, and could not properly address the questions asked by the students.

#### **4.4.3.a Summary**

All three of Jennifer's teaching philosophy statements were about teaching in general, without being particularly specific about mathematics teaching; she did not write much about how she would approach teaching mathematics to college students. Based on her teaching philosophy statements, it was found that there were very few changes in her teaching philosophies over time during the pre-service phase.

There were no differences between her TPS I and TPS II, although she did observe some general differences in teaching culture between her home country and the US. For example, she learned to respect students' confidentiality from her experience as a graduate student in the US. But no changes were detected that were specific to mathematics teaching. In her TPS III, she added only two additional things: making eye contact with the students, and being prepared for class. She also realized from her teaching presentation experience (as a part of the mathematics graduate teaching assistant preparation course) that she needs to speak a little slower.

#### **4.4.3.b Factors**

In addition to the factors that were detected to influence or shape her TPS I and TPS II, the only additional factors detected in TPS III were the ITA test and her teaching demonstration during the mathematics GTA preparation course (MATH 5902).

#### **4.4.4 Interview I**

The first interview (Interview I) was conducted during the early summer 2013 semester. She had conducted two recitation sections of business calculus course during the spring 2013 semester. She was not teaching any course during the summer, but was preparing for her Ph.D. qualifying exams.

### **Content Knowledge**

Jennifer said that the first criterion to be a good teacher would be to have strong knowledge of mathematical content. If instructors have enough content knowledge, she believed that that they can teach and bring relevant examples even from outside of the textbook, and that they can answer students' questions. She said that her role model high school math tutor had strong knowledge of mathematical content.

### **Experience**

She believed that she will learn more about teaching and learning as she gains more teaching experience. She learned many things from her teaching experience during the spring 2013 semester. She had a hard time understanding students' questions earlier in the semester, but she felt that that she had gotten better as the semester progressed, because her actual teaching experience enabled her to better understand American students. She said:

At first I am really afraid about the questions students ask me. I just think I did not understand those questions. But now after several classes, I can understand. I think I can know the students, their mathematical background very quickly from their homework and quizzes. Yes, I can see what parts they understand and what part not. Yes, so that things I can explain something. I know where the problem is. So I can emphasize that. I can explain why they just did, did incorrectly here.

She said that she was confident that she can teach American students because she also had teaching experience in her home country. However, she was facing challenges due to her English communication skills, and the way that ideas were presented differently in American textbooks.

### **Learning Environment**



She believed that students can learn in a comfortable and welcoming learning environment. The following are the ways in which she thought she could create such an environment.

*Equal treatment of students.* She believed instructors should treat their students equally. As she had previously described in TPS I, she once again mentioned the high school physics teacher who had not treated his students equally and cared only about those with high exam grades. She said that she was not good at physics, and therefore performed poorly on the exams. But when she went to seek his help, he was unwilling to help her, which negatively impacted her learning. She said: “He just judged his students by grade, I mean he just like the students who had high grade in exams. Unfortunately, I was not that student. So I think he just treat me not very good.”

*Humor.* Jennifer said that she was very impressed with her high school math tutor because she was very friendly and humorous. Because of the comfortable environment she created with the use of humor, Jennifer felt more comfortable to learn, and chose mathematics as her college major. She said that most teachers in her home country do not use humor, but she found that it was very common in American classrooms. She said that she likes to use humor, but she doesn't know how to joke with students:

I just view American students that they are not very serious, the Chinese students, they never joke with teacher. Yes, but the American students sometimes, they just, I mean they are humorous. ...I like them to be humorous, and I don't like them to be so serious. ... Actually the students sometimes, they like to joke with me but I don't know how to joke with them (laughter). I think in [her home country], we rarely do that.

*Patience.* She said that some students understand things very slowly, and therefore teachers should be patient. She believed that teachers should be kind, explain mathematical concepts several times until the students understand, and should not judge them by their grades: “I think I should be patient. You know sometimes, the students grab things very slowly. So I need to explain the problems just again and again.”

### **Out-of-class Support**

Even though she did not mention it explicitly, Jennifer implied that instructors should provide out-of-class support to the students for their mathematics learning. She said that she was disappointed when her high school physics teacher refused to help when she approached him to seek his support. She believed that she could have improved her performance in the course if she had gotten help from the teacher, but instead she had to eventually withdraw from the course.

### **Preparation**

She realized that she needed to see how mathematical concepts are explained or presented in American textbooks before beginning any classroom teaching, because many topics are presented differently in textbooks from her home country. She also said that studying other instructors' lecture notes was helpful.

When she explained mathematical concepts in class, she said that American students sometimes could not follow her, because she taught in a way she had learned in her home country, which was unfamiliar to American students. She was not explicit as to what particular ways of teaching were different though. Therefore, she said that she needs to read American textbooks, and be prepared to explain mathematical concepts so that the students will understand. Moreover, she had not used graphing calculators very often in her home country, so she did not have good calculator usage skills. She had to learn how to use a calculator before she went to the classroom.

### **Students**

Jennifer thought that her students' evaluations of her teaching will help her to improve for next time. She said that she would like to study the students' feedback from the evaluations and adjust her teaching accordingly. When asked what factor helped her to learn about teaching, she said:

I think students' feedback. ... I think it's the best. Because I used to teach in [home country] for five years, I am just familiar with the teaching in [home country]. But students' feedback can just make me know the difference from American teaching and [home country] teaching.

Based on her teaching experience in the spring 2013 semester, she found that her students had difficulty in understanding the mathematical concepts she taught, because she explained them in the way that she had learned them in her home country. Later, she realized that she had to explain in different ways that the students would understand. She said:

The tricks we learned in [home country], well some tricks the American students they never learn that, so in class when I use that tricks, most students they just said they just don't understand what I am talking. So I just need to avoid that situation. So that means I have to use the tricks or method they know and they understand to explain the problems.

She had heard that American students had a negative attitude towards learning mathematics. But she found that most students are serious about their studies and that they can learn. She also found that some of the students are even better than her students in her home country. At the same time, she also realized that some students' mathematical background was not good, but she found from her teaching that they can also learn.

### **Teaching My Way**

Although she acknowledged that the support from the mathematics department was very helpful, she said that she can grow as a teacher only if she is given sole responsibility for teaching courses. When she was asked what kind of sections (recitation or independent) she wanted to teach, she said that she prefers independent sections: "I like to explain not only the home work or something to students but I just, I think if I just teach the independent section, then I can display more than what I can talk."

#### **4.4.4.a Summary**

In summary, only a few changes were detected in Jennifer's teaching philosophy at the stage of interview I. She still believed that instructors should have strong mathematical knowledge, and that they should create a comfortable learning environment for the students. She believed that

they can create such an environment by treating students equally, using humor, and being patient. She believed that instructors should also provide out-of-class support to students when needed.

She said that she needs to be more prepared before going in for classroom teaching. She said that she needs to see how mathematical content is organized and presented in American textbooks, and also how American students learn and are taught mathematics. In her previous teaching philosophy, she had also discussed that she needs to be well-prepared, but she was not specific as to what kind of preparation she will need. Unlike the other MGTA participants, she said that grading and preparation did not take long, as she tried to be organized by allocating certain times to prepare for the class.

Unlike in her previous teaching philosophies, Jennifer had now developed a belief that instructors can learn about teaching from their own teaching experience. She said that she learned many things from her teaching experience during the spring 2013 semester. She believed that teaching experience would allow instructors to review students' feedback from their teaching evaluations, which would enable them to improve their teaching for next time. She said that she could not learn much from her five years teaching experience in her home country, because students there did not complete teaching evaluations of their instructors. She said that the students are the best people to learn from and to assess their teaching. She also believed that instructors should learn appropriate ways to deal with the students and student-related issues.

She expressed a little dissatisfaction about teaching the recitation sections. She said that MGTAs cannot fully implement their teaching philosophy in the classroom, because they are just doing things as told by their course coordinators. She believed that she can grow professionally only if she is given the opportunity to teach her way. This was an additional aspect of her teaching philosophy that had not been detected at previous stages.

She believed that the instructors should be proficient in English language skills. She said that her inadequate English language proficiency limited her from being an effective teacher, and that she will work hard to improve her listening skills and oral English in the future. She had not discussed the role of English proficiency in her previous teaching philosophies.

She did not mention anything about the use of technology in her teaching philosophy. When asked, she said that she had used the chalkboard in her home country, but now used PowerPoint in the classroom because the class sizes were too big. But she did use the chalkboard in the spring 2013 semester, because it gave her more flexibility to engage with the students and adapt the course content.

She said that whether or not to allow students to use calculator depends on what we want students to learn. In her home country, students are not allowed to use calculators because teachers want them to have a good hand calculation ability. That is the reason why the hand-calculation ability of students from her home country is better than that of American students, she said. She found that American students are allowed to use calculator as a tool to help them solve mathematical problems and calculate numbers. She said that she likes the idea of using calculator because that saves students time.

She did not mention anything about employing collaborative learning in her teaching philosophy. When asked what she thinks about this teaching strategy, she said that she likes the idea of employing group work because students can learn new ideas from group discussions. She found that American students are familiar with working in groups, but group work is not common in her home country. She had never experienced or employed collaborative learning in her teaching.

She found that students from her home country are smarter than than American students in terms of mathematics learning. She also said that students from her home country learn multiple techniques to solve mathematical problems, but she did not find that to be the case here. She also

found that some American students are very weak in mathematics; she said that sometimes it was hard for her students to understand even simple mathematical concepts. She also said that this difficulty might just be caused by different teaching methods between the two countries, as her American students might not have been familiar with the kind of explanations that she provided to them. She also found that most American students are not as weak as she had heard before she started to teach.

She appreciated the idea of the teaching preparation course offered by the mathematics department. She said that she learned a lot from the course, especially how to deal with student issues. She also learned to reflect on her own teaching, and to learn other peoples' perspectives on teaching. She said that she learned from observing other teaching assistants' classroom presentations, as well as from their feedback on her teaching presentation. For example, she said that she learned from her fellow TAs' feedback that she needed to speak louder in the classroom. However, among all the support she got from the math department, she said that the student evaluations were the most beneficial. She said that students do not provide teaching evaluations in her home country.

Jennifer's teaching philosophy at this stage was still influenced mostly by the teaching she had experienced as a student in the past, especially by the teaching of an "effective" and an "ineffective" teacher during her high school. Her teaching presentation experience during the pre-service phase, and her teaching experience during the spring 2013 semester also had an influence in her teaching philosophy. She realized that that she can improve her teaching based on the students' feedback.

She found that she needed to adjust her teaching style in order to fit the learning habits of American students because she noticed some differences in teaching culture between her home country and the United States. Moreover, she found that she needed to study American textbooks

in order to see how mathematical concepts are presented and explained. Another new factor detected in her teaching philosophy was her English proficiency. She realized that she needed to be proficient in communicating in English, which she had not discussed in any of her previous teaching philosophies.

Jennifer learned from the instructor of the MATH 5902 course that instructors should learn appropriate ways to deal with the students. She said that they can improve their teaching based on the advice of other fellow or experienced instructors; learning other peoples' perspectives on teaching is beneficial.

#### **4.4.4.b Factors**

The factors that were found to influence her teaching philosophy are described below.

*English Language.* Rebecca perceived that her lack of proficiency in spoken English had posed challenges in explaining concepts. Describing the challenges she experienced in teaching, she said: "The first one is language, oral English. I don't know some English words; sometimes it's really difficult for me to express my ideas." Beside her lack of spoken English proficiency, she said that she needed to improve her listening skills as well. She believed, therefore, that she would have been a much better instructor if she was proficient in English language skills.

*Experience as a Student.* She was very influenced by the teaching she had experienced as a student, especially by her role model high school math tutor. From this instructor, she learned that a good teacher needs to have enough content knowledge, and be friendly, humorous, patient, kind, and caring. That instructor used to interact informally with the students, which made Jennifer feel that she cares about them. Moreover, Jennifer also learned from instructor not to judge students by their exam grades. She said that she was influenced by the personality of that teacher and was still guided by her philosophy.

In addition to the role model high school math tutor, the teaching of another “ineffective” high school physics teacher also helped to shape her teaching philosophy. She said that this teacher used to care about only those students who used to have higher grades in the exams, but was unwilling to help her even when she approached him for help. The teacher’s attitude had a negative impact on her learning, and she eventually had to drop the course. She then developed a belief that teachers should treat their students equally.

*Other Instructors.* She believed that instructors can learn from other instructors. She admitted that she had some flaws in her teaching, because she was just a beginning instructor. In order to improve her teaching, she would like to seek other instructors’ help whenever she needs.

*TA Preparation Course.* Jennifer believed that she learned about better ways of dealing with American students from the instructor of the TA preparation course (MATH 5902). She said that the instructors in her home country were not allowed to deal with student issues; they used to have a separate department for dealing with student issues, such as giving make up exams.

*Students.* She said that she learned to adjust her teaching after she actually started to teach American students. In particular, she said that the student evaluations of her teaching had been useful, as they had helped her to identify her weaknesses and to improve for the next semester. Even though she had taught for five years in her home country, she said that she did not learn much because there used to be no student evaluations. She further described that the students in her home country did not complain or provide their teachers with feedback, even if they did not understand anything. She said that she would like to get students’ feedback about her teaching.

*Teaching Culture.* Jennifer said that she had some difficulties in teaching American students because of the differences in teaching cultures between her home country and the United States. She used to teach in the way she had been taught, but her American students had difficulties



understanding. She then had to learn how American students learn and how they are taught, and adjust her teaching accordingly.

*Teaching Experience.* She said that she learned a lot of things from her classroom teaching experience, which she thought she would not have learned if she had not taught.

*Textbooks.* She said that she had to adjust to how the American textbooks presented material. She found that they had more application problems, but the textbooks in her home country focused more on theories and problem-solving methods. She realized that she needs to study American textbooks in order to better understand how materials are presented or explained in them.

#### **4.4.5 Interview II**

The second interview was conducted during the fall 2013 semester. She was conducting two recitation sections of precalculus during that semester, and two sections of business calculus during the spring 2013 semester. Unlike other three research participants, she had not taught independently as an instructor of record.

The following themes were identified from coding: explanation, learning environment, making students think, out-of-class support, passion, preparation, students, and technology.

#### **Explanation**

Jennifer believed that the mathematics instructors should explain mathematical concepts clearly. She recalled the teaching of an undergraduate professor and said that he used to explain things very clearly. He used to bring some examples from outside the textbook in order to explain and help students understand the concepts.

#### **Learning Environment**

As in her previous teaching philosophies, Jennifer believed that creating a good learning environment is important for student learning. The following are the ways in which she thought she can create such an environment.

*Collaborative learning.* She said that she was employing collaborative learning strategies in the class she was teaching during the fall 2013 semester. Even though it was her course coordinator's idea, she believed that it was good for her students because they can learn from each other. While she acknowledged that group learning is beneficial, she did not like some aspects of group learning. She said: "Some students just sit there and do nothing, just let other students write the answer. They just wait. If other students have answers, they just copy. They do nothing." She also said that group learning is time-consuming.

When asked what aspect of American teaching she would like to take home, she said that she would like to take the idea of collaborative learning.

*Equal treatment of students.* She still believed that instructors should treat their students equally. She repeated again that instructors should not judge their students exclusively by their exam grades, but should provide support to everyone.

*Interactive classroom.* She said that her classroom is usually quiet, and that she would like to encourage students to interact with her. She admitted that she was having difficulty in involving the students and having them answer her questions. Her course coordinator observed her classroom and advised her to walk around the classroom and interact with the students when they are solving problems.

She said that there used to be very little teacher-student classroom interaction in her home country. But after observing the classes taught by other professors and having some classroom teaching experience, she believed that classroom interactions are beneficial to student learning.

She said that other students can also benefit from the questions asked by their peers. Therefore she encourages her students to interact and ask questions while teaching.

*Patience.* As she had described in her previous teaching philosophies, she said that instructors should be patient.

She also expressed the need to create a comfortable learning environment in her teaching philosophy at the interview I stage. During interview II, she repeated that treating students equally and being patient would contribute to such a learning environment. She added that employing collaborative learning and promoting an interactive classroom environment would further create a favorable learning environment.

### **Making Students Think**

Jennifer said that she would like her students to think and learn how to solve mathematical problems. In order to do so, she said that she does not provide her students answers to the mathematical problems. She said: “I want students to think more about some problems. ... Actually we have many different ways to solve them. I just want them to think more about the problem.”

She said that the students in her home country learn many different ways to solve mathematical problems. If they know that there are more than just one method of solving problems, she implied that the students are encouraged to think and solve problems on their own.

Making students think was an added belief in her teaching philosophy, which she said that she learned from the course coordinator.

### **Out-of-Class Support**

As she described in her teaching philosophy from previous stages, she said that instructors should provide students with out-of-class support when they need it. She said that she had some designated office hours to help students but her students did not come.

### **Passion for Teaching**

She added a new belief in her teaching philosophy, that instructors should have a passion for teaching in order to develop.

### **Preparation**

As she described in her teaching philosophy at the stage of TPS III and Interview I, Jennifer said that instructors should be well-prepared before teaching in the classroom. She added in Interview II that knowing the mathematical content they are going to teach is not enough, and they should also be prepared to explain mathematical concepts so that the students can understand.

### **Students**

Jennifer said that the instructors should adjust their teaching styles based on the students' questions, their responses, and their feedback. She also described that students should also work hard to learn mathematics. She said that the students in her home country work a lot harder than American students, and therefore, they are more successful. She realized that the teachers in the US assign a lot less homework to the students than their counterparts in her home country.

### **Teaching My Way**

She repeated again that she wants to teach an independent section instead of the recitation section so that she can teach the way she wants. She said that teaching recitation sections limits her ability to do things on her own because she had to follow the course coordinator's policies and

instructions. Although she said that she wanted to teach an independent section and teach the way she wanted, she was not specific as to what things she wanted to in her own style.

### **Technology**

After observing her class, Jennifer's course coordinator advised her to use a graphing calculator and other available technology in the classroom. However, Jennifer said that she mostly writes on the chalkboard instead of using ELMO and the projector.

#### **4.4.5.a Summary**

Except for a few changes, Jennifer's teaching philosophy at the stage of Interview II was similar to her philosophy from the Interview I stage. She repeated again that creating a favorable learning environment is key to a teacher's success, and that being patient and treating students equally could help her accomplish this goal. During Interview II, she also added that employing collaborative learning and promoting an interactive classroom environment would also help in this regard.

She also added that instructors should be able to explain mathematical concepts clearly, and should teach students that any mathematical problem can be solved many different ways. She also added that instructors should make their students think about mathematical ideas, instead of just providing answers to the students' questions and the mathematical problems.

As she described in her teaching philosophy from the Interview I stage, Jennifer believed that instructors should have a good preparation of the mathematical content they are going to teach. In Interview II, she added that just knowing the mathematical content is not enough; instructors should also be prepared to explain those concepts clearly.

She said that instructors should have a passion for teaching in order to succeed. She also realized that student learning depends not only on the instructors but on students' own willingness to work

hard and learn. She said that students did not come to seek her help during her designated office hours. She perceived that the students in her home country learn mathematics better because they work much harder than most American students. She therefore expressed the need to assign more homework problems, in order to engage her American students outside the classroom.

She said that her course coordinator advised her to use available technology in order to enhance student understanding. Without elaborating further, Rebecca said that she found the use of ELMO and the projector was not as effective as using chalkboards.

The changes in Jennifer's teaching philosophy were mostly influenced by the course coordinator during the fall 2013 semester. Jennifer was also influenced by the teaching of an undergraduate mathematics professor who used to explain things very clearly. She also implied that students should be taught how mathematics can be applied to other fields. She said that she liked American textbooks better than those of her home country, because they focus more on application problems instead of procedures to solve problems.

She was also influenced by her teaching experience, especially by the students she taught. She said that students' responses and feedback can help instructors to improve their teaching. She also realized that the success or failure of the students depends on how much effort they put into their learning.

Jennifer perceived that her inadequate English language proficiency has been limiting her ability to become a successful teacher. Unlike other MGTA participants, however, she said that devoting time to her own graduate coursework has not posed a significant challenge in her teaching.

#### **4.4.5.b Factors**

A number of factors were found to influence her teaching philosophy, which are described below.

*English proficiency.* She said that her lack of English proficiency was still a problem, and that she believed that she would have been a much better instructor if she was more proficient in English. She said that non-native speakers like her should improve their language proficiency in order to succeed as instructors in the US.

*Experienced as a student.* In addition to the high school math tutor that she had described in Interview I and her pre-service TPSs, she was also impressed by an undergraduate math professor who used to explain mathematical concepts very clearly. She said that he was very patient, and used to provide detailed explanations even if she asked him questions on some prerequisite material or other simple mathematical concepts.

*Other instructors.* Jennifer said that her course coordinator observed her class and provided feedback. She advised her to employ collaborative learning, and walk around the classroom when students are solving problems. She also advised her to incorporate technology instead of doing everything on the chalkboard. Jennifer had expressed that seeking feedback from other fellow and experienced instructors is beneficial for beginning instructors during interview I. But in interview II, she spoke mostly about her course coordinator.

She said that she used to worry that she might make mistakes in class. But she learned from her fellow MGTAs that she should not worry too much about making mistakes, as she should correct her errors later on.

*Students.* She said that she learned to adjust her teaching style based on the students' questions, responses, and feedback. She said that sometimes she becomes upset because her students do not show willingness to interact with her and learn. She found that they did not respond to her questions in class, even if they know the answers.

In her teaching philosophy at the stage of interview II, she added that the students should also work hard in order to succeed. She believed that the students in her home country work harder than American students, and therefore are more likely to succeed.

*Teaching experience.* She believed that beginning instructors can learn from their own teaching experience. She said that she learned to adjust her teaching based on her teaching from the spring 2013 semester, and the fall 2013 semester during which the interview II was conducted.

#### **4.4.6 Interview III**

The third interview with Jennifer was conducted during the early spring 2014 semester. She was teaching two sections of business calculus course during the semester. The following themes were detected from coding: experience, explanation, learning environment, making students think, preparation, teaching my way, and technology. No changes were detected in her belief about being more experienced in teaching, and her belief that she could develop as a better teacher if she can teach the way she wants. So these themes will not be discussed below.

#### **Explanation**

Jennifer repeated her earlier statement from Interviews I and II that instructors should be able to explain mathematical concepts clearly. She believed that the instructors should teach multiple ways to solve mathematical problems, although she had learned that when she was in her home country.

She found that American textbooks discuss more applicable problems, but the books in her home country discuss more techniques and tricks for solving mathematical problems. She said that she would show some of those techniques to solve problems in her future teaching.

#### **Learning Environment**



Jennifer believed that instructors should create a comfortable learning environment. As she described in TPS II, she said that instructors should also smile at their students. From her students' feedback, she believed that smiling at them will help them feel comfortable to approach their instructor and ask questions.

*Application of mathematics.* She believed that the instructors should motivate students to learn, and said that they should show the application of mathematical concepts to other fields. She liked her role model high school math teacher because she used to bring a lot of examples of application problems. When asked what she would like to change in her future teaching, she said that she would like to bring more applicable problems to the class. She used the word "motivation" for the first time in Interview III, even though she had already discussed about application of mathematics in other fields in her TPSs from the pre-service phase.

*Caring.* She said that instructors should not judge students exclusively by their grades, which she thought would discourage them. She believed that instructors should care about all of their students and encourage them to learn, because they might have other skills even if they are not good at learning mathematics.

*Collaborative learning.* She said that she employs collaborative learning, an idea she learned from her course coordinator. She repeated that she liked the idea of employing collaborative learning because students can learn from group discussion. She also said that she could answer students' questions when they are engaged in group discussion. She also said that her students perceived that collaborative learning was effective. She had also said during interview II that she like the idea of letting students work in groups. She said that her earlier belief had been reinforced and that she would employ more collaborative learning in the future, because she believed that it contributed to a successful learning environment.

*Creating positive feeling for mathematics.* Jennifer added a new belief that instructors should create a positive feeling for mathematics, because most students believe that mathematics is a tedious and a boring subject. She said that instructors should make students' mathematics learning experience more interesting. She did not lay out any specific plan as to how the instructors can create a positive feeling for mathematics.

*Engaging students.* She believed that students learn better if they are engaged in the classroom. She said that she asked her students more questions in her second semester than the first semester. She said that she would like to involve and engage her students in the problem-solving process in the classroom.

*Interactive classroom.* She said that instructors should interact with the students, and seek their feedback on their teaching.

*Patience.* She believed that instructors should be kind and patient, but did not elaborate further. She said that her earlier belief of being patient and kind to the students had been reinforced.

### **Making Students Think**

She believed that instructors should push students to think on their own instead of just providing them answers. Asking questions, such as "What will happen if...?", will promote student thinking.

### **Preparation**

Jennifer repeated again that instructors should prepare for teaching very carefully. She said that they should have the knowledge of the mathematical content they will be teaching, and also how mathematics is applied to other fields. She added that beginning instructors should observe classes taught by experienced instructors, and study the textbooks before going in for classroom teaching.

## **Technology**

She repeated again that she had started to use the chalkboard instead of using ELMO and projector because she thought the chalkboard made it easier to explain the solutions step by step. She also found that some students cannot even see clearly on the projector in a big classroom.

### **4.4.6.a Summary of Changes**

Jennifer's teaching philosophy at the stage of interview III was essentially the same as compared to her teaching philosophy at the interview II stage except for a few minor changes. She added that showing how mathematics can be applied to other fields helps to motivate students to learn mathematics. She also added that engaging students in the classroom would further contribute to creating a good learning environment. She did not elaborate on how she would engage her students though.

As in interview II, she said that she wants to make her students think about the mathematical ideas instead of just giving them answers to their questions or mathematical problems. But she added that she would ask students questions such as "What happens when?" to encourage them to think.

Even though she had acknowledge the importance of preparing for a class, she said this time that she needed to prepare "carefully". But she did not elaborate what she meant by careful preparation. She justified her idea of not using the chalkboard by saying that the chalkboard would be more helpful to explain the solutions to mathematical problems step by step as compared to using the ELMO. She implied that the chalkboard would give her more flexibility than using the ELMO.

Some interesting observations were made from this interview. Jennifer did not know what professional development of an instructor meant even though she said that she had taught for five

years in her home country. She said that she would not need any additional support from the mathematics department in order to grow and develop as a teacher. When asked what help she would like to have from the department in her teaching, she said: "I think they do this very well. I think that's enough for me." She implied that she did not see any significant scope of professional development opportunities, and that she can learn mostly by her own teaching experience.

She claimed that her teaching philosophy from the earlier stages had not changed even though coding had detected some changes. She said that employing collaborative learning was an added belief in her teaching philosophy, which she said is beneficial to student learning. However, she said that it was nothing more than an adjustment of her teaching in the American context. She said that her teaching experience in the US had not really changed her teaching philosophy.

She said that a teacher should be friendly and should also have informal discussions with the students. She said that she does not like the teachers who talk only about the subject they are teaching. She also added that she would like to teach upper division mathematics courses instead of teaching lower division courses.

Jennifer's teaching philosophy did not change much during the pre-service and in-service phases. She was a shy and introverted person who had difficulty understanding and responding to the researcher's questions during the interviews, because English was not her first language. The researcher perceived that she seemed to be somewhat afraid to express her opinions during the interview.

Jennifer's teaching philosophy during the pre-service phase remained essentially the same. In her TPS I, she believed that an essential characteristic of mathematics instructors is to have knowledge of mathematical content. In addition to having required content knowledge, she wrote that they should also create a learning environment, and provide students out-of-class support whenever they need. She did not change any of these beliefs throughout the pre-service and in-

service phases. However, later during the in-service phase, she realized that having content knowledge alone was not sufficient. She said that they should also know how to explain mathematical concepts clearly to the students, and be prepared to explain things in many different ways.

Throughout the pre-service and in-service phases, the biggest aspect of her teaching philosophy was to create a favorable learning environment for students. In TPS I, she wrote that she would like to do so by motivating students, showing them how mathematics can be applied to other fields, treating students equally, and being caring, compassionate, friendly, and patient. In TPS II, she added that instructors should also smile at their students in order to help them feel comfortable asking questions and learning from the instructor. In TPS III, she added that instructors should also make eye contact with students. Later during the interviews, she said that the instructor of the MATH 5902 course had advised her to do so. In Interview I, she said that using humor could also contribute to creating a comfortable environment for students. She also added in Interview II that creating a positive feeling for mathematics, employing group learning strategies, and engaging students in the class further contributes to a successful learning environment.

Another aspect of her teaching philosophy that she added in TPS III, and kept throughout the three interviews, was preparation. Based on her teaching presentation during the pre-service phase, she realized that she needed to be well-prepared to teach before going into the classroom. Later during the in-service phase, she said that she needed to study the textbooks, and learn various ways to explain mathematical concepts in order to be prepared for the class.

She developed a new belief at the stage of Interview I that she would learn more about teaching and learning as she became a more experienced instructor. She said that she would have opportunities to interact with the students, and learn from their feedback on her teaching

evaluations. She kept this belief at the stages of Interviews II and III as well. Later, during Interview II, she said that student learning depends also on students, and teachers alone cannot do everything for student learning. She believed that the students in her home country are better in mathematical skills than their counterparts in the US, because they work much harder. However, she said that the American students were also good in mathematics, unlike what she had heard before she had started to teach.

At the stage of interview I, she developed a belief that she would grow and develop as a better teacher if given the opportunity to teach independent sections instead of just conducting recitation sections. Also, she said that she would like to teach her way and learn from that experience, but she had to follow the instructions and the policies of the course coordinator and was not allowed to do things on her own.

At the stage of Interview II, she added that the instructors should make students think instead of just providing them answers. She believed that they should encourage students to figure out their own solutions because there are different ways to solve the same problem. She added therefore, in interview III that they should teach multiple ways to solve problems.

In interview II, she added another belief that a person should have a passion for teaching in order to succeed as a teacher. She also added that using technology is also helpful to enhance student understanding. There were almost no other changes detected in her teaching philosophy at the stage of interview III. She only seemed to have reinforced her beliefs from her teaching philosophies from earlier stages.

Jennifer's experience as a student had the biggest influence in her beginning teaching philosophy at the stage of TPS I. She was mostly influenced by a high school math tutor, and also by the teaching of an "ineffective" physics teacher. During the stages of TPS II and III, other influences included her observation of her faculty mentor's classes, and the instructor of the SPTCM class.

As she entered the in-service phase, the biggest influencing factors were her own teaching experience, and other instructors, especially her course coordinator. Other influential factors detected in the interview data included English proficiency, differences in teaching culture, undergraduate students and their teaching evaluations, American textbooks, and the TA preparation course (SPTCM). Even though it was detected from coding that her own teaching experience had some influence in her teaching, she did not admit that her teaching philosophy actually had changed based on her teaching experience in the US. However, she said that her future teaching philosophy might change based what she learned from her future teaching experience.

#### **4.4.6.b Factors**

*Class observation.* When asked how a beginning instructor can grow as a better teacher, she said that observing other instructors' classes would be helpful.

*Experience as a student.* She said that her teaching philosophy was largely influenced by the teaching she experienced as a student. She said that she was mostly influenced by her role model high school math tutor. She said that she was also impressed by the teaching of a mathematics professor in her current graduate program. She said that the professor was very responsible as a teacher, because he made her feel comfortable whenever she had questions, and helped her whenever she needed it, including during office hours.

*Language and culture.* Jennifer reinforced her earlier belief that proficiency in English is essential to succeed as an instructor in the US. She said that she was having difficulty in explaining things clearly because her English proficiency was weak. When asked what advice she would give to beginning mathematics GTAs, she said: "Well, if he is American, I think I have no advice to him but if he is from another country, well, the first thing is the language." She realized that she needed to learn some mathematical terminology in English.

She perceived that cultural differences were also causing her some trouble in her attempt to become a successful instructor. She said that her students did not like to interact with her. She thought that students' unwillingness to interact with her might have been caused by cultural differences. She had also described in her Interview II that students did not come for help during her office hours.

*Other instructors.* When asked what she thinks the best way to learn and grow as a teacher, she said that the best thing would be to observe experienced instructors' classes. She said that observing online videos of classes taught by other instructors, and discussing with other fellow graduate teaching assistants would also be helpful.

She said that she also learned a lot of things from the instructor of the SPTCM course, especially about dealing with student issues. She also learned from the feedback the instructor gave her when she taught a demonstration class that she should make eye contact with the students.

*Students.* She said that instructors should interact with students and seek their feedback to improve their teaching. When asked how she identifies her weaknesses, she mentioned her teaching evaluations and her students' responses to her classroom teaching.

She said that she had to learn alternative ways to explain mathematical concepts because her students did not understand those concepts when she taught them using methods she had learned in her home country. She realized that she needs to learn the methods that the students in the US are familiar with.

*Teaching experience.* She believed that she will learn more as she gains more teaching experience. She said that her teaching philosophy might change with the increase in experience.

#### **4.5 Chapter IV Summary**



This chapter provided the detailed descriptions of the participants' teaching philosophies at various stages of their pre-service and the in-service phases. Themes resulted in from coding the data, and the factors that were detected to influence their teaching philosophies were presented in alphabetical order. After the descriptions of their teaching philosophies at each of the six stages, each subsection was followed by a summary of their teaching philosophies at those stages.

## CHAPTER V

### SUMMARY AND DISCUSSION

The purpose of this study relates to exploring and describing with four purposefully selected mathematics graduate teaching assistants (MGTAs) their beginning and changing philosophies of teaching during their pre-service and in-service phases as mathematics instructors. It also relates to describing the factors that affect their philosophies of teaching during the transition period when external forces are decreasing but acquisition of teacher autonomy is increasing. This chapter will present the summary of the results presented in the results section and the related discussions.

The four mathematics graduate teaching assistants (MGTAs) expressed varying opinions about teaching and learning in both pre-service and in-service phases. In addition, their teaching philosophies evolved differently over time during the pre-service and in-service phases. People's experiences and opinions vary by nature, even while going through similar experiences. This is a case study, and because of the subjective nature of participants' opinions, it would not be appropriate to generalize and draw conclusions about what novice college mathematics instructors believe. Indeed, the purpose of this study was not to generalize about what they think or believe, and how their philosophies change over time. However, some of the themes found in the participants' TPSs were shared either by all four of them, or a specific sub-group of them, such as international MGTAs or women.

Presented below are the summary and discussions of results obtained from analyzing the data from the pre-service and the in-service phases, and the factors that influenced the participants in both phases. Also presented are a discussion of MGTAs' about teaching and learning mathematics from cognitive apprenticeship perspective, recommendations for future MGTA preparation programs, and possibilities for future research.

### **5.1 Pre-service Phase.**

The first part of the research question 1 was: What are the teaching philosophies of beginning MGTAs? The data relevant to this research question was the participants' first teaching philosophy statements (TPS I), which were collected at the beginning of the pre-service preparation program. As found in studies involving pre-service and beginning teachers (Stuart & Thurlow, 2000), these MGTAs had also simplistic views of teaching, and they did not seem to realize what it takes to be an effective teacher. For example, summarizing his TPS I, David said: "One can be an effective or a successful teacher if he/she prepares well on the subject matter before going into class, develops positive attitudes, high expectations, and fairness in his/her teaching." The gist of Andrew's TPS I was to have high expectation for students and employ a tough-love attitude. Similarly, the summary of Jennifer's TPS I was: "An effective teacher is a good friend of you, helping you to surmount difficulties and sharing the joy of success with you." Rebecca's TPS I was more detailed than those of other participants, but she too wrote very little that was specific to mathematics teaching.

The beginning teaching philosophies of the participants had a few elements in common, such as giving importance to conceptual understanding and creating a good learning environment. Even though not all participants expressed it explicitly, they all implied that the foremost goal of mathematics instructors was to help students understand mathematical concepts. This belief did not change during the in-service phase.

All four participants wrote in TPS I that creating an effective learning environment is essential, although they had varying opinions about what constitutes an effective learning environment. Andrew, Rebecca, and Jennifer believed that they can motivate students to learn mathematics by showing how the concepts they learned in class can be applied to other fields. David also expressed this belief later, during the in-service phase. The domestic students, Andrew and Rebecca, wrote that instructors should engage and involve students in the learning and problem solving processes. An interesting element found from the analysis was that both international students wrote that treating students equally would help to create the desired learning environment. Rebecca was the only MGTA who believed that employing student-centered instruction would also enhance the learning environment.

Three participants (David, Andrew, Rebecca) wrote that teachers should have high expectations for students. Based on the teaching they experienced as students, they believed that they were pushed to work harder and succeed in their courses because their professors assigned challenging problems in assignments and exams. For example, David wrote that his professor “always had high expectations in our progress, which definitely helped us to work hard and try to learn any concept more and in detail.” Similarly, Andrew and Rebecca wrote that they learned a lot from instructors who had high expectations. Andrew wrote that his role model professor used to employ a tough-love attitude in order to force students to work harder, and that he would like to emulate this professor in many aspects.

Only two participants, David and Andrew, wrote about the importance of being prepared before going into the classroom. But David only emphasized content preparation, while Andrew underscored the importance of developing lesson plans, and creating challenging homework and exams. However, he also wrote that considering his other obligations as a graduate student, he might not even be able to do so due to time constraints. Jennifer also wrote that the instructors

should have enough knowledge of mathematical content but none of the domestic students wrote anything about it.

All the participants except David wrote that providing out-of-class support was an essential supplement to classroom teaching. Later during the in-service phase, David also stated that providing such support is important.

An interesting element detected from TPS I data was that Andrew, one of the two domestic participants, wrote that instructors should learn to cope with the institutional culture. He said that universities and mathematics departments expect more than just teaching from instructors. As a result, instructors should maintain a balance between the instructional and other duties. He wrote that he developed this belief based on the experience of his role model undergraduate professor, who quit his job despite being an excellent professor, as he was unable to adjust to the institutional culture. Even though first year teachers often have difficulties adjusting to a school's culture (Schuck, Aubusson, Buchanan, & Russel, 2012), it was interesting to see any pre-service instructor expressing such opinions.

Many aspects of participants' first teaching philosophy statements were mostly motivated by their experience as students. Along the line of the assumptions made by the researcher prior to conducting this study, and also evident from existing research with pre-service K-12 teachers (Stuart & Thurlow, 2000), they brought to the preparation program perspectives about teaching and learning heavily influenced by their past experiences as students. They discussed the teaching of their role model teachers or the teaching of some other teachers who, according to them, were "ineffective". Such "apprenticeship of observation" is very common in the stories of the pre-service or first year teachers (Schuck, Aubusson, Buchanan, & Russell, 2012). Similar to the researcher's assumptions prior to conducting this study, these MGTAs mostly described the teaching behaviors of their past teachers instead of writing their own opinions, beliefs, and plans.

Although some aspects of these beginning MGTAs' teaching philosophies mirrored existing research about the beliefs of pre-service teachers, some of the themes were not at all common in the existing literature. The elements that were not common were their belief in having high expectations for students, the international MGTAs' belief in equal treatment of students, and Andrew's belief in the importance of "coping with" institutional culture.

In summary, they expressed simple views about teaching and learning mathematics. Unlike the researcher's assumption that they could imitate existing models of teaching philosophy statements, the MGTAs did not seem to have incorporated ideas from outside sources.

The second part of research question 1 was: How do their philosophies evolve during the pre-service phase? Data analysis showed that the philosophies of these participants changed very little during this period, from TPS I to TPS III. During the period between the TPS I and TPS II stages, the participants had started to observe their faculty mentors' classes, kept a log of their practicum experiences such as noting any questions or concerns that surfaced during their observations. These questions were discussed with other MGTA peers and instructor of the SPTCM course during the weekly seminar sessions. At the point of TPS II, they generally made only minor revisions and added a few more beliefs to what they had described in TPS I. Jennifer, for example, added only that instructors should smile at students to make them feel comfortable. Rebecca added that being prepared to teach is very important, a change that she attributed to the observation of her mentor's classes. David wrote that instructors should also prepare teaching materials and "effective teaching techniques," in addition to preparing mathematical content they are going to teach. Both of them added that the instructors should be well-organized in addition to being prepared to what they are going to present in the class. But these changes were all relatively minor, with all participants' major beliefs remaining unchanged. In fact, all four participants' belief in creating a comfortable learning environment had actually been strengthened during this period.

David and Andrew added that active classroom interaction will further contribute to creating a good learning environment. They also wrote that instructors should have a positive attitude.

David added that the instructors should be caring, but at the same time, he wrote that they should also maintain the role of an authority figure. He also wrote that teachers should be able to explain mathematical concepts clearly to the students.

The participants gave teaching presentations during the period between the stage of TPS II and TPS III, in addition to observing the classes of their faculty mentors and participating in the weekly seminar meetings. At the point of TPS III, near the end of the pre-service phase, all the participants except Andrew developed or reinforced their belief that they should be well-prepared before going to teach a math class. David realized that he should have even more preparation than he used to think. Jennifer wrote, for the first time, that she should be well-prepared to teach a class. She attributed this change to her teaching presentation experience.

Both male participants, David and Andrew, believed that they will grow as effective teachers as they gather more teaching experience. David cited his teaching presentation experience to conclude that he needs more preparation before entering a classroom. He also realized that people should have a passion for teaching if they want to succeed in the profession. Andrew added that he would reflect on his own teaching and try to improve for next time. He also added that instructors should share their passion for mathematics if they want to motivate their students and create an effective learning environment. He also wrote that he would encourage his students to seek out-of-class support during his office hours, but his earlier beliefs, including the importance of a tough-love attitude, did not seem to change.

David realized that instructors, especially non-native English speakers, should be proficient in English language skills, and should also have a strong understanding of American culture. However, Jennifer, who seemed to be much less proficient in English than David, did not

perceive any difficulties relating to her lack of proficiency. One added belief for her in TPS III was that instructors should make eye contact with students. Rebecca did not add any new beliefs in her TPS III.

In summary, changes were detected in the teaching philosophy statements of these four participants during the pre-service preparation program but the pre-service preparation program course SPTCM had little impact on their teaching statements. For example, Jennifer only added in TPS II and TPS III that she needed to make eye contact and smile at students to make them feel comfortable. Her situation was unique in that she was a pre-service teacher in the US, but she already had five years of college teaching experience in her home country. She attributed her philosophical changes to her observation of undergraduate classes taught by her faculty mentor during the pre-service preparation program. There are few interesting observations worth noting here. First, if she had five years of college teaching experience in her home country, why was this really the first time that she realized the need to make eye contact with her students and smile at them? Second, if it was, is that all she learned from a semester long seminar and practicum experience in the SPTCM course? She realized in TPS III that she needed to be a little more prepared, which she attributed to her teaching presentation experience in the SPTCM course. But she could have already realized the need to be prepared from her five years of teaching experience. It is possible that she might just be adding something to her philosophy as required by the prompts (see Appendix A) for revising her teaching philosophy statements.

Rebecca's case was also interesting. Although her TPS I was more detailed than those of other participants, the only changes detected in her TPS II were her realization of the need to be prepared and organized, which she attributed to her class observation. There were no additional changes detected in TPS III. It was interesting to see that no other activities, such as reading assignments, seminar discussions, and her teaching demonstration experience were detected to influence her teaching philosophy at the later stage of the pre-service phase.



## **5.2 In-service Phase.**

This is the phase when the MGTAs were assigned to teach undergraduate mathematics courses either as instructors with full responsibilities or as recitation leaders after the conclusion of their pre-service preparation program. Three one-on-one interviews were conducted with the participants during this in-service phase, one during the summer 2013 semester, another during the fall 2013 semester, and the last during the spring 2014 semester.

Many common themes were detected in the teaching philosophies of all four participants as the MGTAs entered into the in-service phase and started to teach. All the participants considered creating an effective learning environment, being prepared, and providing out-of-class support as fundamental components of their teaching philosophies.

All four participants felt strongly that they would develop as better teachers as they gain more teaching experience. They said that the best way to learn about teaching is to experience teaching as a real classroom instructor. When asked to express their opinions on the importance of professional development activities and opportunities in their future teaching, they said that professional development activities may have little impact on their development as instructors. Even though they said that they learned many things from the pre-service preparation course (SPTCM), they said that the course mostly contributed to alleviating their anxiety and increasing their confidence as beginning teachers. Previous research has also shown similar findings with participants in pre-service preparation programs (Belnap, 2005; Harris, Froman, & Surles, 2009). The participants in this study appreciated that they did not have to teach during the first semester, which gave them some time to adjust to a new environment. They expressed that they felt a lot more comfortable knowing that they were not alone when problems arose. They all said that the math department did a good job in helping them during the first semester, but interestingly, they all felt that they would not need any further support. This is not consistent with many of the

teaching assistants' perception that the preparation program did not adequately prepare them for classroom teaching (Moore, 1991). It is, however, consistent with previous findings that MGTAs do not see the importance of pre-service preparation programs and any other professional development programs because they believe that the only way to learn about teaching is by experience (Chae, Lim, & Fisher, 2009; Harris, Froman, & Surles, 2009).

These participants seemed to have given the SPTCM course not as much importance as the mathematics department expected, and they might have considered this course just as an additional burden to their situation. They might have enrolled merely because it was mandatory for all MGTAs. Many MGTAs chose not to enroll in similar preparation courses, in institutions where the course was not mandatory (Harris, Froman, & Surles, 2009).

Graduate teaching assistants are in a unique situation where their primary responsibility is their graduate coursework and research. Even though all the participants said that they were committed to their undergraduate students, and to planning ahead and being organized, they still seemed to view their own graduate work as their primary responsibility. Therefore, these participants may have considered teaching as a secondary responsibility. Moreover, they might consider learning about teaching, and participating in professional development activities as a distant second priority. However, participants had somewhat varying opinions about the value of professional development activities. For example, Rebecca believed that one would need to take advantage of professional development opportunities that are specific to mathematics teaching, although she did not have any idea what kind of opportunities she would benefit most from. But when Andrew was asked what he thought about opportunities for professional development and its importance in enhancing classroom instruction during Interview III, he said that he was not so sure about how important the professional development activities would be. Without being asked, he said that mathematics education might just be doing nothing more than "pampering students". He said that some concepts are difficult to learn because they are difficult but students should work hard.

All four MGTAs said that they learned many things about teaching from the SPTCM course such as showing caring attitude and dealing with students. It was also evident from the data that some new beliefs were added in their teaching philosophies that the MGTAs attributed to the SPTCM course. But they said that their initial teaching philosophies had not changed essentially. As described in the assumptions of this study, and also evident from existing research (Golombek, 1998), the beliefs of beginning teachers are deeply ingrained, and they are resistant to change. It is also possible that many MGTAs might have not been consciously aware of how their pre-service preparation programs affected them (Belnap, 2005).

The participants said that they changed some of their perspectives in teaching because of their teaching experience during the in-service phase, especially because of the students they taught. Jennifer said that the students are the best source to learn from. She said that teaching evaluations would help her to adjust and improve her teaching for the future. They all developed a belief that teachers' effort alone are insufficient, and the students should also put effort into their learning. For example, Andrew said in TPS III that students should "bust their butt" in order to succeed, and that that he would require them to work hard. This belief was then reinforced during the in-service phase, when he said that students' learning is mostly up to them. He said at that time that he used to feel unsatisfied when his students underachieved on tests and other assignments, but that he does not care as much anymore. He developed a belief that the failure of the students is their own problem if they do not work hard, but said that he was doing his job as much as he could. He found students succeeded if they attended his classes, worked hard, and had a positive attitude toward learning. David also developed a similar strong feeling about the importance of student effort. During Interview III, he said:

I used to think like everything needs to be done by the teacher not by the students. Now I feel like there's equal responsibility of both students and teacher when you are learning because I'm teaching now. Before I was just a student. Hey, you must teach me all. I'm not going to get it. Right? I just come to listen to you. You must be the main role. The teacher must be the main role. That's what I used to think. But now, I became a teacher

myself I feel like, okay, there are some things that students need to do also. Being myself I can't do everything perfect.

During the in-service phase, one significant change detected in the teaching philosophies of David, Andrew, and Rebecca was that they realized the importance of developing the role of an authority figure. Otherwise, they believed that students would treat them as their peers because of the small age difference between them and their students. Andrew and David said that some of their students tended to make noise and disrupt the classroom environment. Andrew employed a strategy of becoming even tougher and sterner with students to discourage them, while David decided to keep a professional space with the students. Rebecca also found that students were likely to take advantage of her friendly behavior, and she learned to “stay her ground”. Previous research had also found similar perceptions of some of the MGTAs. A female participant in one study said that some of her students tried to socialize and even make unsolicited advances with her (Belnap, 2005).

All four participants said that they want to learn from their own experience and mistakes. Even though they would like to have someone to help whenever they need, they all said that they want to teach their way and become the kind of instructor they aspire to be. They did not seem to like teaching coordinated courses that involve moving at a similar pace across all sections, and following the instructions of the course coordinator.

As three of the participants became more experienced teachers during the in-service phase, they gradually reinforced their earlier belief that they need to be prepared for class. During the pre-service phase, Andrew had acknowledged the importance of being prepared for teaching. He admitted that preparation tasks such as developing challenging homework sets and exam problems are very time consuming, and that he might not be able to adequately complete these tasks because of time constraints. But during the in-service phase, he only focused on reviewing the content before going to teach. He said that he does not do lesson plans or any other

preparation. His belief was unique from other participants: he believed that all he needs to be able to teach is to know the relevant mathematical content, and be able to explain examples “on the fly”.

Later in the interviews during the in-service phase, one of the domestic participants, Rebecca, also said that she felt more comfortable teaching College Algebra than Calculus because she was more comfortable with the College Algebra materials. Andrew also said that he had to review the material before going to teach, even though he said that he does not do any kind of preparation. Interestingly, the international MGTAs realized in the in-service phase that they need to have more than just content preparation. The domestic MGTAs, Andrew and Rebecca, did not express anything regarding content preparation during the pre-service phase, but realized its importance during the in-service phase. They might have realized that need after having actual classroom teaching experiences.

By the time they reached the stage of Interview III, they all said that use of technology could enhance student understanding, and added that calculators and ELMO were the only technologies they had used. However, all the participants said that they had started to use the chalkboard more than ELMO because chalkboards make it easier to engage with students. Andrew and Rebecca said that they realized the importance of using technology but rarely had enough time to use it in the classroom, a finding that matched previous studies of beginning K-12 teachers (Schuck, Aubusson, Buchanan, & Russel, 2012). None of these participants had discussed the use of technology in any of their teaching philosophy statements from the pre-service phase.

There was some variation in participants’ beliefs about creating an effective learning environment. All the participants said, in some or all the interviews, that students can be motivated by showing applications of mathematical concepts to other fields. All the participants said that use of humor could contribute to a fun learning environment. Similarly, all the

participants mentioned in at least one interview that instructors should try to change students' mindset that 'math is hard' to create an effective learning environment. They believed that an engaging, active, and interactive classroom environment also contributes to a good learning environment. Andrew, David, and Rebecca believed that sharing instructors' passion for mathematics with the students would make a positive impact on how the students respond to them. Being caring, inspiring, and encouraging were other ways they all thought they could create a good learning environment.

An interesting element detected from the interview data was that all the participants developed a belief that employing collaborative learning is a good idea to engage students, provide them opportunities to learn from each other, and ask instructors questions. They said that they would like to create an active and interactive learning environment to engage students and involve them in the learning process. Jennifer and Rebecca said that their course coordinators encouraged them to employ collaborative learning in their classes, and supported their attempts to do so. Even though Rebecca had acknowledged the importance of student-centered instruction in her TPSs from the pre-service phase, she said in the interviews later during the in-service phase that she would not have been able to employ such instruction without the support of her course coordinator. Other researchers had also found that the participants from a multi-day workshop identified change in their teaching philosophies from teacher-centered to student-centered instruction (Schussler et al., 2011; White et al., 2012). The participants in the existing research attributed this change to the feedback from experienced faculty and their reading of educational theory (Schussler et al., 2011). Jennifer and Rebecca confirmed their learning from their course coordinators but none of the participants attributed their newfound appreciation for collaborative learning to any reading assignments, although the participants in this research had a lot of reading assignments during the pre-service phase.

Andrew said that his students complained all the time because they could not solve homework problems, and could not identify the mistakes they had made. He then decided to engage students by giving them in-class assignments so that he could answer their questions and correct their mistakes. David realized that some students hesitated to interrupt the lecture and ask questions during class. He then started to use in-class group assignments so that students could ask him questions, and also ask their group members.

Some participants in this study said that such interactive learning is more time consuming. This was consistent with the participants' opinion in an existing research that involved MGTAs (Belnap, 2005). Moreover, some participants in this study said that groups are often dependent mostly on their smartest group member. David, Rebecca and Jennifer said that their course coordinators encouraged and supported them to employ group learning.

As they became more experienced, they started to develop a belief that they should be able to clearly explain mathematical concepts to the students. All the participants expressed at some point during the interviews that instructors should be able to clearly explain mathematical concepts to the students. They said further that instructors should employ multiple teaching methods, and multiple ways to explain mathematical concepts to help students understand them.

Some of the beliefs were common to a particular group or category such as international MGTAs or women. For example, both international MGTAs held a belief through all the stages that instructors should treat students equally. During the in-service phase, both of them perceived that they would have been much better instructors if they were more proficient in English, and had a stronger understanding of American culture. Rebecca developed this belief during the in-service phase, but David carried over this belief from the pre-service phase. They stated that American students did not show willingness to interact with them both in and out of the classroom because of their cultural differences, and their self-perceived lack of adequate proficiency in English.

They said that very few students visited their offices during their designated office hours. Their perception was consistent with the findings from earlier research that American students show unwillingness to have international MGTAs as their mathematics teachers, and also to interact with them (McCroskey, 2002). These challenges of international MGTAs due to cultural differences were also identified by Chae, Lim, and Fisher (2009). Some other research on teaching assistants has also suggested that differences in communication styles and behaviors may have contributed to the negative interactions and misunderstandings with their students, and hence their perceived decreased teaching effectiveness (Liu, Sellnow, & Venette, 2006; McCroskey, 2003). Moreover, East Asian teachers have been perceived less positively than Latin American and European teachers by American students (McCroskey, 2003).

The development of this new belief in their teaching philosophies therefore, might be the cause of undergraduate students' unwillingness to interact with them (Damron, 2003). Although some attribute this problem to the lack of English language proficiency, it is evident from research that lack of English language proficiency may not be the only reason of international MGTAs' perceived less effective teaching (Tang & Sandell, 2000). For example, with high levels of sociocultural adaptation difficulty, Kim (2009) found a strong relationship between perceived English fluency and efficacy in classroom management. But the association between perceived English proficiency and efficacy in classroom management was not statistically significant with international teaching assistants' low levels of sociocultural adaptation difficulty (Kim, 2009).

The development of the belief about the importance of interacting with the students might not be the only cause of the cultural differences and their inadequate English language proficiency. Even the two domestic MGTAs in this study realized the need to interact with the students more frequently. These domestic MGTAs also said that their students rarely visited their office during designated office hours. It was not clearly evident what led them to develop the belief about the importance of interacting with students, but they might have learned this from their course



coordinators, the instructor of the SPTCM course, or from their own teaching experience. For example, Andrew wrote in TPS II that students were not very interactive in his first teaching presentation, but he put more effort into interacting with them in his second presentation. He might have had a more enjoyable experience teaching those students who were more interactive.

Both female participants, Rebecca and Jennifer, said that they were impressed with professors who used to have informal interaction with them and showed interest in their lives, even outside of the classroom and academia. They said that such behaviors of their instructors helped them to feel more comfortable, and to interact with them when they had any questions.

All participants but Jennifer expressed at all three stages of the in-service phase that having high expectations for students would force them to work harder, a belief that they carried over from the pre-service phase. Andrew even said that his philosophy was to employ a tough-love attitude to force them to realize their responsibility and to put effort into their education. Even though these participants expressed at all six stages that having high expectations was an important component of their teaching philosophies, some of them started to feel less strongly about this as they gained more teaching experience. For example, Rebecca said that she does not like to intimidate her students by giving very challenging problems at first. She said that she wants to first assign them a few easy and doable problems, and then slowly build up their confidence before having them solve more challenging problems. Andrew also seemed to have softened somewhat, as he underscored the need to become patient and show compassion for students' difficulties. However, he also said that he would become tougher with students who do not work but keep complaining about the level of effort needed to successfully learn mathematics. The participants developed the belief of having high expectation for students and employing a tough-love attitude from the impressions of their role model teachers from the past. It is reasonable to assume that MGTAs were some of the best students in mathematics when they were undergraduates, and they might have learned more when they were forced to work harder. With a

few exceptions, however, the undergraduate students they will be teaching will be mostly average, and maybe even less than average students. This may be attributed to their lack of understanding of undergraduate students' mathematical background and their ability to learn. These MGTAs might not have realized that these average and weaker students may give up if their instructors employ a tough-love attitude and have high expectations for them.

There were a few aspects of the data that are of interest in understanding beginning MGTAs' perspectives in teaching and learning mathematics. Jennifer had already taught for five years in her home country, but the other three MGTA participants were new instructors, and all these new instructors had 'high expectations' as an important component of their teaching philosophy. It would be interesting to know if most novice MGTAs have high expectations when they start teaching. Andrew had the strongest feeling for having high expectations and even employing tough-love attitude among these participants. He was home-schooled during the last three years of his high school education. He said that his father was a tough navy veteran who believed that people should work hard to fulfill their American dream. Moreover, he said that he liked his former professor who used to employ a tough-love attitude. He said that he developed a philosophy of "do as told" from his childhood and wanted to have similar expectation for his students. It would be interesting to learn any association between MGTAs being tough or kind and their home environment, their upbringing, and their schooling.

Vygotsky's sociocultural theory posits that learners construct their knowledge based on their surroundings, the interaction with other people, and the culture in which these interactions take place (Vygotsky, 1978). It is possible that MGTAs' home environments, their upbringing, or schooling in particular, shape the teaching philosophies of MGTAs. It would be interesting to know how Andrew's home schooling may have impacted his teaching philosophy. A more promising thought on why they developed this belief on having high expectations for students would be to assume that these MGTAs might have been able to learn more from the teachers who

had high expectations for them when they were undergraduate or high school students. In fact, the MGTA participants confirmed that they learned a lot from their role model professors. As a result, these MGTAs developed a belief to have higher expectation for their students. An implication of this finding would be to encourage beginning MGTAs not to have unreasonably high expectation for their students, and design some activities in the preparation programs so that they realize or learn that not all students can learn equally. This could mitigate MGTAs' frustrations when they enter classrooms with high expectations, which their students may not be able to live up to.

In one study of international teaching assistants, Chae, Lim, and Fisher (2009) found that the participants did not see the importance of reflecting on their teaching practices as long as the visible outcomes of their teaching, such as their students' average test scores, were reasonable. This was not the case in this study, as participants said that they wanted to learn from their teaching experience and the self-reflection of their own teaching. Although it was not clearly evident what factor led them to develop this belief, the importance of reflecting on one's own teaching practices was discussed during the SPTCM course. They were also required to maintain a log of their classroom observations, surface questions they had, and write a reflection on their teaching presentation and read that in front of their peers. They also emphasized that they do not give the students' course grades as much importance; but their primary concern was to make sure that their students had understood the mathematical concepts.

Both international MGTAs carried over a philosophy of treating students equally from the pre-service phase. They had developed this belief from the teaching they had experienced as a student back home. Jennifer said that unequal treatment from one of her high school teachers had a negative impact on her learning. Neither of the domestic participants expressed such a belief in their philosophies at any of the six stages. It is possible that the teaching culture in the US is more professionally developed than in the home countries of the two international MGTAs, but it

would be difficult to draw such general conclusions based on this small number of research participants. It is important to note, however, that both of these participants represented countries that send a large number of mathematics graduate students to the American universities.

All four participants expressed that 'making students think' is an important component of their teaching philosophy. Even though both domestic participants had expressed this belief in their TPSs from the pre-service phase, the international MGTAs also developed a belief that they should not simply give answers to mathematical problems or students' questions. David said that he would encourage students to make a guess, even if they are not sure whether their answers are right or wrong. He said that the habit of guessing answers would eventually enable students to find the correct solutions or answers.

Moreover, these MGTAs also developed a belief that they should be able to clearly explain mathematical concepts to the students. They realized that they should employ multiple teaching methods or techniques to explain mathematical concepts so that the students understand better. It was not clearly evident what factor or factors led them to develop this belief. It is possible that their preferred methods of explanation might have been ineffective in helping students understand mathematical concepts in all situations.

Changes were detected in their teaching philosophies both during the pre-service and in-service phases, but these changed slowly over time, as described in the researcher's assumptions. In fact, MGTAs said that their teaching philosophies during the in-service phase were essentially the same as their teaching philosophies from the pre-service phase.

### **5.3 Learning from the Perspective of Cognitive Apprenticeship**

All research participants' learning from *modeling* was clearly visible. In behavioral modeling, learners develop by observing more experienced and knowledgeable members in action. Their conceptualization of teaching based on their previous experience as a student, and the observation

of undergraduate classes taught by their faculty mentors, therefore fall under behavioral modeling. All the participants had expressed that the foundation of their teaching philosophy was largely based on the teaching they had experienced as a student. During the pre-service preparation phase, class observations had also influenced their teaching philosophies, as discussed in the results from the previous chapter.

Learning from more experienced members of the learning community is an example of cognitive modeling, where these members share their skills and knowledge as ‘tricks of the trade’. All the participants said that they learned many aspects of teaching from interactions with their faculty mentors, the instructor of the SPTCM course, other experienced instructors, and fellow teaching assistants. Specifically, MGTAs said that they learned many aspects of teaching such as showing caring attitude, and dealing with student issues from the instructor of the SPTCM course. Jennifer and Rebecca said that they also learned to use technology and employ collaborative learning from their course coordinators.

Another phase of learning in cognitive apprenticeships is *approximating*. Approximating allows learners to clearly articulate their thoughts about what they plan to do, and why, before performing an activity (Hansman, 2001). MGTAs were required to give teaching presentations in the actual classrooms during the SPTCM experience. Before they gave teaching presentations, they were required to make lesson plans, and discuss those plans in advance to the instructor of the SPTCM course, and the faculty mentor whose classes they were observing. They had to develop a detailed lesson plan and explain how they had planned to present the lesson.

Once an activity is performed, approximating also enables learners to reflect on their activities and compare their performances with those of the experts. In the seminar sessions following their classroom presentations, they were required to present a short reflection of their own presentation to their peers, which included things such as what went well and what did not. Their faculty

mentors, the instructor of the SPTCM course, and their MGTA peers observed their classroom presentations. Following the recitation of the presenter's self-reflection, peers also provided feedback on the teaching presentation they had observed. Each participant's learning from teaching presentation, reflection, and feedback was discussed in detail in the previous chapter.

In the *fading* process, as new members become more experienced and able, the scaffolding provided by the experts begins to fade gradually. This is exactly what happens when the MGTAs are at a later stage of the pre-service phase, or enter into the in-service phase and begin to teach in actual classrooms. There were faculty course coordinators who overlooked some of the activities of these beginning instructors, such as by reviewing their syllabi, quizzes, and exams, and providing feedback. At the beginning stage of the fading process, the coordinators occasionally observed the MGTAs' classes and provided support. For example, some course coordinators observed their classes and encouraged them to employ group-learning activities, making eye contacts with the students, and walking around the classroom. However, this support kept fading gradually, until the MGTAs were left on their own as instructors.

During the *self-directed learning* phase, the participants begin to perform activities independently in the real world, based on what they learned from modeling. Experts provide occasional support at the request of the learners. In the context of this study, the MGTAs were engaged in classroom teaching, either as an instructor of record or as a recitation leader. As they encountered issues that they did not know how to solve on their own, they sought support from the course coordinators, and also from other experienced instructors and MGTAs. They began to learn from their own teaching experiences, their interaction with the students, and other instructors, including the course coordinators. As evident in the interview data, they implemented in the classrooms mostly what they had learned from the modeling phase. Since they were left alone as instructors, they engaged in learning based on their first-hand teaching experience and their interaction with and behavior of their students. The course coordinators provided support only when the MGTAs

sought it on occasions when they were not sure how to deal with issues they encountered while teaching.

During the *generalizing* phase, the learners generalize their learning from discussion and their own practices, and employ their learning in real world situations. By the time these MGTAs reached the generalizing phase, they had opportunities to learn from earlier stages, and from their direct classroom teaching experience that included the interaction with the students. They also learned from their interactions with other experienced and fellow teaching assistants, the behavior of their students, and their self-reflection on their own teaching. By assessing their learning from these various sources, they adopted and generalized their learning in order to draw on it in the future. Vygotsky's sociocultural learning theory posits that learning occurs first at the social level and then at the individual level (Vygotsky, 1978). During the process of internalization, the experience or skills learned from a social context are processed inside the learners' minds, and an understanding is developed to fit into their own independent use (Bonk & Kim, 1998). For example, Rebecca said that she used an ELMO and a projector during her first semester teaching, because she had seen her mentor use those while observing her classes. However, after she taught for a couple of semesters, she realized that using the chalkboard made it much easier to engage with the students, so she started to use the chalkboard most of the time. When asked why she used ELMO during her first two semesters before switching to the chalkboard, she said: "Part of that was because my mentor that I sat in on during my teaching course, that's the method she used. And then the method that my course coordinator used the first class I taught was also that way." Another participant, Jennifer, said that using collaborative learning was her course coordinator's idea, but she found that it was beneficial because students could learn from discussing with their peers. She then decided to implement more collaborative techniques in her future teaching.

In the case of learning about teaching, there is not an absolute procedure to be followed. It is a life-long learning process, and therefore learning occurred not necessarily in sequential phases

but in random cycles of the five phases discussed above. As an example, cognitive modeling occurred even during the self-directed learning and generalized learning phases.

The data used in this study is only an approximation of what these participants believe or think. What they have in mind might not have been written in the teaching philosophy statements or expressed during the interviews. Therefore, it is not appropriate to conclude what they really think or believe based on this data set alone. Also the changes detected might not be caused solely by their learning during the pre-service or in-service phases. Their teaching philosophy statements (TPSs) could have been different if the prompts for writing their TPSs were different, or if they had been instructed to draft new statements instead of revising their old ones. Similarly, the philosophies they reported in the interviews might not have been the same if different interview protocols had been used, or if the interviewer was a different person. Also, participants' beliefs that were first detected in the interview data from the in-service phase might also have been held during the pre-service phase, but not reported in the TPSs, as it would be impossible to report all of one's beliefs about teaching within a 1-2 page statement. But during interviews, it is possible to express a lot of things in a short time, making it possible for participants to describe their teaching philosophies in much greater detail.

The third research question asked: What are the major contributing factors that affect MGTAs and their teaching philosophies during the pre-service and in-service phases? The following is a summary of the factors that were detected to influence the teaching philosophies of the research participants during the pre-service as well as during the in-service phases.

#### **5.4 Factors: pre-service phase.**

There were some common factors that influenced the teaching philosophies of most of these participants. As found in existing research (Belnap, 2005; Schuck, Aubusson, Buchanan, & Russel, 2012), their past experience as a student, especially their role model teachers, had a strong



influence on their teaching philosophies. It is also important to note that the prompt for writing their beginning teaching philosophy had also asked them to discuss the teaching of instructors who they thought had been effective (see Appendix A). They all wrote that they would try to follow the traits of their role model teachers from the past, but they added very little of their own. Some participants' teaching philosophies were influenced not only by effective instructors, but also by the teaching of ineffective instructors. For example, Jennifer developed a belief that instructors should treat students equally. She attributed this learning to the behavior of a high school teacher who used to care only about those students who had higher grades on the tests. Andrew's first teaching philosophy statement (TPS I) was also influenced by time constraints. Even though he acknowledged the importance of preparing teaching materials, he said that he would not be able to do so because of his situation as a graduate student. In summary, their TPS I was influenced predominantly by their past experience as students.

At the points of time of TPS II and III, their teaching philosophies were increasingly influenced by the observation of undergraduate classes taught by their faculty mentors, and also by the teaching presentation experiences required in the SPTCM course. A combination of factors such as lack of time, teaching presentation experience, and observation of classes led them to realize that they needed to be well-prepared for the class and also to be organized both in and outside the classroom.

Although it was not evident from the pre-service data, the participants said in the interviews during the in-service phase that the instructor of the SPTCM course had some influence in their teaching philosophies. Some of them said that they learned from the instructor to be caring, and to be professional when dealing with students. They learned a few aspects of teaching from the course, but they said that it had little impact on their teaching philosophies.

### **5.5 Factors: in-service phase.**

The foundation of their teaching philosophy during the in-service phase still came from their experience as high school or undergraduate students. They discussed the teachings of their role model teachers or professors in all three interviews during this phase. Surprisingly though, none of them discussed the teaching of their current professors, even after completing three semesters of their graduate coursework.

The most influential factors were their teaching experience, and the undergraduate students they taught during the in-service phase. Toward the end of the pre-service phase, and during the in-service phase, all four MGTA participants developed or reinforced an existing belief that they will develop as a better instructor as they become more experienced. Two beliefs were developed after observing their own students' behavior and performance: maintaining the role of an authority figure, and the importance of students' own efforts. By the stage of Interview III, they had all developed a belief that instructors can do only so much to promote learning if there is lack of effort on the student side.

Other research has also found that MGTAs' current teaching experience was perceived to be the most influential factor in their teaching philosophy (Belnap, 2005). Teaching philosophies of the participants were not only influenced by their current teaching experiences, the participants said that their future teaching philosophies might change depending on their learning from their future teaching experiences. MGTA participants in a study with international teaching assistants has also found that they consider teaching experience as the most important source to learn (Chae, Lim, & Fisher, 2009). Some participants in that study used a 'learning to swim' metaphor which implied that if one teaches people how to swim without taking them to water, they will eventually drown if forced to swim in real life, even if they know all the rules.

In addition to the pre-service factors discussed above, the other factors that seemed to influence their teaching philosophies were other instructors, time constraints, undergraduate courses,

language proficiency, and culture. All MGTAs believed that they would like to seek advice from other instructors and fellow MGTAs if they encounter issues that they cannot solve on their own. Other instructors, such as course coordinators, the instructor of the SPTCM course, and their fellow MGTAs were also found to impact MGTAs' teaching philosophies. Jennifer and Rebecca said that they were encouraged and supported by their course coordinators to employ collaborative learning. Jennifer said that she learned to make eye contact and create a comfortable environment for students by observing her mentor's classes. Her course coordinator encouraged her to incorporate technology in the classroom, such as graphing calculators and other available technologies. All four participants said that they learned to deal with student-related issues professionally from the instructor of the SPTCM course. David said that he also understood the importance of showing a caring attitude from that instructor. Although they said that it was helpful to understand the perspectives of their peers, it was not evident what they learned from them.

In summary, MGTAs' initial teaching philosophies are highly influenced by their past experience as students, especially by their role model teachers. Research in K-12 teacher preparation shows that students are sometimes so impressed with their past teachers that they choose to attend pre-service preparation program based solely on these teachers' positive impressions in anticipation to become future teachers (Schuck, Aubusson, Buchanan, & Russel, 2012). Even though the foundation of their philosophies still came from those teachers, their in-service teaching philosophies were influenced mostly by their teaching experience.

## **5.6 Recommendations for Future Practices**

As evident from this research, and other existing research, MGTAs value teaching experience far more than any pre-service professional development activities (Belnap, 2005; Chae, Lim, & Fisher, 2009; Harris, Froman, & Surles, 2009). Findings from these studies suggest that pre-

service preparation programs do not make a significant impact on novice TAs' philosophies, other than alleviating their anxiety about being a first-time teacher and increasing their confidence. Teacher educators also consider practicum experience as the most important element of teacher preparation (Schuck, Aubusson, Buchanan, & Russel, 2012). Given this dynamic, mathematics departments might want to consider focusing more resources on in-service support, but not at the expense of pre-service preparation programs. Such on-the-job learning assistance in teaching is also recommended by researchers (Kung & Speer, 2009). Citing the success of on-the-job learning as a means of professional development for K-12 teachers, and considering that only limited time is available for graduate students, Kung and Speer (2009) suggest that helping MGTAs learn from their own experiences would be more constructive and beneficial.

However, this does not mean that mathematics departments should not pay attention to the pre-service preparation of MGTAs, which is extremely important for enhancing undergraduate classroom instruction. The bigger task is to change MGTAs' attitudes toward professional development, and also to incorporate their perspectives, such as by including more teaching in the pre-service program. Such effort could make it more relevant for MGTAs to participate in professional development programs, and more constructive for mathematics department as well. Jenkins (2011) found that many teachers often expressed dissatisfaction with professional development activities that did not incorporate their perspectives, perceiving them as "controlling and irrelevant" (p. 85) to their teaching practices. She argues that any professional development activity "that fails to take into account teachers' philosophies of teaching is doomed to disappointing results" (p. 77). Because these MGTAs expressed that this pre-service preparation program made only negligible contribution to their teaching philosophies, this would imply that they learned mostly the procedural aspects of teaching from the SPTCM course. Although it would be too early to reach to any conclusion, one can ask why the mathematics departments should expend a semester-long effort, and cost for the pre-service preparation program, only to

teach some procedural aspects. Although some researchers suspect that MGTAs may not be aware of how their teaching is being impacted by the preparation programs (Belnap, 2005), we still lack any reasonable evidence to support this.

It is evident from research that teachers' beliefs are resistant to change at first, and change slowly over time as they become more experienced (Rimm-Kaufman et al., 2006; Simmons et al., 1999). It would therefore be unreasonable to expect a lot of changes in their beliefs and perspectives in a period of just one semester. But given the limited time the MGTAs spend in graduate school, and the limited professional development opportunities and other support available for these instructors when they go on to become mathematics faculty in the future, it would be wise to use the resources to provide on-the-job learning assistance throughout their graduate program. The mathematics departments can choose to fade that support gradually as MGTAs become more experienced instructors. Mathematics departments should develop an in-service model for the professional development of MGTAs recognizing the research literature on the professional development of in-service teachers. There are professional development models for the K-12 teachers that go beyond more than just teaching experience. More research should be done to adopt these evidence-based existing models (Aichele & Coxford, 1994) for the professional development of in-service MGTAs.

At the beginning of any given semester, it would be wise to understand MGTAs' perspectives by asking them to write and discuss their teaching philosophy with other peers and the instructor of the pre-service preparation program course. An analysis of their teaching philosophies would inform necessary adjustments in the preparation programs of every new cohort of MGTAs. Every such new cohort is a unique combination of graduate students whose backgrounds and perspectives may be completely different from any other preceding or following cohorts. For example, having higher expectation for students was a belief which has not been mentioned much in the existing literature. If they learn from the pre-service preparation program that having

unreasonably high expectation from mostly average and less than average students is not always as effective as they might think, they would not have to figure this out on their own from their first few years of teaching experience. It is evident from existing research, and in the beginning teaching philosophy statements of the research participants of this study, that beginning MGTAs do not place much importance on incorporating technology and student-centered instruction. Discussing the importance of these elements in the pre-service preparation programs, and encouraging MGTAs to learn their importance would be beneficial.

An implication of international MGTAs' perceived lack of teaching effectiveness due to socio-cultural differences would be to incorporate various aspects of general teaching culture in the US, and the culture of American undergraduates in the preparation programs. Many preparation programs are already incorporating this, but requiring international MGTAs to read books on teaching American students, such as a book by Ellen Sarkisian, would be beneficial for them to conceptualize the teaching culture in the US. This will also be helpful to alleviate their anxiety of teaching these students for the first time.

## **5.7 Future Research**

There are a number of areas that are of interest for future research. First, Andrew had the strongest feeling of all participants about having high expectations for students, and employing a tough-love attitude in his classroom. Moreover, among all participants, he had the strongest feeling that students' success depends on the students themselves and that they should "bust their butt" in order to succeed. He was the only participant who said explicitly that he would not do teaching for his career, and that we are trying to replace hardwork by "pampering students". Future researchers should therefore examine the career priorities of MGTAs as indicators for their perspectives on the teaching and learning mathematics. Understanding their perspective is important because they play a significant role in undergraduate mathematics instruction for

several years during their graduate study even if they do not go on to become college mathematics instructors in the future. Moreover, this study and few others have confirmed that beginning MGTAs do not place much importance on student-centered instruction and the use of technology, but none of them included a large number of participants. Future research should confirm (or disconfirm) this finding with large sample of beginning MGTAs.

It is evident from this and other studies involving MGTAs that they consider teaching experience as the most valuable means of developing professionally but they do not see the importance of pre-service or any other professional development opportunities (Chae, Lim & Fisher, 2009). Research also shows that instructors' teaching philosophies become more personalized and richer as their classroom experience increases (Rimm-Kaufman et al., 2006). Contrary to such finding, Jennifer's teaching philosophy did not seem richer than other participants', despite her five years of teaching experience in her home country. For example, she wrote that she only learned to make eye contact and smiling at her students in her TPS II and III. If she had five years of teaching experience in her home country, one would easily guess that she might have learned this even before she attended this preparation program. Moreover, she was one of the participants who said that her future teaching philosophy might change with more teaching experience. It is possible, although it cannot be said with a high degree of certainty that these participants and other MGTAs might have enrolled in the preparation program course only because it was required. Researchers might want to consider what can be done to instill a more positive attitude about pre-service professional development activities, and change MGTAs' perspective that teaching experience is the only way to develop into a better teacher.

This study suggests the importance of providing on-the-job learning assistance to the MGTAs during their in-service phase, and developing an in-service model for their professional development as discussed in the previous section. Then researchers should examine how student success is related to such in-service professional development model of MGTAs. Moreover,

future research should examine how the implementation of such professional development model contributes to the improvement of the teaching of mathematics at the university level from a longitudinal study.



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## APPENDICES

### Appendix A: Prompts for Teaching Philosophy Statements

#### A.1 Teaching Philosophy Statement I

In one of the optional textbooks, Rishel (MAA, 2000) says, " ... let me address a very common view about the discipline of teaching; namely, ... '**great** teaching can't be taught.' Well, maybe, just maybe, **great** teaching is lightning in a bottle and can't be explained, but I claim emphatically that **good** teaching can be taught. ... I believe not only that teaching **can** be taught, but that if mathematics is in progress, it **must** be taught -- to the bright young people who will carry it on after us."

Write a short paper of about 2-3 pages discussing what *you* have learned about effective and ineffective teaching from being a student. Describe the teaching of someone who was, in your experience, a particularly effective teacher, and analyze why you think this person succeeded as a teacher. This is just the beginning on your journey to develop your own philosophy of teaching, a philosophy that will probably change several times during your teaching career.

The conclusion of your paper should be a thoughtful initial statement of *your* emerging philosophy of teaching. Be sure to include your thoughts on what you believe now.

## A.2 Teaching Philosophy Statement II

Earlier this semester you made an initial effort to characterize your philosophy of teaching. Recall, in our textbook, Rishel (p. xi) says, " ... let me address a very common view about the discipline of teaching; namely, ... '**great** teaching can't be taught.' Well, maybe, just maybe, **great** teaching is lightning in a bottle and can't be explained, but I claim emphatically that **good** teaching can be taught. ... I believe not only that teaching **can** be taught, but that if mathematics is in progress, it **must** be taught -- to the bright young people who will carry it on after us."

In this paper, you discussed what you have learned about effective and ineffective teaching from being a student. You described the teaching of someone who was, in your experience, a particularly effective teacher, and analyzed why you thought this person succeeded as a teacher. You concluded this paper with an emerging statement of your philosophy of teaching.

Your job now is to revisit this paper, rethink its contents, and revise it based on reflections on your practicum and seminar experiences this semester - so far. You will have yet another opportunity to reflect as we approach the end of the semester.

### **A3. Teaching Philosophy Statement III**

Earlier this semester you made efforts to characterize your philosophy of teaching. Recall, in our textbook, Rishel (p. xi) says, " ... let me address a very common view about the discipline of teaching; namely, ... '**great** teaching can't be taught.' Well, maybe, just maybe, **great** teaching is lightning in a bottle and can't be explained, but I claim emphatically that **good** teaching can be taught. ... I believe not only that teaching **can** be taught, but that if mathematics is in progress, it **must** be taught -- to the bright young people who will carry it on after us."

In your first paper, you discussed what you had learned about effective and ineffective teaching largely from the perspective of being a student. You described the teaching of someone who was, in your experience, a particularly effective teacher, and analyzed why you thought this person succeeded as a teacher. And, you concluded this paper with an emerging statement of your philosophy of teaching.

You revisited this paper about midway through the semester, rethought its contents, and revised it based on reflections of your practicum and seminar experiences this semester - so far.

Now, you have the chance to revise it yet a final time. This final revision provides you with an opportunity to build into your philosophy statement those most recent experiences in the classroom as a teacher. Hopefully, you will recognize and appreciate the journey we have taken this semester - a journey that began with your beliefs about teaching being based on your experiences as a student and is ending with your beliefs about teaching being based on learning first-hand what is involved in the art of teaching.

## Appendix B: Interview Protocol Forms

### B.1 Interview I Protocol Form

Title of the Project: An Exploration of Mathematics Graduate Teaching Assistants' Teaching Philosophies: A Qualitative Case Study

Date \_\_\_\_\_ Time \_\_\_\_\_

Location \_\_\_\_\_

Interviewer \_\_\_\_\_ Interviewee \_\_\_\_\_

#### Notes to interviewee:

Thank you for your participation. I believe your input will be valuable to this research and also inform future teaching assistant preparation practice.

Confidentiality of responses is guaranteed, pseudonym will assigned to the participants

Approximate length of interview: 30-60 minutes

Purpose of research:

The purpose of this study relates to exploring mathematics graduate teaching assistants' beginning and changing philosophies of teaching during their pre-service and in-service phases as mathematics instructors. It also relates to describing the factors that affect their philosophies of teaching during the transition period when they enter in-service phase from pre-service phase.

Methods of disseminating results: dissertation, journal articles

1. Please tell something about your background.
  - Where were you before you came to this school? Where did you go to college and high school?
  - Please tell about any teaching experiences you had before you came to this university
  - To what levels, what subjects and how long did you teach? (if any)

Response from Interviewee:

Reflection by Interviewer:

2. Where do you think you will find yourself in the next 5-10 years?
  - (If needed) Why would you choose teaching over other professions?

Response from Interviewee:

Reflection by Interviewer:

3. Please tell something about your experience as a graduate teaching assistant at this institution.
  - Please share experience as a graduate teaching assistant.
  - Please tell about your teaching experience at this institution so far.
  - In what ways is your experience similar or different from your previous expectations?
  - Specifically, what expectations (regarding teaching) did you have before you began teaching in classroom?
  - Here are some examples that may help you: expectations from mathematics departments, undergraduate students, your own expectation as an instructor etc.
  - What expectations were met and what expectations were not? Why? How?

Response from Interviewee:

Reflection by Interviewer:

4. Please describe in detail your philosophy of teaching mathematics to college students.
  - Please list all the factors that shaped your current teaching philosophy.

Response from interviewee

Reflection by Interviewer

5. Please describe what views and beliefs about teaching and learning changed since you began teaching?
  - What experiences, circumstances or factors led you to change those beliefs?

Responses from interviewee

Interviewer's reflection

6. What kind(s) of instructional delivery are you following in classrooms (for example, student-centered, teacher-centered (lecture-based))?
  - Why did you choose one method over others?
  - In what ways is the teaching you had experienced in your undergraduate institution/country similar/different from the teaching you are doing in your classroom?
  - Which method of delivery do you think students are most likely to benefit from? Why?
  - What additional tools do you use in classroom to enhance your mathematics instruction? For example, technologies etc. Describe why you believe that these tools are helpful?

Response from interviewee:

Reflection by the interviewer:

7. Please tell me about any actions you are taking to help you grow and become a successful mathematics instructor.
- What types of professional development have you experienced since you began teaching at this university?
  - In what ways the professional development activities you participated in during the enrollment of the course ‘MATH 5902’ was beneficial to your teaching?
  - In what ways they were not?

Response from interviewee:

Reflection by the interviewer:

8. Based on your experience so far at this institution, what external factors most helped/hindered your learning about teaching?
- What external factors or forces? (If needed) here is a list of potential factors that may help you...
  - Why? How?
  - What were some challenges that you faced during the first few weeks of the semester when you first began teaching?
  - What factors or forces have influenced your decision making while teaching?

Response from Interviewee:

Reflection by Interviewer

9. Based on your own assessment and feelings, how successful do you think you have been as a mathematics instructor so far? Please explain in detail.
- Please tell me more why you think so.
  - Tell about your future plans that you will carry out in order to become more successful mathematics instructor.

Response from interviewee

Reflection by the interviewer

- Closure
  - Thank you to interviewee
  - reassure confidentiality
  - notice for follow-up

## B.2 Interview II Protocol Form

Title of the Project: An Exploration of Mathematics Graduate Teaching Assistants' Teaching Philosophies: A Qualitative Case Study

Date \_\_\_\_\_ Time \_\_\_\_\_

Location \_\_\_\_\_

Interviewer \_\_\_\_\_ Interviewee \_\_\_\_\_

### Notes to interviewee:

Thank you for your participation. I believe your input will be valuable to this research and also inform future teaching assistant preparation practice.

Confidentiality of responses is guaranteed, pseudonym will assigned to the participants

Approximate length of interview: 30-60 minutes

Purpose of research:

The purpose of this study relates to exploring mathematics graduate teaching assistants' beginning and changing philosophies of teaching during their pre-service and in-service phases as mathematics instructors. It also relates to describing the factors that affect their philosophies of teaching during the transition period when they enter in-service phase from pre-service phase.

Methods of disseminating results: dissertation, journal articles

1. Please describe your overall experience at this University so far. For example, your experience as a graduate student, a teaching assistant and a mathematics instructor.

Response from interviewee:

Reflection by Interviewer:

2. Please describe in detail your current philosophy of teaching mathematics to college students.

Response from interviewee:

Reflection by Interviewer:

3. What factors influenced your current teaching philosophy (or beliefs about teaching and learning) the most? Did any of these factors influence you: teaching preparation class, your teaching experience, your students, your role model teacher etc.?

Response from interviewee:

Reflection by Interviewer:

4. Thinking back to the time when you were a new graduate student here but you were not teaching (i.e. your first semester), how does your current teaching philosophy differ from your teaching philosophy back then? Or what beliefs about teaching and learning mathematics have changed since then?

Response from interviewee:

Reflection by Interviewer:

5. Please describe what you usually do from start to end in a typical class period that you teach.

Response from interviewee:

Reflection by Interviewer:

6. How has your teaching behavior this semester changed from previous semesters?

Response from interviewee:

Reflection by Interviewer:

7. Describe some features that you think would contribute to a meaningful learning environment. Please elaborate more on why you believe so? What do you do to facilitate such an environment?

Response from interviewee:

Reflection by Interviewer:

8. What are some of the instructional strategies and tools that you believe would enhance students' mathematical understanding? Please elaborate more on your belief. How do you employ such strategies and tools in your teaching practices?

Response from interviewee:

Reflection by Interviewer:

9. Describe any out of class activities that you believe are important in your role as a teacher.

Response from interviewee:

Reflection by Interviewer:



10. Describe some of the improvements in teaching you have made since you began teaching here?

Response from interviewee

Reflection by Interviewer

11. Looking ahead to next semester, what actions do you see implemented in your teaching behavior?

Response from interviewee:

Reflection by Interviewer:

12. What challenges did you face or are currently facing as a mathematics instructor? How did you address those challenges?

Response from interviewee

Reflection by Interviewer:

13. What factors are helping or hindering your teaching effort? What factors are influencing your decision making ability?

Response from interviewee

Reflection by Interviewer

14. Now that you already have some classroom teaching experience and are currently teaching a mathematics course, what kind of departmental support on teaching do you think would help you the most?

Response from interviewee:

Reflection by Interviewer:

15. Describe how you measure your overall success as a mathematics instructor?

Response from interviewee:

Reflection by Interviewer:

16. Looking ahead 2-3 years, what changes do you see in your teaching behavior?

Response from interviewee:

Reflection by Interviewer:

17. How does teaching recitation section differ from teaching an independent section?

Response from interviewee:

Reflection by Interviewer:

18. Being an international student (if it applies), what additional challenges are you experiencing and what differences do they bring to your teaching?

Response from interviewee:

Reflection by Interviewer:

19. Please describe what aspects of teaching from your home country do you want to bring in American classrooms? What aspects of American teaching do you want to take away with you in your home country?

Response from interviewee:

Reflection by Interviewer:

Title of the Project: An Exploration of Mathematics Graduate Teaching Assistants' Teaching Philosophies: A Qualitative Case Study

Date \_\_\_\_\_ Time \_\_\_\_\_

Location \_\_\_\_\_

Interviewer \_\_\_\_\_ Interviewee \_\_\_\_\_

**Notes to interviewee:**

Thank you for your participation. I believe your input will be valuable to this research and also inform future teaching assistant preparation practice.

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Methods of disseminating results: dissertation, journal articles

1. How do you describe yourself as a math teacher? Your teaching style?

Response from Interviewee:

Reflection by Interviewer:

2. Compared to your first semester teaching, what things do you do differently in class now? What things do you want to change or improve in your teaching if you should continue teaching mathematics in the future?

Response from Interviewee:

Reflection by Interviewer:

3. How do you identify your weaknesses or strengths in your teaching? What did you do or will do to correct your weaknesses?

Response from Interviewee:

Reflection by Interviewer:

4. What advice regarding classroom teaching would you give to a new graduate teaching assistant? In what ways do you think can an average/novice math instructor grow as a successful teacher?

Response from Interviewee:

Reflection by Interviewer:

5. In your opinion, what is the best way to learn about teaching mathematics?

Response from Interviewee:

Reflection by Interviewer:

6. Please tell your opinion on the role of professional development opportunities for beginning and continuing mathematics instructors.

Response from Interviewee:

Reflection by Interviewer:

7. Please describe some key characteristics of a successful mathematics instructor.

Response from Interviewee:

Reflection by Interviewer:

8. Please describe your current teaching philosophy.

Response from Interviewee:

Reflection by Interviewer:

9. What things in your teaching philosophy were developed, changed or reinforced since you came to this school?
- What beliefs were changed?
  - What beliefs were reinforced?
  - What new beliefs were formed?

Response from Interviewee:

Reflection by Interviewer:

10. In your opinion, what factors contributed to your current teaching philosophy? Which of the following factors contributed most? How?
- Your past professors or teachers
  - Your own experience as a student
  - Your teaching experience here or elsewhere
  - Your course coordinators, your fellow TAs and other instructors
  - Your students
  - MATH 5902 course
  - Other (please describe in detail)

Response from Interviewee:

Reflection by Interviewer:

11. Thinking back to the time when you were a new graduate student here but you were not teaching (i.e. your first semester), how does your current teaching philosophy differ from your teaching philosophy back then? Or what beliefs about teaching and learning mathematics have changed since then?

Response from interviewee:

Reflection by Interviewer:

12. Describe some features that you think would contribute to a meaningful learning environment. Please elaborate more on why you believe so? What do you do to facilitate such an environment?

Response from interviewee:

Reflection by Interviewer:

13. What is the connection or relation between your teaching philosophy and your teaching practices?

Response from interviewee:

Reflection by Interviewer:

14. What challenges did you face or are currently facing as a mathematics instructor? How did you address those challenges?

Response from interviewee:

Reflection by Interviewer:

15. Other than the support that you are getting from the math department currently or you got in the past, what additional departmental support on teaching do you think would be beneficial for you to grow as a better teacher?

Response from interviewee:

Reflection by Interviewer:

16. Being an international student (if it applies), what additional challenges are you experiencing and what differences do they bring to your teaching?

Response from interviewee:

Reflection by Interviewer:

**Appendix C: Pre-service Preparation Program Course Syllabus**  
**Seminar and Practicum in the Teaching of College Mathematics**

**MATH 5902**

**Fall 2012**

**Instructor:**

**Office:** 426 MS

**Office Hours:** 2:30 – 3:30 MW or by appointment

**Telephone:**

**E-mail:**

**My Web Page:** Course information is available through my home page at:

**Course Description from University Catalog.** Foundations of college mathematics teaching, including lecturing, grading, and exam preparation. Adapting classroom activities to better serve different types of learners. Current trends in mathematics education such as calculus reform, cooperative learning, and technology in the classroom.

**Course Prerequisites.** Graduate standing in mathematics or consent of instructor.

Note. To be effective in achieving its goal of preparing college mathematics teachers for assignments during the Spring 2013 semester, members of the class must be able to communicate in English (written and oral) well enough to participate in all discussions and written assignments.

Students who have inadequate English communication skills or who are taking, or who have recently taken, English 0003 should carefully consider their readiness for this course.

**Course Objectives.** For most of you this is your first semester of graduate study in mathematics at this university and you are supported by the department with a Teaching Assistantship

(TA). As the name TA implies, you will soon be responsible for teaching mathematics to college students. We regard your role as mathematics instructor very seriously and we want to help you prepare for this responsibility. Through your enthusiastic participation in activities such as regular seminar meetings, mentored classroom observations, preparation of course materials (e.g., syllabus, lessons, exams), appropriate use of technology, and instructional decision making (e.g., classroom management), we believe you will be ready to assume full responsibility for instruction during the 2013 Spring semester.

**Course Structure.** The principal elements of this seminar/practicum in support of meeting the course objectives are the following.

1. **Weekly Seminars.** You will be expected to complete all out of class assignments such as written assignments (syllabi, lessons, exams, papers, etc.) and retain them as part of your course portfolio.
2. **Classroom Practicum.** You will be placed with an experienced instructor who will serve as your mentor. You will be expected to attend/participate in all assigned activities prescribed by your mentor. You will be expected to maintain a log of your practicum experiences in your course portfolio; following each class meeting, you should write down your observations, questions, and reflections on the class session in your practicum log - these will be discussed in our regular seminar meeting each week. Your mentor will submit an evaluation of your performance at the end of the semester.
3. **Enthusiasm.** You will be expected to participate enthusiastically in all seminar and practicum activities.

**Course Materials.** I have designed special assignments that will be usually completed outside of the regular class meetings.

1. **Course Portfolio.** Each of you is required to maintain a course portfolio (3-ring binder) which will contain your practicum logs and associated classroom materials, written assignments you will complete outside of the seminar class (syllabi, lessons, tests, etc), and materials related to the weekly seminar. Periodically, your portfolio will be submitted and assessed.
2. **Optional Textbooks.** You may also wish to purchase the following books. a. *Teaching First - A Guide for New Mathematicians* by Thomas W. Rishel. MAA, 2000. ISBN: 0-88385-165-2. b. *Teaching American Students - A Guide for International Faculty and Teaching Assistants in Colleges and Universities* by Ellen Sarkisian. Derek Bok Center for Teaching and Learning, Harvard University, 2006. ISBN: 0-674-02141-X. c. *First Day to Final Grade - A Graduate Student's Guide to Teaching (2nd edition)* by Anne Curzan and Lisa Damour. The University of Michigan Press. 2006. ISBN: 0-472-03188-0.

**Meeting the University policy on Responsible Conduct of Research (RCR).** Recently the university has put in place a policy requiring all graduate students to complete training in the ethical and responsible conduct of research (RCR). The training involves completion of an on-line module. Those who are new Teaching Assistants in the Department of Mathematics will be expected to complete the RCR module during Math 5902. The policy states that graduate students will not be allowed to enroll for the spring 2010 semester until they complete this training. For information about completing the module, go to the graduate college website. Once you have completed the module you should print the completion report and return it me; I will then forward it to one of the graduate coordinators.

**Course Evaluation.** Your course grade will be determined by your (1) attendance/enthusiastic participation in assigned practicum (40%); (2) completion and discussion of written assignments and seminar activities (40%); and, (3) enthusiastic participation in seminars and discussions

(20%); each of these components is influenced by your ability to communicate in English (written and oral).

**Academic Integrity.** The university has explicit rules governing academic integrity. Please consult the university's fall 2012 Syllabus Attachment mentioned above on the web. Working with another person or in study groups on problems can be helpful in learning the material. I encourage you to work together if you find it helpful. However, **all written work submitted must be your own.** Copying someone else's problem solution or showing your written solution to someone else are prohibited; such behaviors are regarded as violations of academic integrity and will be treated according to the University's policy. In order to be successful in learning the material and doing well on the examinations you must think very hard about the problems themselves **before** discussing them with anyone else.

**Special Accommodations for Students.** "If you think you have a qualified disability and need special accommodations, you should notify the instructor and request verification of eligibility for accommodations from the Office of Student Disability Services (315 Student Union). Please advise your instructor of your disability as soon as possible, and contact Student Disability Services, to ensure timely implementation of appropriate accommodations. Faculty have an obligation to respond when they receive official notice of a disability but are under no obligation to provide retroactive accommodations. To receive services, you must submit appropriate documentation and complete an intake process during which the existence of a qualified disability is verified and reasonable accommodations are identified" (Fall 2012 Syllabus Attachment).

**Office Hours.** I encourage you to come talk to me during my office hours (or email for an appointment if you can't make any of those times) when you have questions or concerns.

**Final Note.** Any changes in this syllabus will be communicated to you by the instructor in class.



## Appendix D: Practicum Log

### Practicum Log

*To assist you in maintaining the log of your practicum experiences: (1) use the form below to record your practicum observations; (2) file this form in the 3-ring binder for this course; (3) bring the binder with your logs to the seminar each week.*

Date of Observation: \_\_\_\_\_ Day: \_\_\_\_\_

Present an overview of mathematical content discussed (briefly list major topics).

Describe how the instructor managed the routines of the class (attendance, collecting/returning papers, etc.).

Discuss method(s) of delivery. Describe how the instructor delivered the mathematical content citing any innovations you observed.

Discuss student interaction(s) with the instructor. Describe how the instructor motivated students to be involved.

Discuss how the instructor utilized instructional technologies.

Identify at least one technique that you observed that you would like to discuss further and possibly incorporate into your teaching praxis.

Pose at least one question you would like to ask your mentor about what you observed.

VITA

Kedar Mani Nepal

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN EXPLORATION OF MATHEMATICS GRADUATE TEACHING ASSISTANTS' TEACHING PHILOSOPHIES: A CASE STUDY

Major Field: Mathematics

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Mathematics at Oklahoma State University, Stillwater, Oklahoma in August, 2014.

Completed the requirements for the Master of Science in Mathematics at Oklahoma State University, Stillwater, OK in July, 2009.

Completed the requirements for the Bachelor of Science in Mathematics at Tribhuvan University, Kathmandu, Nepal in December, 2000.

Experience:

Graduate TA, Oklahoma State University, Aug 2007-July 2009

Graduate TA, Oklahoma State University, Aug 2009-July 2014

Mathematics Instructor, Sainik Aawasiya Mahavidhyalaya, Nepal, Sept 2003-May 2006

Mathematics Teacher, Man Singh Secondary School, Nepal, Jan 1998-Dec 2000

Professional Memberships:

Mathematical Association of America

American Mathematical Society

Nepalese Mathematics Society

Nepalese Mathematicians in America