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An Autoethnography: A Mathematics Teacher's Journey of Identity Construction and Change

Anthony B. Stinson

ACCEPTANCE

This dissertation, AN AUTOETHNOGRAPHY: A MATHEMATICS TEACHER'S JOURNEY OF IDENTITY CONSTRUCTION AND CHANGE, by ANTHONY B. STINSON, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

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ABSTRACT

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Despite some gains, improving secondary mathematics instruction remains an area of concern of the National Council of Teachers of Mathematics (NCTM). Recitation, also known as lecturing, prevails as the practice of choice of mathematics teachers in the United States. However, the report of the NCTM Research Advisory Committee 2000 indicates that the mathematical proficiency of students increases when the practice of choice includes more than recitation. Therefore, changes in instruction in the mathematics classroom should occur to improve student learning.

The purpose of this dissertation is to provide a personalized account of one mathematics teacher's use of reflective teaching as an agent of change. This dissertation is about a journey of change in instruction fostered by a change of identity as a mathematics teacher. This dissertation chronicles the identity construction of the teacher. This study has relevance because the process utilized by the teacher provides a method of self-examination and identity construction for other mathematics classroom teachers who want to improve their practices. This study also has relevance because it describes the process of how a classroom teacher takes ownership of self-improvement.

This qualitative dissertation uses autoethnography as the methodology. Autoethnography is research, writing and story where the researcher is the subject and the researcher's experiences are the data (Ellis and Bochner 2000). The theoretical frame for this autoethnography is identity theory as it relates to teacher identity construction. Memory, videotaped lessons, student commentary and a reflective journal serve as supporting data sources to render narratives detailing the findings. The research question guiding this dissertation is: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change of practice?

The findings show that a teacher's identity can be interwoven by many characteristics that at times work simultaneously. The findings also indicate that changing one's practices is an arduous process but can be accomplished and the process given "voice."

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Anthony B. Stinson

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CHAPTER 1

INTRODUCTION

> Great teachers are not born, they are made. Beginning teachers become accomplished teachers, and skilled teachers become great teachers, by thinking hard about their teaching and finding ways to improve it.
> (Artzt, 2002)

Since seventh grade, I longed to be a mathematics teacher. I can recall how I was turned on to mathematics by my mathematics teacher, Mrs. Perdue. I can remember thinking, "I want to excite my students about math like she is doing when I become a math teacher!" I wanted to possess the same knowledge, wit, charisma and patience exhibited by this engaging teacher. Little did I know that her identity and the characteristics she possessed were not acquired over night. I had to realize that the same journey which she had taken to arrive where she was, I too had to take. I also had to understand that teaching is an art which is never perfected, only enhanced.

This dissertation is the story of my journey as a mathematics teacher. In this dissertation, I share my experiences of introspection, examination, change and professional growth. I provide a personalized account of the triumphs, disappointments, periods of vulnerability, and the difficulties of critical reflective teaching. This autoethnography, writing about the researcher's experiences (Ellis 2002), articulates the process I followed in constructing my identity as a mathematics teacher and describing

the changes that occurred in my practices as a result of my identity. How did I arrive where I am as a mathematics teacher? Why do I teach the way I do? How does my identity guide my practices? How did I change my practices? Was changing my practices easy?

Telling my story of identity construction, change, and growth resulted from the current discussions about standards-based mathematics instruction and my desire to give voice to a mathematics teacher who saw a need for self-improvement. The reformers of the current standards-based mathematics movement in the United States lists the teaching practices of mathematics classroom teachers as an area of utmost concern (Kilpatrick, Martin & Schifter 2003). Mathematics scholars contend that if the United States is serious about improving students' mathematical learning, it has no choice but to invest in more effective and sustained opportunities for teachers to learn about their practices (Kilpatrick, Martin et al. 2003). The 'new math' era of the 1960s concentrated its efforts on changing the mathematics curriculum, however the current standards-based movement has placed an emphasis on the need for not teaching better mathematics but teaching mathematics better (Klein 2003).

These concerns resonated with me as a mathematics teacher because I knew if student learning was to occur in my classroom, I had to take ownership of the investigation of my practices to determine what worked and what did not. It was incumbent upon me to take control of my domain as a mathematics teacher to insure that my students received the best instruction possible. That best instruction had to come from me, which meant that I had to take a good look at what I was doing as a mathematics teacher.

This autoethnographic approach gives me the opportunity to speak from the inside out as a teacher having experienced a deeper understanding of "self" and the changes that occurred in my practices along my journey of teaching (Ellis 2004). My story describes how I took an inward glance at myself as a teacher to really examine what I was doing in facilitating learning, and how I changed many of my practices as a result of the examination.

When I began teaching as a new college graduate, all of the theory courses I had attended and pedagogical examples which I had observed made it explicitly clear as to what I thought my role as a mathematics teacher would be: Stand at the board to explain a concept, through working some examples; give the students a few problems to work at their desks, and make the homework assignment for the following day. The next day, I would survey the class to determine if there were any questions on the previous night's assignment. If there were questions, I would then work the problems for the students and proceed with the same routine as the day before.

My classroom routine mirrored that of the majority of mathematics classrooms throughout the United States and this routine has prevailed for many decades (Kilpatrick, Martin et al. 2003). According to the report from the Third International Mathematics and Science Study (TIMSS), mathematics teachers' practices have not changed greatly because teachers mimic the practices of their forbearers (Hiebert & Gallimore 2002). But, the National Assessment of Educational Progress (NAEP) indicates that there is a need for change in the practices of mathematics teachers because students are not being served well by the traditional pedagogical approaches (Burrill & Hollweg 2003).

I realized that the art of teaching was not just one in which I stood in front of the class and presented algorithms and procedures for solving problems. My role as a teacher required consistent planning and strategies for a multitude of learning styles. I realized that my role as a teacher constituted the consistent, deliberate, thoughtful and unselfish commitment to the cause of captivating and motivating learners to maximize their potential in reasoning, problem solving, mathematical communication and conceptual understanding. But, I had to learn how to perform this feat more efficiently and with a deeper understanding of my identity as a teacher who wanted to facilitate student learning in a manner such that students understood mathematics conceptually rather than just computationally. I realized that as a teacher, I had been given a blank canvas on which I could paint a portrait which could forever be refined as my artistry improved. Having taught secondary mathematics for twenty-eight years, I have experienced changes in my teacher identity and the practices that encompass that identity. This autoethnography permits the use of my voice in detailing the journey I experienced in painting that portrait.

The Problem

The dominant mode of instruction in the secondary mathematics classroom is recitation (Kilpatrick, Martin et al. 2003). Recitation is the traditional method of teaching which entails a formal lecture on a particular concept with a few examples of the concept worked by the teacher, and an assignment given by the teacher. The teacher begins the next day with explanations on any difficulties from the previous assignment, and then the routine continues. However, this same research report indicates that the mathematical

proficiency of students in mathematics classrooms in the United States increases when instruction is multifaceted (Kilpatrick 2003). This suggests that the traditional forms of instruction are not serving students in the United States. Consequently, efforts should be made to assist mathematics teachers in incorporating more pedagogical methods in their instruction, which could mean changing or augmenting their practices.

The problem is that the power of critical reflection as an agent of change by mathematics teachers is only minimally realized (Artzt 2002). There is a need for the articulation of the processes utilized by mathematics teachers when using reflective teaching for understanding themselves, their practices, why they perform as they do when facilitating learning, and improving their practices. Thus, there is reason to believe that when mathematics teachers develop into better reflective practitioners more changes in the practices of mathematics teachers will occur. As accountability for mathematics teachers in the United States increases, more self-empowering mechanisms for mathematics teachers should ensue to equip teachers with the necessary tools for evaluation and improvement.

Purpose of the Study

The purpose of this autoethnography is to give a highly personalized account of the power of reflective teaching in constructing my identity as a mathematics teacher through self-examination, and to reveal the humility, desire, courage, and honesty necessary for change. This autoethnography tells my story from an inside perspective. My experiences, my challenges and my triumphs will be given a voice so that others in similar situations may gain better insight concerning their experiences. My

autoethnography, writing which provokes the reader to reflect, provides self-narratives about the power of reflection and introspection in examining and changing my practices. Reflective teaching is the conscious explicit inquiry into or reconsideration of instructional beliefs, practices, decisions or problems with the goal of enhancing student learning (Remler 2000). Reflective teaching can be a powerful method of enhancing teaching practices in the mathematics classroom. Dewey (1933) contends that teachers must be reflective practitioners who use reflective teaching to examine and improve their practices. Reflective teachers are those who are concerned with professional artistry and are willing to construct new teaching practices when they see the need to change those practices (Schon 1987). Schon (1983) refers to two types of reflection: reflection-on-action and reflection-in-action. Reflection-in-action refers to reflection occurring simultaneously as the action happens. Reflection-on-action refers to the process of reflecting after the action has taken place in order to improve the future implementation of the action. In this study, I use reflection-on-action.

In this study, I give detailed descriptions of my process of using reflection and introspection to scrutinize my pedagogy when teaching mathematics. My experiences of constructing knowledge about my teaching and using that knowledge to change my practices and role as a mathematics teacher will provide insight to others with similar goals. This autoethnographic study can serve as a vehicle to mathematics teachers who are in search of methods of examining and improving their teaching in an increasing era of accountability and a call for change in mathematics teaching practices. I invite readers from all disciplines to find facsimiles of their experiences in my narratives about identity construction, self-examination and change of practices. I want my story to fulfill one of

the purposes of autoethnography which is for "all people who can benefit from thinking about their lives in terms of other people's experiences" (Ellis & Bochner, 1996, p. 18). The research question guiding this autoethnographic study is: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change of practices?

Rationale of the Study

The rationale for my dissertation is based on the recommendation that more research on improving teaching be done (Kilpatrick 2001; Romberg 2003; Kennedy 2002; Hiebert 2003). Improving one's own teaching practices and documenting that process is a complicated endeavor, yet one that Hiebert (2001) advocates as a means to assist other teachers in improving their own practices. The Rand Report (Ball 2003) indicates that there are not enough resources available to classroom teachers on ways to improve their practices through self-examination. The report points to the fact that teachers should be provided with a knowledge base which provides insightful research findings on teaching practices which can be used to enhance their own. Lampert (2001) contends that this knowledge base is critical because without a professional discourse about classroom practice, education is in a weak position to improve itself. Hiebert (2001) suggests that this knowledge base can be strengthened as teachers construct knowledge about their teaching practices through experiential knowledge. Hiebert (2001) purposes using documented teacher knowledge as a means to provide research reports that will be meaningful and useful to classroom teachers in improving their own practices.

Standards-based instruction, advances in technology, greater expectations of teacher competency, the NCLB Act of 2001 and world competitiveness have cast an illuminating light upon how mathematics is taught in classrooms across the United Stated (Kilpatrick, Martin et al. 2003). Increased accountability and a call for improved student learning have shifted more responsibility to the mathematics classroom teacher for enhanced teaching practices when facilitating learning (Klein 2003). For mathematics teachers, enhancing their practices entails changing or abandoning non-effective pedagogical practices and developing new strategies for improved student learning.

In looking at the expectations placed upon the mathematics teacher community and my desire to gain a deeper understanding of my journey as a mathematics teacher, I felt it appropriate to tell my story in autoethnographic form. My study allows me to do something meaningful for myself and possibly the world (Ellis 2000). In the telling of my story, I am not proclaiming my findings as scientific truth or generalizable, but rather as my creative construction of my lived reality (Dyson 2007). Richardson (1995) contends that I am not writing for the purpose of representing an objective reality. I am writing giving my particular view of my constructed reality. Autoethnography is that form of writing (Reed-Danahay 1997).

Other professions have created ways to accumulate and share knowledge. For example, in the field of medicine there is case literature from which those in the field can learn. Lawyers have case law, which shows interpretations of previous court decisions, thereby assisting them with their cases. However, teachers have not fully developed a professional knowledge system with personal accounts of teacher self-study (Hiebert & Gallimore 2003).

Even though the reflective teaching process has been used in other disciplines, there is limited literature on using reflective teaching through autoethnography in the mathematics classroom. Heibert (2002) contends that the body of research in mathematics education is showing an appreciation for the knowledge of classrooms teachers generated through reflection, and the worth of this knowledge in addressing the issues of classroom practices in the mathematics classroom. Consequently, in an effort to change and improve the practices in the mathematics classroom, a broader knowledge base for teachers needs to be established and the knowledge of classroom teachers needs to be documented and available to teachers. This autoethnography contributes to that knowledge base.

Significance of the Study

My dissertation is important because I provide detailed descriptions of my process of change relative to my teacher identity, with emphasis on the factors that influenced the process (Clarke 1997). One of the challenges for the secondary mathematics classroom teacher is to make the classroom standards-based (Kilpatrick, Martin et al. 2003). With the standards-based classroom, the teacher should function as the orchestrator of classroom discourse and the facilitator rather than the validator (Herrera and Owens 2001). This autoethnography details my reflective journey of changing from the validator to the facilitator.

It was not until I videotaped myself teaching, as a requirement for a graduate course, did I come to realize the need to examine my own teaching practices for the reasons stated above. My identity was not one of a teacher-facilitator who prompted

students for discussion and reasoning. Much of my practice centered on my imparting procedures with inadequate connections. My students recited eloquently the algorithms and procedures given to them but they possessed minimal conceptual understanding of the underlying principles. Consequently, I realized that I needed to examine my practices more critically to improve in the area of engaging students in mathematical discourse for conceptual understanding. This seemingly small graduate assignment evolved into a major shift in my practice and perspective on my identity as a mathematics teacher. It was at this moment that the ownership of improving my practices became mine. It was at that moment that I realized what Lampert (2001) meant by stating that teachers are more accepting to examining and refining their practices when they see the need for change, rather than an observer who spends much less time in the teacher's domain. The videotape assignment was an epiphany of "I need to really look at what I am doing." I wonder how many other teachers who have been teaching for more than five years and consider themselves wonderful teachers would feel the same way. This dissertation can be useful for all who desire to change or assist others to change in a manner as I did.

Theoretical Framework

In this dissertation, I discuss who I am as a teacher, how I facilitate learning, and the effects my identity as a mathematics teacher have on my practices. My philosophical beliefs about how students learn have helped form my identity as a teacher. What do I believe about how students learn mathematics? Do I believe that students learn mathematics in a manner such that there are topics presented which require them to only do algorithmic operations (Jaworski, 1994)? Or do I believe that students learn

mathematics through thinking, discussing, agreeing, disagreeing, conjecturing, searching for formal or informal contradictions, and 'doing' mathematics (Stein, 2000)? In providing an answer to the above questions, I reflect on my methods, activities and interactions exhibited in my classroom. Therefore, my dissertation is guided by the theoretical perspective of identity theory as it relates to teacher identity.

In my journey of identity construction, I examined different perspectives of teacher identity to determine which seemed more appropriate for telling of my story. Johnson (2002) examined teacher identity construction from the perspective of social identity, which espouses that the concept of identity is based on social categories created by society. His perspective looks at the identity construction from the social identity theory viewpoint in which society denoted the characteristics of 'teachers'. On the other hand, Varghese (2005) looked at teacher identity construction through situated learning which allows a teacher to construct identity by becoming a part of a community of practice. For example, a group of mathematics teachers identifying with each other in a situated learning environment.

However, these perspectives did not speak to my need for identity construction because I wanted to construct my identity from a personal perspective. I wanted to construct my identity and describe my journey of change. Kelchterman (1993) does examine teacher identity from an individual perspective. He suggests that a teacher's identity evolves over time and is constructed by factors of self-image, job motivation, task perception and future perspective. This perspective does investigate the identity construction from a personal stance but the approach of Danielewicz (2001) was the best to guide my study.

In *Teaching Selves: Identity, Pedagogy and Teacher Education,* Danielewicz (2001) describes teacher identity as a 'state of being'. She contends that a teacher's identity is continuously being formed and that each teacher has a recognizable identity. Through working with pre-service teachers in teacher education programs, working with teachers already in the field, and drawing from the works of theorists Dewey, Vygotsky, Freire, Batkhtin, and Foucault, Danielewicz (2001) proposes 10 principles that constitute teacher identity development. Each principle is theoretically and pragmatically significant. Therefore, in constructing a teacher's identity, any principle individually or several integrated together may constitute the teacher's identity. This suggests that my identity as a teacher has individual principles but the principles are blended together to form who I am. The 10 principles are divided into two categories, structural and performative. Structural principles are those which should characterize the curriculum, classroom environment and inform the teacher's approach to the course methods and design. These principles are discourse richness and openness, dialogue and a dialogic curriculum, collaboration, deliberation and reflexivity. Performative principles, on the other hand, focus on the actions of the teacher. These principles are theorizing in practice, agency, recursive representation, authority and enactment.

In my study, I look for the recognizable characteristics of the principles proposed by Danielewicz (2001) in my practices. I also describe how the characteristics of the principles shape my practices as a mathematics teacher. I examine how taking on my identity brought about changes in the planning of lessons and the interaction with learners. Each of the principles has defining properties which should characterize the environment of the classroom and actions of the teacher.

Discourse richness and openness constitute fostering open communication between learners when facilitating learning. It is through discourse that reality is constructed for a community. This discourse allows one to construct an identity through communication which means connecting with others. Discourse richness and openness promote activity between students which causes them to understand how to process information when learning.

Dialogue and dialogic curriculum promote conversation in order to get a reaction. This principle propels participants to question, to listen, to answer and to agree. Knowledge is constructed by the teacher and students in a dialogic format rather than a transferring of the knowledge from the teacher to the student.

Collaboration is the principle which assists in identity construction through joint efforts; ideas shared and commonly held social values held by others. This principle involves identity constructed through social interaction with others holding membership in the same group, such as teachers. Collaboration is the principle which identifies membership individually and collectively.

The principle of deliberation activates the imagination to rehearse various courses of conduct by the teacher when facilitating learning. Deliberation prompts an experiment, in the mind, about the possibilities of certain actions. For the teacher, deliberation propels the thought process about the actions that will activate the curriculum into meaningful learning.

Reflexivity is the act of self-conscious consideration. The principle of reflexivity questions past activities and the circumstances of those activities. A dialectical process occurs because there is a review of self while taking into consideration the other.

Reflexivity is instrumental and involves active analysis of past situations, events and products with the explicit purpose of achieving understanding that can lead to change in thought or behavior.

Theorizing in practice is the principle that advocates theory is the account that action gives of itself. This implies that every act of teaching is embodied theory and theory enables or informs practice. This principle is transmutable and leads to creative, realistic practice which can be improvised and adaptable.

Agency is the principle which fosters the "I want to make a difference" attitude. Agency is the power or freedom or will to act; make a decision to participate, exert pressure or intentionally remain silent. Agency is interactive and is cultivated in the classroom by a teacher's attitude and expectations for students. Agency ignites action.

The principle of recursive representation denotes that a teacher's identity is constructed through representing the self to others as a teacher. These representations may come in various forms depending on the situation such as lesson plans or conversations. Representations may also be actions, behaviors, performances, simple or complicated, unitary or extended, happening in one form or in multilayered combinations of forms.

The principle of authority carries the most weight but is the most difficult to cultivate. Authority is exercised rather than possessed; meaning that authority generates a classroom where respect is generated for the one with authority. Yet, the one with authority breeds authority in learners. The students and teacher are partners in the discourse, yet the students are called upon to inspect, judge and question the topic under

discussion. The teacher's authority controls the environment of the classroom through a sense of community of thinkers rather than one of dictatorship of thought.

The principle of enactment connects teaching to the theory. With this principle, the teacher fully invests himself/herself into the constructed teaching identity. The activities, environment, discourse and interaction are brought to fruition when enactment is utilized. In exemplifying the principle of enactment, the teacher's behavior represents the teacher's theory in practice.

For this dissertation, identity theory guides my process of constructing my identity as a teacher. Additionally, constructivism and metacognition aid in constructing knowledge about my practices while establishing my identity. Constructivism helps me delve beyond the identity construction. Knowing my identity is the first step in understanding more about my practices and who I am. Constructivism contributes to that endeavor. Metacognition provides a mechanism for thinking through the process of how the theory assists in the identity construction, and what I learn about my teaching from knowing my identity.

Constructivism and Metacognition

Constructivism, which has many facets, is a theory of knowledge which has roots in the disciplines of psychology, cybernetics, and philosophy. According to Ernst von Glaserfeld (1987), the two main principles of constructivism are

1. Knowledge is not passively received but actively built up by the cognizing subject.

2. The function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality.

As a classroom teacher, the first principle implies that I construct knowledge about my teacher identity by accumulating lived experiences as I engage in the practice. I then connect the accumulated experiences to new perceptions and experiences to form new knowledge about my identity and practice. The second principle implies that as an individual, I adapt through cognition as I construct knowledge in my experiential world of teaching. As I face new encounters, the encounters either add to my experiences or challenge them. Amidst the adaptation, I organize my own experiential world of teaching. Simon (1995) states that constructivism derives from a philosophical position that we construct our knowledge of our world from our perceptions and experiences. These perceptions and experiences, which are mediated through our previous knowledge, help to formulate our world of reality, and assists in connecting new knowledge to the constructs already formulated. According to Vygotsky's theory of learning, I construct knowledge from interactions with others and the representations, meaning and constructs that I have learned through those interactions with others, in my study, my students (Dixon-Krauss 1996).

Vygotsky (1962) refers to learning through interaction with others as social constructivism. Ernest (1991) and Taylor & Campbell (1993) identify three key features of social constructivism:

1. Knowledge is actively constructed based on experiences and previous knowledge. The concepts and hypotheses constructed serve the purpose of guiding future actions.

2. Experience and interaction with the physical and social worlds play essential roles in the development of knowledge.
3. Knowledge is constructed intersubjectively, meaning that it is socially negotiated between the members of a community who are able to share meanings and social perspectives of a common lifeworld.

Critical constructivism also looks at constructivism with a social context, but adds a dimension aimed at reforming these environments in order to improve the success of constructivism applied as a referent (Dougiamas 1998). For teaching, the critical constructivist teacher engages students in a knowledge construction process which entails analyzing, interpreting and constructing a wide variety of knowledge emerging from diverse locations (Kincheloe 2005). Consequently, because I am facilitating student learning, critical constructivism promotes me to reflect on my practices for the production of myself as a mathematics teacher (Dougiamas 1998).

Constructivism is one of the many theories that has been used in research on student learning. However, minimal research has been done with constructivism and teacher learning (Simon 1995). Shulman (1989) suggests that even though there is an abundance of research on constructivism and student learning, much more research is needed as it pertains to constructivism and teacher learning.

This study communicates the power of reflective teaching and its impact on constructing an identity as a mathematics teacher and how the identity construction leads to changing one's teaching practices. In this study, I investigate the mathematical tasks, student-teacher interactions, student-student interactions and the impact of each of these on student learning. I construct knowledge as I interact with the students to determine

how my setup facilitates them in the working of the tasks. I have to understand my students' understanding in the mathematics classroom to determine the effectiveness of my teaching. During my interaction with the students and understanding how they are constructing their knowledge based on my setup and implementation, I am also constructing knowledge about my identity as a mathematics teacher. In the classroom, the students and I construct knowledge based on our shared meanings, which have been established through symbols, e.g., $\int_a^b f(x)dx$, $\lim_{n\to\infty}\sum_{i=1}^{\infty} f(x_i)\Delta x$, and communication in our mathematical community.

Metacognition is knowledge or beliefs about factors affecting one's own cognitive activities (Houston 1995). Simply stated, metacognition is thinking about thinking. Metacognitive thinkers are aware of their own thinking processes, have effective strategies to achieve their learning goals, and make conscious choices about how they are going to learn. They use executive control mechanisms to monitor their learning and adjust their strategies when they are not being as effective or successful as they would like. There are three aspects of these control mechanisms (Houston 1995):

1. Declarative knowledge- ability to describe some thinking strategies
2. Procedural knowledge- knowledge of how to use the selected strategy
3. Conditional knowledge- knowledge of when to use it.

In learning mathematics, Schoenfeld (1987) describes metacognition in three ways:

1. Your knowledge about your own thought processes-How exact am I in describing my own thinking?
2. Self-awareness or self-regulation-How accurately do I keep track of my processes?

3. Beliefs and institutions-What ideas about mathematics do I bring to my work in mathematics and how do they determine the way I do mathematics?

Limitations of the Study

This study is limited in its scope to the viewpoints and experiences relative to my teaching experiences. The experiences and personal accounts rendered do not necessarily produce generalizations. Another limitation of the study is the level of the students. These students are highly motivated and could be considered above average.

Summary

This autoethnography communicates the details of my journey as a mathematics teacher; a journey of identity construction, and one of how my practices changed as a result of my identity. In my story, I tell how I construct my teacher identity using memory, videotaped lessons, my reflective journal, and student commentary. The purpose of my story is to provide a deeper understanding of why I am the teacher I am and why I exhibit the characteristics I do. Danielewicz's (2001) ten principles of teacher identity construction serve as the basis for my identity construction.

Identity theory, constructivism and metacognition serve as the theoretical frame for the study. Autoethnography, a research approach about the experiences of the researcher, guides the methodological frame for the study. This autoethnography is written in narrative form and conveys my journey of identity construction.

In Chapter 2, I highlight literature which focuses on reflective teaching, autoethnography and teacher identity construction. I examine the research that has been

done in these three areas as it pertains to my study. The chapter connects the studies reviewed to my study and explains why I chose to reference the studies.

Chapter 3 details the research paradigm and methodology for the study. I provide information about how the supportive data sources were collected. I also discuss the analysis of the supporting data.

The analysis of the supporting data is given in Chapter 4. In addition, in Chapter 4, I communicate my identity profile and how I arrived at my conclusions. I describe how my practices changed as my identity changed.

I conclude my study with Chapter 5. I give a complete summary of my study and discuss the findings and implications. I also explore future research possibilities relative to my study. I discuss the benefits of future research for the larger research community.

CHAPTER 2

REVIEW OF THE LITERATURE

This autoethnography provides a first-hand account of the power of critical reflection in the construction of teacher identity, self-examination and change as a mathematics teacher. In this chapter, I have chosen to review the literature in three areas that best support my study. First, I investigate the literature regarding reflective teaching and its impact on teacher examination and change. I then examine the literature on teacher identity and how it is constructed. Finally, I delve into the burgeoning literature about autoethnography as methodology in qualitative research studies.

As I write this autoethnography, I am articulating the power of reflective teaching when constructing my teacher identity. I am also expounding on the power of reflective teaching in changing my teaching practices as a result of the teacher identity. The process of critical reflection requires an introspective glance into my world of methods and strategies when facilitating learning. My reflective procedure is an on-going, natural process which facilitates the development of future action from the contemplation of past and/or current behavior (Park Han 1995). The action follows from the thought process of reflection and the action is a type of artistry interwoven into my standard of practice (Osterman 1990). This implies that as I reflect on my practices, I interject any improvements I deem necessary as I continue to teach.

For example, Fulton (2006) showed the power of reflection by creating a model of self-study for the pre-service teachers at her institution. Fulton wanted to illustrate how

teachers can use reflective teaching to examine and refine their practices. Fulton incorporated collaboration as a part of the reflection process used in her study. Through collaboration, the pre-service teachers were able to discuss their personal beliefs and construct shared understanding in a social context which Zeichner (1996) promulgates as critical to the reflection process.

Through collaboration from a social perspective, Hung (2008) conducted a study using WebCT to illustrate how the participants' reflective practice online engaged them in identity construction and a shared understanding of good pedagogy. The collaboration aspect of reflection in a mentor-mentee situation was utilized by Dinkleman (1997) in a study with three pre-service teachers in a teacher education program. The purpose of the study was to promote reflective teaching in the program at the university. The study showed the influence teacher educators can exhibit with pre-service teachers.

Even though the preceding studies showed how reflection can involve a collaborative process of discussion about one's reflections, the process of reflection is also a personal experience. A personal perspective of reflection guides my study. The personal aspect of reflection is evident in the work of John Dewey (1933), who is credited with its inception. Dewey posited that reflective teachers should consider the physical environment of the classroom in conjunction with the differences in the students' motivation, intelligences and orientation. Dewey further stated that for a teacher to accomplish this, the teacher must be a well-educated professional who is actively drawing upon the tacit knowledge of the experiences and make decisions so students can learn and grow. As I investigate my practices, I should be open to improve in those areas for which the actions taken during instruction did not produce the desired

outcome in student learning. The reflection becomes personal as I strive to construct my identity and improve my practices.

Ross (1989) reiterated this point by defining reflective teaching as a way of thinking about educational concerns that involves one's ability to make rational choices and assume responsibility for those choices. Ross contends that the reflective teaching process has the following components:

1. Recognition of an educational problem
2. Responding to the problem by identifying the aspects that it has in common with previous problems as well as its uniqueness
3. Framing and reframing of the problem
4. Experimentation with the problem to find out the consequences and implications of different solutions, and
5. Determination of which solutions result in a desirable outcome.

Lampert (2001) conducted such a study on her practices using critical reflection. She collected data in an effort to explain her decision making process when teaching mathematics to students from a 'problem solving' perspective. Lampert's study used reflective teaching in a manner such that other teachers can use her model of decision making in examining and changing their practices.

Camacho (1997) also conducted such a study to investigate her delivery of instruction when teaching two seventh grade mathematics classes. Camacho delivered instruction on ten units and then received evaluations from her students on the delivery of instruction. In addition, she reflected on her own delivery of instruction. Modifications

in the delivery were made after analyzing the student feedback and her personal critique of the delivery. The student evaluation form included five questions: (a) On a scale of 1-5, how would you rate the lesson? (b) Before the lesson began, I thought that… (c) If I could change this lesson, I would … (d) The thing(s) that I really enjoyed most about this lesson was …, and (e) The thing(s) that I did not enjoy about this lesson was …. The study provided empowerment to both the teacher and the students.

As I reflect on my teaching, I should consciously consider my actions when facilitating learning to ascertain if my practice exemplifies my philosophical theory about teaching and represents my identity as a teacher. Griffith and Tann (1992) contend that reflection gives meaning to the theory-practice dialectic. The theory-practice dialectic maintains that when I consider the theoretical position underlying my instructional practice, my practice is enhanced. The theory-practice dialectic supported an action research study conducted by Draper (1994) to reflect on her practice as a teacher. She took field notes between September and December 1992 while teaching a class of thirty one third and fourth graders. Draper indicated that the study facilitated in developing her understanding the relationship between her personal and educational philosophies. She also noted that her identity as a teacher was constructed and her identity led to changes in her classroom activities when teaching.

Sprinkle (2001) also conducted a study related to the theory-practice dialectic. The study focused on four composition instructors reflecting on writing instruction theories. The instructors were investigating their feedback to writers and how their commentary aligned with the writing instruction theories also developed. The study

assisted the instructors with analyzing and establishing clear goals for their commentary and improved their commentary to writers.

This autoethnography provides insight into how my practices changed as a result of my teacher identity construction when using reflective teaching. Teacher identity construction is an area of recent research receiving great interest (Lipka 1999). A teacher's identity guides the practices of the teacher and the practices determine the effectiveness of the teacher with respect to student learning. The theory of learning, personality and understanding of self help to shape a teacher's identity, and the dimensions of that identity influences the practices and effectiveness of the teacher. Lipka and Brinthaupt (1999) suggest there are seven components of the framework that categorizes a teacher's concept of self and contribute to identity construction of the beginning teacher: (a) the developing self, (b) the performing self, (c) the significant self, (d) the salient self, (e) the environment, (f) psychological experiences and g) the behavioral dialogue. Each of these components falls into the area of physical environment, significant/salient other or internalizing/organizing psychological experiences. Therefore, with this framework, the teacher identity is constructed through the processes of internalizing and organizing psychological experiences. The experiences result from an exploration of the environment by the teacher and a reflective look at how significant/salient others view him/her. For my study, one aspect of my reflection uses the commentary of my students as the salient others.

Alsup (2006) highlights another perspective of teacher identity construction. This perspective states that teacher identity is constructed through 'borderline discourse'. Borderline discourse contends that a teacher's identity is constructed from a mixture of

the personal and the professional. Kelchtermans (1993) suggests that there are unavoidable interrelationships between personal and professional identities. He expounds on the notion that teachers identities are constructed based on the teachers' personal experiences, the social, cultural and institutional environment in which they function on a daily basis. Kelchterman (1996) conducted a study with ten Belgian primary school teachers and found that the two recurring themes in the teacher identity construction were stability in the job and vulnerability. The vulnerability aspect related to the judgment of colleagues, the principal, parents or other outside entities. These two themes support the interrelatedness of the personal and professional in identity construction. Day (2004) states that a positive sense of identity with subject, relationships and roles is important to maintaining self-esteem or self-efficacy, commitment to and a passion for teaching which centers around one's identity as a teacher.

Gee (1996) defines discourse as different ways in which we humans integrate language with non-language "stuff" such as thinking, acting, interacting, valuing, feeling and believing as to enact and recognize different identities and activities. Gee posits that discourse has more significance for identity formation and enacting local change. This local change occurs through the discourse and the process of change is then articulated. As I write this autoethnography, I communicate the process of my changing as a teacher.

Varghese, Morgan, Johnston and Johnson (2005) articulated the process of teacher identity construction in their study. Johnson (2002) investigated the identity construction of a new nonnative language teacher. The perspective used in the study was social identity theory. Social identity espouses the concept of identity based on the social

categories created by society. Individuals, therefore, construct identities from the social categories to which they belong. Johnson (1992) collected data on a Mexican woman enrolled in a two year Teaching English to Speakers of Other Languages Program at a large urban university in the United States. Johnson articulated that the participant had difficulty in constructing her identity as a teacher of a second language because she was also a student of the language. The participant had to reconcile the social aspect of who she was to be as teacher of a second language but also who she was to be as a student of the language. The participant had to establish an in-group identity that was positive and supporting for her to develop a positive self-esteem which keeps with the motivations outlined in social identity theory. She therefore attended a convention of Teachers of English to Speakers of Other age's convention to establish a sense of belonging and comfort that she was not "the only one." Social identity theory as a framework was valuable in this particular study because it provided the participant with a better understanding of self through an association with a social category.

Varghese (2005) conducted a study of teacher identity construction from the perspective of situated learning. He observed a group of bilingual teachers, pre-service and in-service, in the United States who were enrolled in a program to address bilingual concerns. Situated learning makes the link between learning and identity by viewing learning as an identification process. This identification process was done through learners developing with peers and master teachers. The strength of the use of situated learning in teacher identity construction is viewing teacher learning as a process of becoming rather than what a teacher should know.

Morgan (2002) examined teacher identity construction from the perspective of identity as pedagogy. Through self-reflection and student participant observation notes collected over several months, Morgan constructed his teacher identity. Morgan found that those aspects of his personal or professional identity that might be of pedagogical value would need to be discovered based on emergent factors in the classroom. Morgan formulated through his study that the construction of teacher identity as pedagogy does not necessarily guarantee prescribed outcomes but opens up the possibilities for enhanced teacher identity which can inspire unlimited student learning. He concluded that the influence teachers have on students' present learning and future learning depends heavily on the teacher's identity.

The aforementioned studies, with the exception of one, about teacher identity construction articulated the process of the identity construction from the perspective of the researcher as told by the participants. However, the interest in research written by the researcher, autoethnography, has significantly increased in recent decades (Chang 2008). Unlike traditional research, autoethnography embodies self-consciousness, feelings, emotion and dialogue (Ellis 2004).

Such emotions are revealed in an autoethnography by Lewis (2007). Lewis (2007) sought to shed light on individuals with disabilities in her autoethnography about tragedy, travail and triumph. Lewis wrote concerning her change of identity from an able-bodied individual to one with a disability. The disability occurred during her matriculation through a doctoral program at a major university. Lewis' goal was to gain self understanding and to provide understanding about the plight of those whose identity

changes from able-bodied to one with a disability. Lewis triumphed through her identity change and felt compelled to articulate her process.

In my study, I am providing a first-hand account of teacher identity construction and change. Burisek (2006) conducted a similar study describing her journey as a professional teacher. Burisek detailed the developmental steps and stages of becoming a professional teacher. Through the process of developing, Burisek shared the difficulties and accomplishments for others experiencing the same or similar situation. The personal account given by Buriek provided nuances of the process not experienced by a researcher who investigated Buriek's encounters as a teacher.

My study reveals both the positive and negative aspects of my teaching practices. Jerome (2006) brought to light the positive and negative experiences of his educational experiences in his autoethnography. He shared the dilemma he faced when trying to find identity within a group, yet the group considered him an outsider. Jerome used the auto ethnographic experience to reveal the pain of identity construction in a poignant way, thus illustrating the emotional and personal evocation of autoethnography as method. In his autoethnography, Dethloff (2005) wrote about the complexities, interpretations and reflections of a principal in transition from one elementary school to another elementary school in the same district. Dethloff chose autoethnography as method because he wanted to offer the insider's vantage point to the introspection and evaluation involved in the process of transition. His study chronicled the experiences of an administrator going from one school to another, whereas my study chronicles my experiences of transitioning from one stage of teaching to another. Dethloff conducted his study to strengthen his practices and to provide insight for others in the position called the principalship.

One of the purposes of autoethnography as method is to provide insight into the area of concern from an insider's viewpoint. The insider's viewpoint evokes the readers to immerse them into the writer's situation, looking for similarities to their circumstances, thus bringing about better understanding of themselves as related to the topic under investigation (Chang 2008). Liddell (2007) conducted an autoethnographic study describing her use of reflection in illuminating her journey as an African American female student going through a doctoral program. Liddell imparted knowledge about her experiences whereby others like her could benefit from her courage and the power she gained during the experience.

The examination of the literature on reflective teaching, teacher identity and autoethnography has been the primary focus of my literature review. The goal of my study is to provide a highly personalized account of the power of critical reflection in constructing my identity as a mathematics teacher and the changes that resulted in my practices because of my identity. The literature review discussed in this chapter provides snapshots of the power of reflective teaching regardless to the discipline or school setting. The review also emphasized how one's identity as a teacher weighs significantly on the practices and efficacy of the teacher. The review points to the fact that autoethnography as a method of qualitative research is ever increasing. As I write the narratives depicting my journey of identity construction and change as a mathematics teacher, the studies discussed help shape and form the account of my experiences. The key areas of review contribute to a better understanding of constructing my teacher identity and chronicling the process of change in my teaching practices.

CHAPTER 3

METHODOLOGY

The Dilemma

After 28 years of teaching mathematics, I realize that my journey as a teacher has been filled with accomplishments and disappointments. The many facets of teaching have caused me to ponder about my efficacy as a teacher and how to improve my craft. I have often been asked, “How do you do what you do?”, and, “How are you successful as a teacher?” For these two queries, I did not necessarily have an adequate answer. I did not want to begin expounding on the strategies that I have used that work for fear of sounding narcissistic. Nor, did I want to appear arrogant to the point of being a perfected practitioner because I am not. However, the questions posed did spark a series of thoughts about my journey as a mathematics teacher. I knew after twenty eight years of teaching that I was not the same as when I started. Many changes have occurred and those changes have taken place because of my desire for self development as a teacher. I knew that as a mathematics teacher there are certain characteristics that I have and actions that I carry out as I facilitate learning. In other words, I possessed an identity as a mathematics teacher; however, I could not articulate it.

This study is borne out of my curiosity about my identity as a mathematics teacher. My curiosity was further piqued while doing course work in graduate school. I wondered, what is my identity as a mathematics teacher? How do I facilitate learning? How do I improve what I am doing: the facilitation? I realized the ownership of

answering these questions was mine. I also pondered about the many other mathematics teachers whose situation bears resemblances to mine and are having the same dilemma. I thought, "Could telling my story have a two-fold effect? Could I gain insight about my identity as a mathematics teacher and provide narratives that present verisimilitude to fellow practitioners who could benefit from my experiences?" The question guiding this study is: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change of practices?

Qualitative Research

The research methodology for this study is autoethnography which is categorized as a qualitative research approach. A qualitative research approach is one in which the inquirer often makes knowledge claims based primarily on constructivism, post positivism, pragmatism or advocacy/participatory perspectives or a combination of these (Creswell 2003). A qualitative research approach involves an interpretive, naturalistic approach to the world which indicates that qualitative researchers study things in their natural settings (Denzin and Lincoln 2000). The objective of investigating in the natural setting is to interpret the phenomena in terms of the meanings people in the natural setting make of their experiences. For this study, it is the meanings I formulate while constructing my identity as a mathematics teacher. Some characteristics of a qualitative approach are (a) the data is collected as words, (b) the outcome is a process rather than a product, (c) the focus is how the participants make sense of their lives and experiences, and (d) the language is expressive (Creswell 2003). The qualitative researcher's goal is to better understand human behavior and experience (Bogdan 2007). This qualitative

study is conducted using autoethnography, a burgeoning form of research and writing about the self (Ellis 2004).

Autoethnography

Autoethnography is a form of ethnography which makes the researcher's life and experiences the focus of the research (Reed-Danahay 1997). Ethnography is a research approach which focuses on learning about the social and cultural life of communities, institutions and other settings. Ethnography takes the position that human behavior and the ways in which people construct and make meaning of their worlds and their lives are highly variable and locally specific. The product of ethnography is an interpretive story or narrative about a group of people (LeCompte 1999). Ellis (2004) states that ethnography is a research approach which describes people and culture. In autoethnography, the researcher is the subject, and the researcher's interpretation of the experience is the data (Ellis and Bochner 2000). This inquiry method allows the researcher easy access to the primary data source which is the researcher. This easy access makes the researcher's perspective a privileged one over other researchers in data collection and analysis (Chang 2008). Since its inception nearly two decades ago, autoethnography's meaning and applications have evolved. Autoethnography is also described as personal narratives, narratives of the self, personal experience narratives and self-stories, first person accounts and personal essays (Ellis-Bochner 2000). Autoethnography is self-reflexive research delving into the self and the social (Reed-Danahay 1997). Unlike other forms of qualitative research where the researcher is expected to keep personal bias from the writing, autoethnography is written in first person voice. The first person accounts provide richness in the descriptions of significant

events, people and cultural norms. Readers of autoethnographical literature enter the inner workings of the social context studied and are invited to intermingle their experiences with the author's. Patten (2004) describes this experience as somewhat of a collaborative journey between the reader and the author. This study examines and describes my experiences of changing my practices due to my identity as a mathematics teacher and illuminates the profundity of critical reflection in the process. Jones (2002) contends that telling my story, I am setting a scene, weaving intricate connections among life and art, experience and theory, evocation and explanation.

Autoethnography is research, writing, story and method that connect the autobiographical and personal to the cultural and social (Ellis 2004). As I construct my identity as a mathematics teacher, I do so using my philosophy of learning which is personal, and the events which occur in the culture of my classroom which involves social interaction. Autoethnography stands at the intersection of three genres of writing: (a) native anthropology, (b) ethnic autobiography, and (c) autobiographical ethnography (Reed-Danahay 1997). Geertz (1983) refers to autoethnography as a blurred genre because it overlaps with writing practices in anthropology, sociology, psychology, journalism and communication. Denzin and Lincoln (2000) describe autoethnography as a genre of writing and research that connects the personal through multiple layers of consciousness. Using their description, as an autoethnographer, I first gaze through an ethnographic wide-angle lens which allows me to focus outwardly on the social and cultural aspects of my personal experiences; I then make interpretations as I make myself vulnerable through the process. This vulnerability implies that as I give details, reflect, and take an introspective perspective, I confront characteristics and practices about

myself that may be less than flattering. As I convey my story, autoethnography exposes that vulnerability to a larger audience. Ellis (2004) further expounds that autoethnography is writing about the personal and its relationship to culture. Because culture is comprised of self and others, autoethnography is not a study simply of self alone. Autoethnography is a study of self as the main character with others as supporting actors in the lived experience (Chang 2008). In this dissertation, I describe my story of constructing an identity as a mathematics teacher and changing as a mathematics teacher but I cannot effectively describe that change without the supporting actors for this study, my students.

Chang (2008) poignantly states that autoethnography has become a powerful source of research for practitioners in the fields of humanistic disciplines such as education, counseling, social work and religion. The nature of the writing of autoethnography lends itself to appeal to readers more than conventional scholarly writing because the author's voice resonates from the page. The sharing done in autoethnographic writing permits the readers to understand themselves better and also gives the writer more insight about self and others. The writing therefore can transform the lives of the writer and reader in the process of the exchange of experiences. As I share my experiences, the lives of those reading my story can possibly connect their lives to my experiences and undergo a transformative moment.

Autoethnography has close ties to phenomenology and hermeneutics. Phenomenology rejects scientific realism and the view that empirical sciences have a privileged position (Schwandt 2001). Phenomenology questions and describes the experience a person encounters. It aims to identify and describe the subjective experiences of the researcher on a daily level. Phenomenology does not construct a

theory of explanation but offers the possibility of insight that illumines experience (Van Manen, 1990). Examining all aspects of a personalized experience allows the researcher greater opportunity to arrive at the core meaning of the experience.

Hermeneutics is the nature and means of interpretation. It is the study of interpreting meaning. Hermeneutic research would ask the question: What does this experience really mean? It is within this vein that autoethnography is situated. In autoethnography, the researcher is studying him or herself within a subculture and attempting to make meaning of all of the experiences in this setting. A hermeneutic approach helps us connect our thinking with our experiencing of reality (Raudenbush 1994). As I write this dissertation, I connect my thinking to constructing my identity as a teacher and share the relevance of the identity to my practices.

For this dissertation, autoethnography is the choice of methodology because I tell a story of change, combine experience and theory, use narratives with explanations, hoping for readers who will bring the same careful attention to my words in the context of their own lives (Lewis 2007). I provide text that will evoke emotional experiences in readers and impact readers' lives, especially mathematics teachers (Ellis 2004). In choosing autoethnography, I am asking readers to feel the truth of my story and to become co-participants, engaging in the storyline morally, emotionally, aesthetically and intellectually (Ellis 1996).

For this study, through reflection, I employ the narrative approach to tell my story (Denzin and Lincoln 2000). Ellis (2004) notes that 'narrative' refers to the stories people tell----the way they organize their experiences into temporally meaningful episodes. Using the narrative approach, the researcher becomes the object of research

and the text repositions the reader as a co-participant in dialogue and thereby rejects the orthodox view of the reader as a passive receiver of knowledge (Ellis 2000). As I tell my story, I seek to activate subjectivity, compel emotional response, offer lessons for further conversations and substitute the companionship of intimate detail for the loneliness of abstracted facts. Narratives offer perspectives on events and permits past memories to be fully present in the moment toward shaping the future (Lewis 2007). Narratives provide the catalyst to answer the question, "What is happening here?", and provide the author and reader with a deeper understanding of the social setting and aids in the construction of meaning. Richardson (1994) contends that the narrative provides a way of finding out about one's self and the topic under investigation; a way of knowing and discovering new aspects of the topic and one's relationship to it. As I write my story, I gain insight about who I am as a teacher. I want the readers to situate themselves in the story whereby it evokes the readers to look within themselves for connections to their lived experiences and how the story can help to shape their future.

Research Design

My research design describes the guidelines used to connect the theoretical perspective to the strategies of inquiry and gives the methods for collecting the empirical material (Denzin and Lincoln 2000). As I make the connection, I make observations, interpretations and analyses of the situations in my constructed reality. A research design is to a researcher as a road map is to a vacationer or a blueprint is to an architect or contractor; it tells the investigator how to proceed (LeCompte 1999). My research design situates me inside of the culture in which I am the researcher and topic of investigation.

The purpose of this autoethnography is to detail, explain and make meaning of my experiences (Ellis 2004). This process assists me and the readers in gaining insight into the behavior and dynamics of the topic being investigated. The construction of my identity as a mathematics teacher entails an introspective look at my actions as a teacher and how those actions define who I am as a teacher.

My actions as a teacher can be perceived in different ways depending upon the viewer and receiver of the action. For my study, as I tell my story of constructing my teacher identity and changing my practices, I am recalling, journaling and viewing my actions. In addition, my students who are the prompters and receivers of my actions make commentary about my actions in facilitating learning. The commentary provided by those with whom I interact when facilitating learning contributes to the interpretation and analysis of my actions as a mathematics teacher.

The Metaphor

In a similar manner of Janesick (1998), Lakoff (1999) and Dyson (2007), I chose to employ a metaphor to tell my story of constructing my identity and how my practices changed as a consequence. Bruner (1986) posits that there are two modes of cognitive functioning which order experience or construct reality: argument and story (narrative). An argument persuades listeners and readers about truth based with an appeal to particular procedures, which have been developed to establish formal and empirical truth. On the other hand, a good story convinces the listeners and readers because of its lifelikeness; it verisimilitude. A metaphor can be a part of a story that captures the

lifelikeness. A metaphor brings the imagery and scenery into the story that words alone cannot describe (Dyson 2007).

Through the "metaphor of dance," Janesick (1998) corrals the essence of qualitative research design. Janesick remarks, "because dance is about lived experience, it seems to me the perfect metaphor for qualitative research design" (p. 209). Dyson (2007) appreciates this viewpoint of the metaphor. He contends that the qualitative researcher in using metaphor is ordering thought, experiences and is constructing a reality about lived experiences rather than using particular procedures, to generate or establish formal and empirical truths. He says,

> It is my understanding that metaphor has the power to take us to where we have not been, or ever perceived we could go. Metaphor, because it generates lifelikeness, seems to have the power to move a human being to new levels of consciousness and perception as the various parts of a journey story unravel, are investigated and pondered. (p. 41)

Using the works of Lakoff (1990) and Dyson (2007), the metaphor for my study is a "journey of discovery" metaphor. I use the journey metaphor because it provides an essential ingredient for my study: Freedom (Dyson 2007). In using the journey metaphor, Lakoff (1999) points to the fact that freedom alludes to a destination undetermined and discoveries yet unknown. For my study, I am constructing my identity as a mathematics teacher; however, I do not know the scope of that construction. Where will it lead me? What will I further understand about myself? Freedom grants me the professional and personal responsibility to be open to discover what is within me and outside of me which contributes to the identity construction.

In constructing my story, I utilize four phases to apply the journey metaphor to the various components of my research study (Dyson 2007). In the first phase of the journey, I recall the many aspects leading to my desire to take the journey. This phase is the "why" phase. These aspects include my memory of the beginning stages of teaching. What were my practices? How did I facilitate student learning? What sparked a desire to grow as a mathematics teacher?

The second phase of my journey is the "resources" phase. This phase acquaints me with the literature that can aid one on such a journey of discovery. I investigate the literature on reflective teaching, identity construction and autoethnography to determine how others have utilized the resources on their journey.

The third phase of my journey is the stage of putting the resources to work for me. This phase is the "findings" phase. This phase is the investigation of the supporting data sources and what the data show. This phase contributes to reaching some possible conclusions relative to the findings.

The fourth and final phase of my journey is the "gathering" phase. This phase is the gathering of all of the information to make meaning of the journey. This phase is the analysis phase to assess, probe, and interpret the findings garnered along the journey.

Archived Data

For my study, the observational, self-reflective and external data are archived data. The observational data consists of four videotaped lessons where I setup and facilitate the students in an advanced placement calculus class in four tasks. Each of the videotapes is of a different task being implemented. The videotaped lessons were a part

of a staff development initiative for my local school district. The videotapes were to assist mathematics teachers in my county with implementing standards based classroom practices for the new mathematics curriculum adopted by the state department. The four videotapes were done over a four week period in the spring semester of the school year. I wrote anticipated learning outcomes and reflections on each lesson. The students provided commentary about the facilitation of each lesson. In addition, the students were given a pretest before the administration of the four tasks covering prerequisite material covered in the tasks.

In the setup and implementation of each task, there were nineteen students in the class. The students were in groups of three or four students. The students selected their own groups. Each student was given an individual task but they worked collaboratively in their groups. Each student turned in the task upon its completion. After each task, the students then provided commentary about their impressions of the task implementation. When designing this study, the videotaped lessons are so apropos to my research objective. The supporting data sources contribute to the construction of my teacher identity and support the abandoning or retaining of certain practices used in facilitating student learning.

Data Collection and Analysis

In this auto ethnographic study, I am the primary data source. The experiences for this study of teacher identity construction and change of practices are recounted by memory, self-observational (videotaped lessons), self-reflective (journal writing), and external data (student questionnaires) (Chang 2008). The memory, self-observational and

self-reflective data capture the past and present perspectives of my lived experiences. The external data source of student questionnaires about the videotaped lessons provides additional perspectives and contextual information as I write the narratives. The ten principles proposed by Danielwicz (2001) in constructing teacher identity provide the frame for viewing and analyzing the videotaped lessons.

The supporting data for this study: videotaped lessons, student commentary and my reflective journal were used to identify the principles of my identity. In identifying the principles, I used nine different highlighter colors, one for each of the nine principles (enactment cannot be highlighted), as shown (Table 1) to code each of the data sets.

For example, with the videotaped lessons, after transcribing the lessons, I examined the content of the dialogue and color coded the transcription to indicate which of the principles had properties in the dialogue. If the interaction promoted discourse richness, I color coded that vignette red. In examining the student commentary, I color coded each of the comments according to the property of the principle to which it pertained. For example, if students indicated that agreeing, listening or questioning helped their learning, I color coded the response pink. The entries in my reflective journal were color coded in a similar manner. In Chapter 4, I have color coded some of the text to indicate the process of color coding the data.

Quality

In traditional forms of research, the terms generalizability and validity are used to refer to the possible duplication of findings in a similar study and the degree to which a study accurately reflects or assesses the specific topic. However, Feldman (2003) contends that these words should be replaced or augmented with quality when

Table 1

Teacher Identity Characteristics Coding

Principle	Characteristic	Color
Discourse richness and openness	Promotes open communication between learners	Red
Dialogue and dialogic curriculum	Promotes questioning, listening, answering and agreeing	Pink
Collaboration	Sharing ideas of common ideals with other peers	Peach
Deliberation	Makes the curriculum meaningful to the learner	Orange
Reflexivity	Questions past activities for assessment	Indigo
Theorizing	Creative, realistic practice	Green
Agency	Decision to participate, pressure or remain silent	Blue
Recursive Representation	Represents self to others in multiple ways	Yellow
Authority	Controls the learning environment	Purple

referencing autoethnography. Feldman posits that, "as teacher educators, we must study ourselves to understand the ways that we construct who we are and to change those ways, if necessary, in becoming better teacher educators (p. 27)." Feldman indicates that these narratives of studying ourselves then translate into research literature of value because of the quality and rigor they possess. The quality and rigor of the research capture the readers, who authenticate the literature's believability, credibility and coherence, thereby replace accuracy as a warrant for validity (Lincoln and Guba 1985). Ellis (2004) indicates that a story's generalizability is always being tested, however, not in the traditional way through random samples of respondents, but by readers as they determine if a story speaks to them about their experiences or the experiences of others they know.

To strengthen the rigor and validity of an autoethnographic study, Feldman (2003) suggests four criteria: (a) provide clear and detailed descriptions of how data is collected

and what counts as data, (b) provide clear and precise descriptions of how the representation of the data is constructed, (c) provide multiple sources of data, and (d) provide evidence that the research produced change and added value to the body of knowledge for the profession. Bochner (2000) posits that autoethnography takes on the rigor of any legitimate qualitative research because many auto ethnographic projects have produced various methodological strategies which are incorporated in other forms of qualitative research. The acceptance of the validity and quality of autoethnography is championed by Reed-Danahay (1997) who suggest that autoethnography is more authentic than straight ethnography due to the fact that the voice of the insider is assumed to be more true than that of the outsider.

The opponents of autoethnography question the veracity of a story about the researcher as told by the researcher (Phillips 1987). However, in an interpretive, naturalistic approach, the truth has many faces. Autoethnography provides an opportunity for readers to draw from the author's experience to enlighten their understanding of a particular culture. Autoethnography analyzes culture, behavior, and human interaction and enables the researcher to create an objective understanding as both informed insider and analyst outsider (Cunningham & Jones 2005). Autoethnography is evaluated on descriptive details, structurally complex narratives, standards of ethical self-consciousness, and a moving story. Also, autoethnography should emotionally arouse, cognitively engage, and stimulate social action. Increasingly, attitudes are changing about the legitimacy of autoethnography, and writers are encouraged to make personal narratives evocative, engaging and personally meaningful (Ellis & Bochner 2000).

Empirical Conversation

My study involves a conversation with myself about the accuracy of my description of my identity construction and changing as a mathematics teacher. This study provides evocative narratives which depict my conversation with myself about the processes of identity construction and how meticulous I adequately detail their occurrence. The construction of knowledge about my teaching practices occurs as I converse with myself about the past experiences, present observations and future possibilities. In the dialogue with myself, I have to ask the questions, "Am I really looking closely in the mirror at my practices?" "Is my writing convincing to the reader as to its validity and truthfulness?" "Have I really exposed who I am and how I got to be me?" "Have I really changed?" These questions should be answered if I am to bring credibility and trust to my research (Feldman 2003).

Ethical Considerations

My study entails my lived experience or journey of teaching mathematics and how I constructed my identity as a teacher which resulted in changes in my practices. Therefore, the ethical considerations for my study will be for the supporting participants who were a part of my teaching culture. The issues of teleological, covenantal, critical theoretical or a situational approach of research ethics are not germane to my study (Tisdale 2004). If verbatim or summary transcriptions are used in the narratives, pseudonyms will be used when referring to supporting participants.

CHAPTER 4

THE UNRAVELING

The Preconceived Identity

Imagine…four empty chairs in a row…my inventive classroom…my fictitious adolescent students…being occasionally chastised with my disciplinary belt in hand. Yes, I would actually thrash the unoccupied chair as if a living, breathing, disruptive or nonresponsive student resided there!!! "I am in charge!!!", I would say to my imaginative students. My authority was established because I possessed the Enforcer, my leather belt. In my mind, every effective teacher possessed the Enforcer, and I thought that instilling the 'fear of God' in students would solve all problems ever encountered when teaching. So, in my naïve, young, perfect world of teaching I knew what actions to take upon becoming a teacher. My, my, did I have a great deal to learn about teaching and myself. I thought the one characteristic that I needed to be an effective mathematics teacher was to put the fear of God in my students. My perception was totally wrong. Teaching was so much more and required so much more of me.

This chapter conveys how the phases of my journey aided in constructing my identity as a mathematics teacher, which reveals my characteristics, and how my methods of teaching changed as a result of that identity; methods far different from those when I began as a neophyte. This chapter reveals my introspective glance at my actions as a practitioner, the analysis of student commentary as it relates to the classroom environment which my identity should depict, and my observational findings about my

practices when facilitating learning. I open myself up as I delve into who I am as a teacher, and how I got here and who it is that I am. This chapter concentrates on my reflections and the data analysis in answering the question that guides this study: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change?

Reflection: I Am a Teacher, Now What?

There I was, headed for my algebra class on the first day of my teaching journey. What will they think of me? Will they ask me questions that I cannot answer? Will this be like student teaching? Wait!!! I did my student teaching in music and this is mathematics! Oh, my, I have not done mathematics teaching before! Well, the principal told me 'all' of the students wanted to learn, so of course the students will help me out if I stumble over any of the concepts.

Oh, well, I discovered that the principal stretched the truth; all of the students were not eager to learn. And, I was deceiving myself thinking that a class of young adolescents would help a first year teacher. I was a dart board; they each had a dart aimed and ready to throw it at me if I made a mistake.

There was no teacher mentor, nor was there someone with whom I could confide my trepidation because if I expressed my true thoughts, I would be perceived as weak and in need of someone to hold my hand. I could not reveal those apprehensions! I can do this, I thought…but HOW?

How did I do it starting off? I did what most of my previous mathematics teachers did. I got the teacher's edition and started with the first section in the book and

proceeded section by section. Did I make sure the topics were connected? Definitely not!!! I was trying to stay one day ahead of my students. I had to refresh my memory with some of the material or simply learn it. Oh! I had the mathematics degree, however some of the concepts were learned long ago or I learned them from someone but was never faced with the task of teaching the concepts to others. The task was a daunting one. So, I stood in front of my classes with the teacher's edition in my hand and covered the content in each section. I did not meander from the author's explanation, especially in geometry, for fear of taking a direction from which I could not return. The greatest fear was getting a question from a student for which I had no answer.

For example, one day in an algebra class, I was telling my students how to write an equation of a line in slope intercept form when given two points. I showed them how to find the slope using the formula $m(\text{slope}) = \frac{y_2 - y_1}{x_2 - x_1}$, where the points are (x_1, y_1) and (x_2, y_2). They proceeded to write the equations of the lines for which I had given them two points. After writing the equations, I told them that x = a is an equation for a vertical line which has no slope. I told them that y = b is an equation for a horizontal line which has a slope of zero. I quickly rushed through this phase of the lesson for fear of questions. Not so lucky……..Sally Pain raised her hand and said, "Why does a vertical line have no slope?" I paused…I honestly did not know how to answer the question but I tried to fake it...bad idea!!! Sally knew that I didn't know and she became agitated with my attempt to placate her. She said, "Just say you don't know."

That was an embarrassing moment and one that I shall never forget. However, I learned one lesson from that experience and that was to indicate to my students if I did not possess an answer. I realized that I should say, " I don't know the answer to that

question but I will get back to you on that." I also realized that I had a long journey ahead of me. That situation educated me that my preparation time was inadequate and my content knowledge needed refinement.

I continued to teach from the book, never letting it leave my side, section by section. When I taught my first geometry class, I kept the teacher's edition in my possession so I would know the answers to the questions. I would read the answers to the true-false questions to my students or ask the student whether they got true or false, without any justification. I did not ask for justifications because I was not sure of the reasoning myself, so how could I critique their responses with any sense of approval?

I remember the day my department chair came in for an informal observation. "Not geometry, I thought, why not algebra?" At least I know the algebra somewhat better than the geometry. My department chair indicated to me that I needed to ask the geometry students for reasons for the answers they were giving. I wanted to ask him for a script on how to do that but I could not do that because he would surely tell the principal that I was not suited for the job. I wanted to perform better as a teacher so my students could perform more proficiently. I wanted to do a better job, but how? How could I foster the classroom that Mrs. Perdue, my seventh grade teacher, managed so well? I knew I wanted my students to walk away from my class with a different experience in learning. I wanted my class to have a distinct atmosphere of learning. However, I realized that I had to establish the atmosphere for which I yearned. I needed an identity as a mathematics teacher so that my practices could produce the atmosphere I desired. But, how could I construct that identity and what would it look like.

Searching for Identity

After diligently studying and burning the midnight oil, I eventually taught some classes without having the book by my side to answer every question posed. Note the emphasis on "some" classes. Even though the ability to transmit information in facilitating learning improved, the question of how the facilitation occurred continued to manifest itself. Was I doing enough to really facilitate quality learning for my students? In other words, I was concerned about my pedagogy.

I became very concerned about my pedagogy when I did not pass my first official round of observations as a mathematics teacher. For the observations, I was required to submit a portfolio of lesson planning and the implementation of those lessons as my principal, department chairperson, and county coordinator observed. Each one did a separate observation during the same week. After all of the observations were over, they informed me, as a group, that I had some work to do as a teacher. They informed that I did not pass the observations. The events of that week struck a nerve within me. I had to grow as a teacher. I had to take on the task of examining my pedagogical practices to ascertain if what I was doing facilitated student learning.

So, I continued to teach. But, teaching with a sense of finding my 'niche' as a teacher. What was my philosophy about how students learn mathematics? How could I best facilitate students in that process? Where could I go to possibly get better, I thought? Ah!!! Graduate school!!!

My graduate class experiences exposed me to different philosophies of teaching and practices related to those philosophies. So, I pondered about my philosophy and classroom practices. Did I need to change my ways of facilitating learning? Perhaps!!!

The recommendations for teachers to change their practices from the National Council of Teachers of Mathematics (NCTM), the National Assessment of Educational Progress (NAEP), and noted mathematics educators provoked me to re-evaluate my practices and how I facilitated learning.

So, I did evaluate what I was doing and began to change my practices. I tried to engage students more. I had them to go to the board and explain problems. I stopped doing all of the explaining and let the students explain. I started doing group work with my students. Yes, I was somewhat afraid at first but I wanted to do it. So, I did. Eventually, I was asked to teach an analysis class, which was a big step for me. When my department chair decided to retire, he said to me, "Mr. Stinson, you will have to bite the bullet and teach advanced placement calculus." Wow, I was shocked and glad that he thought enough of me to ask me to teach the course. So, I dedicated myself to doing a great job of teaching the class.

As I began the process of writing my story, I thought, "Are there characteristics that I exhibit as a teacher which gives me an identity as a mathematics teacher?" Do the environment and the interactions in my classroom exude who I am as a teacher? I wanted to construct my identity as a mathematics teacher. Little did I know that constructing my identity as a mathematics teacher would carry me on a journey of self-awareness, self-inner examination, self-embarrassment, self-observation, self-actualization and self-improvement.

The Process of Construction

Wow!!! I never thought that I would discover so much about myself as a teacher when this journey began. Identity construction is revealing, enlightening, humbling, continuous and intense.

Identity construction is revealing because through this process I gained more insight as to who I am as a mathematics teacher. Seeing myself teach and examining it showed me that if I look with the lens of 'student learning' in mind, I can remove the piercing lens. The piercing lens seeks to bash or tear down whereas the lens which searches for productive practices does not.

The identity construction is enlightening for me as a teacher due to the fact that I now realize my own power. I now know the power I have with regards to my own teaching. I can honestly ask and answer the question: Did I facilitate that well? I realize that I should ask that question before I blame students for not grasping the concept.

Constructing my identity humbled me. I had to admit to areas of weakness in facilitating learning. I had to be honest with myself and own my mistakes in procedures and tactics. I realized that one of the first steps to growth is humility.

This process has shown me that my identity is continuously being constructed. The dimensions of my teaching will never reach perfection; therefore my identity will continuously be constructed.

My Identity

The "gathering" phase of my journey brings me to the summation of my identity as a mathematics teacher. My identity as a mathematics teacher is a "Coat of Many

Colors." The colors of my coat and the characteristic represented are: red-discourse richness, pink-dialogue, orange-deliberation, yellow-reflexivity, green-theorizing, blue-agency and purple-authority. I describe my identity as a coat of many colors because even though I convey the principles of Danielewicz (2001) individually that are evident in my practices, they are interwoven. My identity as a mathematics teacher is not just one principle but is a combination of many. The principles which constitute my identity as a teacher are not isolated by themselves. Each principle has its own characteristics and each principle has a place and purpose in my identity. When I enter the domain of my classroom, I am wearing my coat of many colors to facilitate student learning. I cannot take apart the different colors represented in my coat because it is one garment. Trying to take a particular color from the coat would dismantle the garment because the colors are interwoven to comprise the complete covering.

The analysis of the color coded supporting data indicates that my identity as a mathematics teacher comprises both structural and performative principles as outlined by Danielwicz (2001). The principles that characterize my identity are discourse richness and openness, dialogue and dialogic curriculum, deliberation, reflexivity, agency, authority, and theorizing.

The narratives that follow provide vignettes of my constructed identity. The vignettes illustrate how the characteristics of my identity are interwoven. For example, agency, theorizing or reflexivity may be present in the vignette even though the dominant characteristic of the vignette is discourse richness and openness. The characteristics of more than one principle can be present in an activity or the activities occurring can abruptly change leading to another characteristic. For example, if the primary objective

of an activity is to promote discourse richness and a student asks a question, I could use agency or deliberation in my response. In other words, the principles woven together are the sum total of who I am.

Task #1

"How do I really get them to understand the difference between area under the curve and evaluating an integral when the region is above and below the x-axis", I thought? Before the lesson, I wrote in my anticipated learning outcomes: I want the students to figure it out without my telling them (green). I was theorizing because I wanted the students to create their own path for determining the difference rather than receiving directions from me. I wanted the learning to make sense to them mathematically. The objective for Task #1 was for the students to determine the value of the integral $\int_{-10}^{6} f(x)dx$ using the diagram in Figure 1.

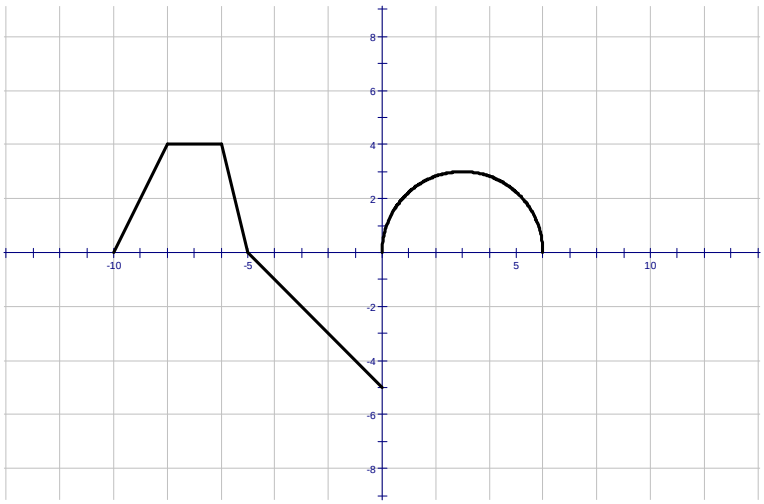


Figure 1. Diagram for Task #1.

At this point, because the students do not know how to evaluate the integral, they must use the notion of area to evaluate the integral. My intent is for the students to engage in discourse richness and openness. I wanted them to ask questions and make meaning with what they were doing. So, as the students enter the room I take authority and direct them to get into their groups. Since they do group work often, they already know their group members and quickly arrange themselves in five groups of three and one group of four. I then give directions.

Stinson: *Now, you've been given the information about the integral, the integral representation, area under the curve. Before you, you have a task. So, I want you to utilize all of the information. You have a calculator in hand. You can use that. I want you to utilize the information that we talked about earlier with the integral, positive, negative,* $f(x) \geq 0$, *thinking about* $f(x)$ *being negative to perform the task. You're going to be discussing this among yourselves trying to figure out what to do with the task. So, turn over the task and begin (red).*

I promoted discourse richness and openness in the setup of the task when indicating to the students that they would be discussing among themselves.

The students begin discussing in their groups, and they are really discussing…some calmly, some not…these students are amiably competitive. As the students are in rich discourse, I could have interjected my personal thoughts on their

discussions. I could have led them down a different path if I detected they were going wrong but I had to think also. "Anthony, be QUIET!! They can figure this out if they have time to reason (blue)." This illustrates that even though discourse richness is the principle the activity promotes, agency, reflexivity, deliberation are ever present. I wanted the students to make sense of the notion of integral as area. I stop at Justine's group because she asked me a question. Fantastic!!! Let the dialogue begin.

Prompting Justine and Sam

Stinson: *So, to find the area are you finding the value of the integral?*

Justine: *You can't find the area because we don't know the function.*

Stinson: *Oh, do we need to know the function if the integral is represented by the area given? The problem says this is f(x).*(Stinson pointing to the diagram)

Sam: *So, if you combine all of the areas between the x and y axes, will that give you the value?...well, the absolute values.*

Stinson: *Ohhhhhh, well is this a positive area?* (Again, pointing to the graph)(pink)

Sam: *Well, that's a positive area* (pointing to the graph).

Stinson: *Is that positive?*

Justine: *No…*

Sam: *It doesn't matter, the question is not asking for the area under the curve, it's asking for the integral, which could be positive, negative or zero.*

Stinson: *True, true, very true, so what are you going to do?*

Justine: *Can we just find the area of all of them and add them up?*

Stinson: *Does that represent the value of the integral?*

Justine: *Yeah!!!* Between *-10 and 6…*

Stinson: *Interesting (blue)* (while nodding and walks away)

Sam: *I guess not* (laughing)

This interaction displayed the manner in which many characteristics can occur simultaneously. Again, illustrating how the colors are interwoven. Walking away and saying 'interesting' displayed agency. While I could have easily shifted Justine's and Sam's thought processes by telling them the error of their ways, choosing to remain silent as they discussed the task was my way of engaging them in more inner group dialogue.

The next vignette illustrates that many times one characteristic has to be intermingled with another. In reflecting, I realized that my explanations are not always as I intend. Kelsey, who I would classify as my greatest challenge in terms of promoting critical thinking, was somewhat perplexed by the task. So, I engaged in dialogue with her group provoking mathematical thinking. As I reflect, more dialogue could have aided her in understanding the task better. Or better explanations about the task would have helped.

Perplexed Kelsey

Stinson: *So you figure it out yet?*

Kelsey: *Subtract the integral?*

Stinson: *Subtract the integral?*

Kelsey: *Yeah, this plus this, minus this…*

Stinson: *You say subtract the integral, do you mean subtract the…*

Carol: *Area*

Kelsey: *Like, I mean the integral of this, plus the integral of this, minus the integral of this…*

Stinson: *Yeah, but what would that integral be?*

Kelsey: *Exactly!!! That!!!*

Stinson: *What would that be…that area…So, you are saying what? What would you do with this, this and that?* (pointing to the three areas)

Sid: *We were thinking about adding these two together and subtracting this.* (Pointing to areas above and area below)

Stinson: *Ok* (walks away)

Kelsey: *So, I should be able to find the function from the diagram?*

Kelsey's question caused reflexivity to occur during the activity rather than after. I had to ask myself if I explained the objective of evaluating an integral in terms of area well enough. So, I made some clarifications.

Stinson: *Class, you don't have to find out what the function is. Everybody keep in mind, you're finding…You're evaluating the integral as "quote" areas*

(indigo). (using fingers to denote quotation marks) *So, you don't have to know what the function is and you gotta keep that in mind because you will see many problems where you are just given the diagram. You don't need to know what the actual function is. You don't have to find some* $x^2 + x + 5$ *or some* $x^2 - y^2 = 7$. *You don't have to know what the function is. The function is represented by the graph. OK…*

I felt the need to reiterate that poignant point as the students worked on the task. I had to do an immediate assessment of my actions because of the need for some of them to try and find the function. This vignette also illustrates the worth of my videotaping myself for reflexivity. The erroneous equations given in my clarifications $x^2 + x + 5$ and $x^2 - y^2 = 7$ are not functions at all. This indicates that as I facilitate learning I need to really think about my thinking.

As I navigated among the groups, Rebecca summoned my assistance. The students were making sense of the task which is deliberation, and I wanted the dialogue to continue.

Rebecca: *What we are confused about is if there is some area above and below do we disregard the area below the x-axis to represent the integral?*

Stinson: *Not disregard…*

Rebecca: *Take the absolute value of it? Wait!!! You were telling us before lunch that when we are using an integral f(x) has to be greater than zero.*

Stinson: *To represent quote "the area under the curve," right? But, here you want to represent the integral from -10 to 6. Now, some of that is under the x-axis so what do you have to do to represent that. What did I say about when the integral actually represents the area under the curve?*

Rebecca: *When f(x) is positive.*

Stinson: *When all of f(x) is positive right. Is all of that positive?* (pointing to the diagram)

Rebecca: *No*

Stinson: *So, would the integral represent all of that area?*

Rebecca: *No…*

Stinson: *So how are you going to represent that area?*

Rebecca: *Do the inverse…I don't know* (looking frustrated)

Stinson: *So, what do you know about these two area?* (smiling, pointing to the graph)

Rebecca: *They are above the x-axis.*

Stinson: *What do you know about the area?*

Rebecca: *It's below the x-axis.*

Stinson: *So, what are you going to do with them?*

Rebecca: *Make the one below negative.*

John Thomas: Add the two above and subtract the one below.

Stinson: Why?

John Thomas: Because that represents the integral. You can't just say add the areas because all of the areas are not above the x-axis.

The questioning, conjecturing, agreeing or disagreeing among the students led many to understand the concept. The interaction compels me to agree with the article 'Never Say Anything a Kid Can Say by Reinhart (2000). If the student can say it, I don't need to. The student gains a sense of accomplishment when saying it. When I do refrain from speaking, agency can foster great dialogue. This again shows the interwoven nature of the colors. I was able to foster discourse through the use of agency. Sam's explanation taught me a great deal about agency. I learned that if I just allow the students to reason and dialogue, they will reach wonderful conclusions.

Sam's Explanation

Sam: You want to see our answer?

Stinson: What is it?

Justine: We can't decide.

Sam: I've decided (A look of confidence on his face).

Stinson: What have you decided?

Sam: I've decided that these two are positive (pointing to the areas above the x-axis) *and this one is negative* (pointing to the one below the x-axis)

because how can the integral of f(x) sometimes be negative if there were not parts of the curve that were negative. Do you understand that I am saying?

Justine: *What?* (looking at me)

Stinson: (laughs) *Yes, I understand but you have to make them understand* (pointing to Justine and Ruth because they looked confused)

Sam: (directing the conversation to Justine and Ruth) *You know how he was saying that the integral of f(x) could be negative right…*

Justine: *Uh huh…*

Sam: *So, how could the integral of f(x) be negative if there weren't parts of the curve that had an area that was 'negative'? If everything is positive, then the integral of f(x) could never be negative.*

Justine: *Oh, I understand it in those terms(red).*

I marveled at the confidence with which Sam explained the concept to the members of his group. The episode showed me how to restrain myself because students can really communicate with each other effectively and in a language that they understand. I could have given the explanation that Sam so eloquently stated but why should I…he did, and so can many other students, if I just remain quiet or ask the correct question.

They are getting it!!! They are getting it!!! Promoting dialogue requires much thinking about questioning before and during the process but it is worth it. Making the

curriculum meaningful and promoting the discourse requires me to critically reflect on my practice. Learning becomes more meaningful for the students because they feel accomplished by using their minds in a constructive manner. Jessica's group felt that sense of achievement.

Jessica's Team Triumphs

Jessica: *We had some questions, which were…Can we do that?*

Stinson: *Do what?*

Jessica: *Just add these two areas and subtract this area?* (pointing to the diagram)

Stinson: *You mean can you mathematically? When does the integral represent the area under the curve?*

Shena: *When* $f(x) \geq 0$

Stinson: *When* $f(x) \geq 0$. *Is all of this area above the x-axis?*

Group: *No…*

Stinson: *So, can I take all of these areas and add them together and say that it represents the area under the curve?*

Jessica: *But you didn't ask us for the area under the curve.*

Shena: *You asked us for the integral which can be negative.*

Stinson: *Yeah, but the integral represents the area under the curve if f(x) is what?*

Shena: *Greater than or equal to zero.*

Nick: *But this says find the area under the curve on this interval.*

Stinson: *No, this says to find the value of f(x) on that entire interval.*

Nick: *So, it wants everything.*

Stinson: *Exactly, so what?*

Jessica: *So, we do need to subtract.*

Stinson: *What?*

Jessica: *The negative…*

Stinson: *Because there is a difference between the integral…*

Jessica: *That's what we had a question about…*

Stinson: *Ok*

Jessica: *Since you asked us for the integral and not just the area under the curve, you want the whole thing, not just the positive(orange)* (Stinson nodding)

Stinson; *Exactly, exactly!!!* (Gives Jessica a high five)

Jessica: *Yeah team!!!(orange)*

The dialogue with Jessica's group led them to an understanding of the concept and a sense of accomplishment in their ability to reason and reach logical conclusions.

I then took authority for deliberation. I wanted to make sure the students understood the meaning of what they had done.

Stinson: *Ok, now, so, with all that you've done. Integral verses area under the curve. Now, with this you had some area below the x-axis. What did you have to do with that?*

Class: *Subtract…*

Stinson: *Why?*

Sam: *Because an integral can be negative.*

Stinson: (laughs) *Yeah, an integral can be negative.*

Shena: *To include everything.*

Stinson: *To include everything. Now, let's go back to* $f(x) = x$. *Give me an integral, INTEGRAL, such that when I do it geometrically, I will get 0. The integral of x from what to what such that I will get zero.*

Julius: *From -2 to 2*

Stinson: *-2 to 2. The value of the integral would be zero because the area below and the area above are what?*

Class: *Equal*

At this point, I sensed a need to probe Kelsey one last time to make certain that she understood. I questioned her to determine if she saw the big picture, deliberation.

Stinson: *Using that same one Kelsey,* $f(x) = x$ *such the value would be negative.*

Kelsey: *Is that the one that we did from zero to seven?*

Stinson: *Yeah, but I want some limits such that when we find the value geometrically it's going to be negative.*

Kelsey: *I really don't understand.*

At this point, I could have simply explained to Kelsey what I wanted her to know, however, I felt that her seemingly lack of understanding was caused by nervousness. So, I proceeded to continue the dialogue.

Stinson: *Ok, we found the value of the integral from 0 to 5 right?*

Kelsey: *Yes…*

Stinson: *The value of that turned out to be what?*

Kelsey: $\frac{25}{2}$

Stinson: *Ok and all of f(x) turned out to be where?*

Kelsey: *Above the x-axis.*

Stinson: *If the integral turned out to be negative, where would the geometric shape be?*

Kelsey: *Below the x-axis.*

Stinson: *So, give me some limits, $f(x) = x$, something to something such that I's going to be negative.*

Kelsey: *Like -2 to 0*

Stinson: *Ok, give me some limits such that it's going to be zero.*

Kelsey: *-2 to 2*

Stinson: *Ok, -2 to 2. Now, give me one such that…Ok, I want an integral such that I have some area above and some area below, but the value of the integral will be positive.*

Kelsey: *That means there is more above than below*. (Class applauds her)

Stinson: *Whoaaaaaaaaaa.……..*

Kelsey: *-2 to 4*

Stinson: *Yes, yes, yes*

Kelsey got it by my continuously questioning her. I could have done what I did during some previous years of teaching which was to stand at the board and directly tell her. But would she have gotten as much from the recitation as the dialogue? I do not think so and the students have indicated so in their commentary. It is because of my belief as to how students learn mathematics that my identity changed from the lecturer to the facilitator through promoting discourse richness and openness. However, the promoting of discourse richness and openness could not have occurred if reflexivity and deliberation were not evident.

Performative and structural principles were revealed about my identity through the observation of the lesson. In addition to the video, the coded student commentary alluded to the structural principles of my identity. The students were asked the following questions about Task #1:

1. What happened in class to help you understand the concept of integral?
2. What happened in class to help you understand when the integral is the total area under the curve?

The structural principles alluded to in the students' commentary were discourse richness and openness, dialogue and dialogic curriculum, and deliberation. Comments made which are characteristic of promoting open communication between learners were:

My classmates attempted to explain it to me (red)

My two partners explained it to me

Small groups

Other classmates reaffirmed my findings (pink)

Group Activities

Applying it with classmates

Discussing with my classmates

In groups

A group to work together to figure out

Engaged learning

Group experiences

One of the most poignant comments made in this area was "understand rather than hearing.(orange)" Lipka and Brinthaupt (1999) would attribute this comment to

children learn by absorbing who you are, not by memorizing what you say to them. This comment spoke volumes to me as to whether promoting communication among learners warranted the time and effort necessary to accomplish it. This comment indicated "yes, I should."

As indicated by the videotape, my identity as a mathematics teacher promotes questioning, listening, answering and agreeing. Structurally, my identity dictates that students should be questioning me as well as each other in the learning process. The student comments indicating this environment existed in facilitating their learning were:

Asking questions out loud to the teacher

Sharing answers and find out what we three did differently or the same

I was not told, I was able to discover

Consulting with my group members

Being able to get feedback from classmates was helpful (pink)

I was forced to explain my reasoning

Viewing my thoughts

Consulting

In-depth discussion

Allowing the student to solve our own problems with guidance

As I facilitated students in this task, I felt that deliberation, which is making the curriculum meaningful, prevailed due to the conjectures and explanations of the conjectures contributed by the students. Comments denoting deliberation consisted of:

I learned the relationship between derivatives and integrals. It's like addition and subtraction. They're just opposite of each other

Finding the area by geometry, then reworked it using integration, I was able to understand the concept better

Related the integral to area

The way in which I was challenged to figure it out myself allowed the concept of integrals to stay in my memory better than if the was just spoken to me

Learning the concepts of integral is easier to absorb when I understand where everything comes from and why it works, not just that it does

The last comment was a "wow" for me because I learned that making the curriculum meaningful helps the content reside with a student longer and provides more of an incentive for the student to learn rather than my just telling. My desire is that the students will answer their own questions through the dialogue. This is why critical reflection is so important in determining what aspects of a lesson worked and did not work.

The principle of reflexivity occurs as I reflect on the setup and implementation of the task. I determine what went well and what could be improved. In observing the videotape and in examining the student commentary, I found areas that could be enhanced. For example, there were times I should have employed agency more, even

amidst the promoting discourse richness, and I did not. There were times when I possibly commented more than I should have.

The other question from Task #1 was: What could have been used to help in your understanding of integral and area? The one theme from the student commentary in answering this question was a desire for more examples. Reflecting on the implementation of the task, the use of more examples could also have sparked more of a dialogue about the value of the integral relative to if there was more area above the x-axis than below. More examples could have given the students a better feel for the objective of the task, and assured them that they did not need to know the equation for the function. Even in my reflective journal, before looking at the student commentary, I wrote that I probably could have used more examples. So, the process of reflexivity worked in conjunction with what the students needed.

Task #2

As a classroom teacher, I often ask myself, "Anthony, are you consistent?" If I am, then my identity should reflect that consistency. I should exhibit at least some of the principles each time I facilitate learning. My coat of many colors is a constant piece of my apparel. Enactment is the principle that indicates that I exemplify the principles of my identity which means I am consistent, and do I have on my coat. In the setup and implementation of Task #2, I examined the supporting data to show that my identity is indeed a coat of many colors.

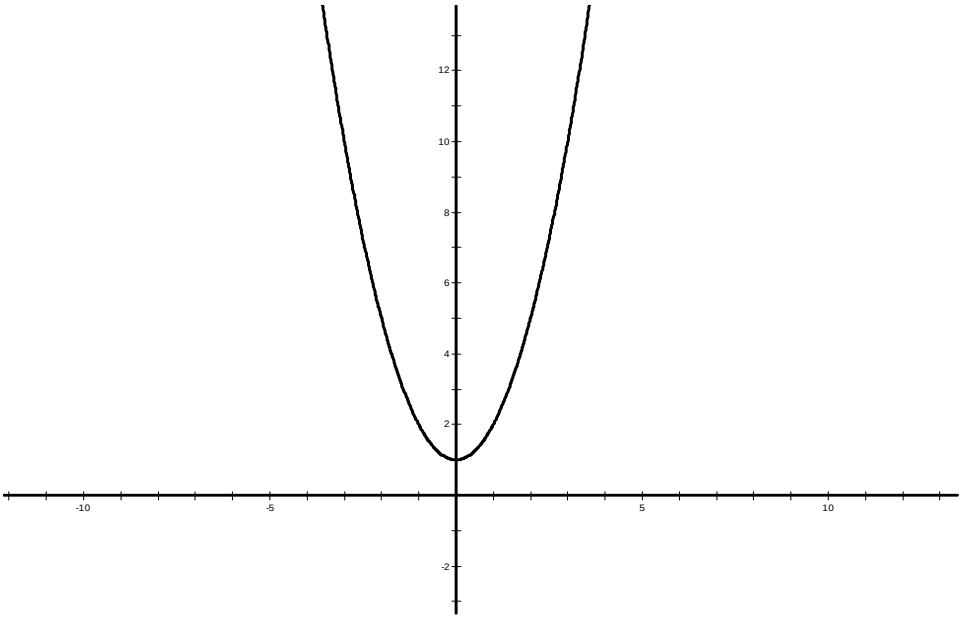


Figure 2. Diagram for Task #2.

Before I began the setup and implementation of Task #2, I wrote in my reflective journal, "Let's hope they can bridge the geometry component of inscribed polygons to approximating the area under the curve using inscribed and circumscribed rectangles." For Task #2, the students were to approximate the area under the curve using inscribed and circumscribed rectangles (see Figure 2).

The students entered the room and I took authority and instructed them to arrange themselves in their respective groups. My setup was:

Stinson: *Ok, remember yesterday; when we talked about inscribed rectangles . . . remember we talked about it being between the curve and the x-axis, and circumscribed being above it. You've gotta remember what that means. Before you, you have a task where you are gonna have to approximate the area bounded, given a certain region, given a certain interval (purple).*

You're gonna have to figure out what to do with what we talked about yesterday. Remember the partitioning and what that means. With that in mind, turn over the task and begin.

The interest with which they began working brought reassurance to me. They immediately began discourse richness and openness and dialogue about the task. I went about facilitating as they worked. Dialogue was employed for much of the beginning of the task because of the dynamic questioning and productive interchange among the students. The interaction between me and the students caused reflexivity because I recalled the occasions previously in my practices where direct instruction, recitation, superseded dialogue. Oh, what lack of faith I placed in my students. Or was it a lack of faith in myself to engage in the dialogue. When dialogue occurs, students will ask questions which requires that I ask question to scaffold their thinking. The agency exhibited during Ruth's desire for my validation reacquainted me with the phrase 'silence is golden'.

Dialogue and Remain Quiet

Ruth: *Mr. Stinson, oh, do you have the right answer?*

Stinson: *Do I* (a look of bewilderment) *do you?*

Ruth: *Well, I know you do. We found the actual area using integral on the calculator and they are not the same. I mean I know they are not going to be the same, but the actual area is less than what we approximated is less cause you're not taking up all of the space.*

Stinson: *Right, now.*

Ruth: *So, we were just wrong?*

Stinson: *Probably* (laughs) *So, what did you come up with.*

Ruth: $\frac{15}{2}$

Justine: *Am I making a math error?*

Stinson: (Looks at work as Justine looks at her work, but does not say anything).

Justine: *Oh, this should be a negative 2. So, that's plus 14.8* (she laughs). *It's 9.3* (she says to Ruth)

Stinson: (Smiles and walks away)

I learned a great deal about myself from this interaction. I learned that I can remain silent and student learning will occur. I learned that students can be their own best monitors of their progress. What a change from the way I thought previously.

As I facilitate student learning, I want the students to connect the concepts, deliberation. This vignette illustrates how a student combined the notion of evaluating a function for a value of x with finding the height of a rectangle. Steve connected the fact that finding the height of the rectangle amounted to substituting the x coordinate into the equation for the function. Through dialogue, he made the connection.

Steve's Making Connections

Stinson: *Now tell me, using this interval, which point of the interval would you substitute in to find the height of that rectangle?*

Steve: *Which point?*

Stinson: *Yes, which point between 0 and* $\frac{1}{2}$*. Which point would you substitute in?*

Steve: *I substituted* $\frac{1}{2}$

Stinson: *You did, so* (leaning over looking at the work) *to find the height of this rectangle* (pointing) *0 or* $\frac{1}{2}$ *did you substitute to find the height of this first rectangle?*

Steve: *Huh?*

Stinson: *This rectangle starts at 0 and ends at* $\frac{1}{2}$ *right?*

Steve: *Yes*

Stinson: *So, which point, 0 or* $\frac{1}{2}$ *did you substitute in to find the height?*

Steve: *I got 1…*

Stinson: *How did you get 1?*

Kelsey: *I have no clue of what you are asking.*

Stinson: (To Steve) *So how did you find the height of this rectangle/*

Steve: *I brought it up*

Stinson: *What do you mean, you brought it up?*

Steve: *It tells me how high it went*

Stinson: *And did it touch the curve?*

Steve: *Yes*

Stinson: *Ok, this point where it touches the curve does it have an x and y coordinate?*

Steve: *Yes*

Stinson: *How would you find that y-coordinate?*

Steve: *Substitute in .5.*

Stinson: *Substitute in .5 into what?*

Steve: *It would be 1.25*

Stinson: *Ok, so I go back to my first question. How would you find the height of the rectangle?*

Steve: *Substitute in 0.*

Stinson: *Ok, substitute in 0. Ok, how would you find the height of this rectangle?* (Pointing to the diagram)

Kelsey: *To keep from having to eyeball it?*

Stinson: *Uh, yeah* (chuckling)

Kelsey: *Ohhhhhhhhhhhhhhhh!!! That's what I've been doing* (laughs)

Stinson: *Now, between 0 and* $\frac{1}{2}$ *which point of the interval is the 0, is it the right most point of the interval or left most*

Steve: *Left most*

Stinson: *Between* $\frac{1}{2}$ *and 1, which point would you substitute in?*

Steve: $\frac{1}{2}$

Stinson: *Which is which point of the interval?*

Steve: *Left most*

Stinson: *Now, let's look at this side* (pointing to the other side of the graph) *Between -1.5 and -2, which point of the interval did you substitute in?*

Steve: *-1.5*

Stinson: *That's what point of the interval?*

Kelsey/Steve: *The right*

Steve: *I think I know where you are going with this. If it's to the right of the y-axis, we substitute in the left point of the interval and if it's to the left, we substitute in the right.*

Stinson: *Huh, huh* (smiles) *Interesting. Well, what is this curve doing?* (pointing to the graph)

Steve: *Increasing.*

Stinson: *So, what is it doing here?* (pointing to the graph)

Steve: *Decreasing*

Stinson: *So, what can you come up with?*

Kelsey: *So, when a line decreases you substitute in the right most point of the interval…*

Stinson: *Curve…*

Kelsey: *And when the curve is increasing, you substitute in the left point of the interval.*

Stinson: *Ok, so when the curve increases, you substitute in which point of the interval?*

Steve: *Left*

Stinson: *And when the curve decreases you substitute in which point of the interval?*

Steve: *Right.*

Stinson: *Good, now you might have to explain that…*

This interaction taught me just as much as it did Steve. When the learning is linked together, the understanding is increased. Students can discern for themselves the correctness or incorrectness of their answers with the correct scaffolding from the

teacher. The student is then able to transfer the learning to others in the learning environment, as Steve did.

Steve's Transfer to the Class

Stinson: *Now, it appears that everyone is done. Steve you were going to explain to the class about which point of the interval to use because this is critical with inscribed.*

Steve: *So, when the curve is decreasing, we substitute in the right most point of the interval, and when the curve is increasing we substitute in the left most.*

Steve's explanation guided the class to the bigger picture of the concept. The students were then able to connect the concepts of derivative to a curve increasing and decreasing. The dialogue led to deliberation. Again, the overlap of the colors of my identity was shown.

Stinson: *Keep in mind that you don't have to have the diagram to determine if the curve is increasing or decreasing. What else do you have in your toolbox to determine that?*

Ruth: *Sign chart!!!*

Stinson: *Who?* (looking bewildered)

Ruth: *Can we use the sign chart?*

Stinson: *Oh, ok, right, which is finding the…*(hands open and arms outstretched)

Class: $f'(x)$

Stinson: *Right, the derivative, That's another way you can determine if the curve is increasing or decreasing, using the derivative.*

Even though constructing my identity was thought provoking, difficult and continuously evolving, my identity helps me understand why I do what I do as a teacher. I have a better understanding of my practices and why I have made the changes I have in facilitating student learning. My characteristics as a teacher shape my activities and interactions.

Task #2 Part II

The dialogue, deliberation, agency, and discourse were apparent as the students navigated through the second part of the task. The students were to approximate the area under the curve using circumscribed rectangles instead of inscribed on the same diagram as Figure 4. The open communication among the students was great. They were able to transfer the discussions of Task #2 Part I to this part. The structural aspect of my identity resonated as the students questioned each other and were able to agree and disagree with a sense of purpose. I promoted discourse richness and openness with Jessica's explanation.

Jessica's Explanation

Stinson: *Ok, Jessica tell me how this was different from the inscribed rectangles.*

Jessica: *Um, this is different in that when the curve is increasing on the inscribed, we used the left point of the partition, whereas with circumscribed we used the right point of the partition. And when it is decreasing, it's vice versa.*

The student commentary from both parts of Task #2 alluded to the atmosphere of the classroom during the implementation of the task. The questions were:

1. What happened in class to help in your understanding of inscribed and circumscribed rectangles?
2. What happened in class to help in your understanding which point of the interval to use to find the height?

The comments were

Small groups

Our groups

Group members

Did the tasks in our groups

I was called upon to explain

Small groups

That is why working in small groups is so helpful

My partner

Conferring with my partners

The group

My peers showed me

I listened to my peers

The diagrams and drawings that were shown

Watching someone draw the rectangles and then helping me draw them

The visual representation facilitated by knowing which points to start with

Continuing to build on what we learned the previous day helped my understanding

When I could see the rectangle, I could determine where the height should be

These comments indicated that discourse richness and openness occurred and dialogue provided insight for the students when working the task. The statement, "the visual representation facilitated my knowing which points to start with", revealed to me that deliberation was at work helping the students make sense of the curriculum. The students connected the geometry to the calculus. Through their dialogue, they convinced each other of the connections. I observed the students reasoning together and monitoring their own progress as they worked through the task.

Task #3

The narrative on Task #3 illustrates the use of many of the colors of my identity. As I reflected on the task, many of the principles were utilized. While in the reflexivity mode of thinking, I too was in deliberation and theorizing modes. I wanted to make sense of my facilitation with regards to making the concept of Task #3 relevant for the students. Observing the implementation of the task and even in my reflective journal writing, I relinquished all elements of pride. I realized through reflection and observation that I failed in the facilitation of the task. As I reflected and watched the video, I felt a sheer sense of vulnerability in revealing my failure as a facilitator. The objective of the task focused on the students' deriving the formula for evaluating a definite integral for the diagram in Figure 3, $y = x^2$ on the interval $[0,4]$.

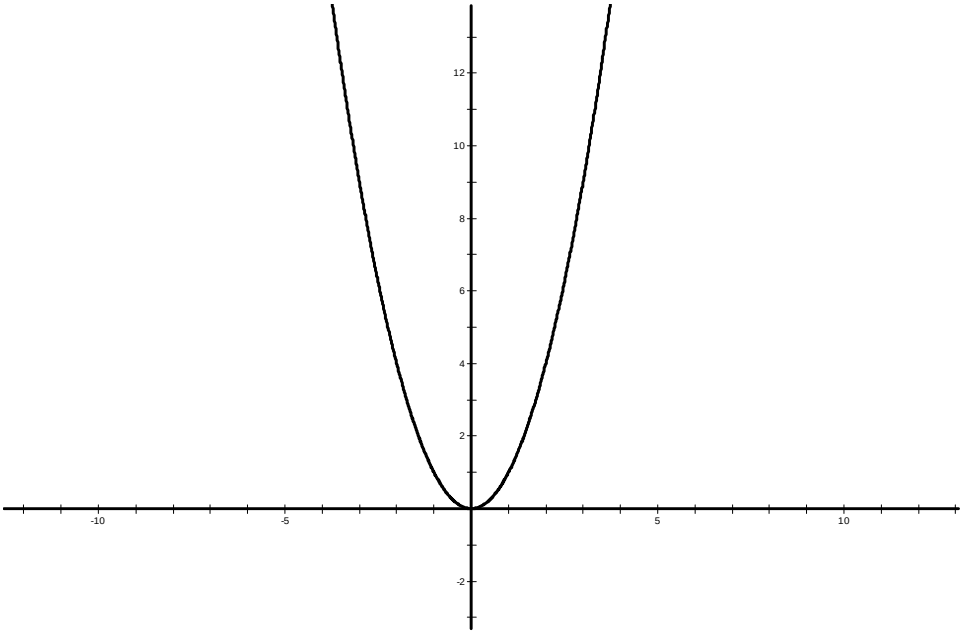


Figure 3. Diagram for Task #3.

This task required more intuitive and abstract thinking on behalf of the students. Therefore, my facilitation required more in-depth questions and insightful scaffolding. I did not provide either. As I reflect, I also concede that I lacked the necessary questions to help my students understand my desired learning outcome for them. For example, in the formula for evaluating the integral, $\int_a^b f(x)dx = \lim_{n\to\infty}\sum_{i=1}^{n} f(x_i)\Delta x$, I failed to ask the poignant questions in helping the students understand the implication of $n \to \infty$ (n approaching infinity, no limit) with reference to the number of rectangles and $f(x_i)$. I facilitated the students to the point that they knew the more rectangles drawn from Task #2 the better the approximation of the integral if $f(x) \geq 0$. However, I found the abstract nature of the concept beyond my ability to guide the students to a conjecture about $n \to \infty$ without actually just telling them. Consequently, as my questioning

techniques waned, frustration ensued for the students and me. Note the exchange that occurred.

Frustration

Stinson: *Now, keep in mind this is really representing the actual area under the curve, that is if* $f(x) \geq 0$. *This is what we call a Riemann Sum, which means, and you have to understand this too, when your calculator finds the area, when it calculates that integral, if f(x) is positive, this is what it is doing, ok. It's actually taking the limit of all of those things. So, you have to keep that in mind because this represents the area under the curve, when* $f(x) \geq 0$.

Kelsey: *What is Rie-----what?*

Rebecca: *How do you spell that?*

Stinson: *Riemann Sum, that's what it is called.*

Jessica: *Yeah, how do you spell it?*

Stinson: *Write that in your notes, RIEMANN.* (spelling it for the class)

Jessica: *Are you sure you're saying it right?* (in a frustrated tone)

At this point I knew my further discourse would be pointless. My desire for discourse richness and openness or dialogue had dissipated. I needed to reflect on what I lacked in the setup and implementation of this task. I could not fault the students because of my ineptness to guide them through the task with questioning which should have

stimulated their thought processes and helped their understanding. Consequently, I was unable to foster the principles of my identity which would have brought the lesson to fruition. I resorted to a method that is the antithesis of my identity, which is the telling approach. I told them the formula and how to write it. Disappointed in myself, I concluded the lesson with much reflecting to do. In my journal I wrote, "lesson failed completely." This moment revealed another vulnerable moment in writing this autoethnography. It is not easy as a mathematics teacher to admit my incompetence in facilitating this task. As I reflect, I should have anticipated the questions and the frustrations of the students. I should have never used the term Riemann sum. Understanding this concept is beyond the scope of the course and the students' level of understanding. If the students can approximate the area under the curve using a left or right sum, that should suffice for this course. I also reflected on my incorrect description of what the calculator does in computing the value of the integral. The calculator is not computing a Riemann sum, it is using Simpson's rule to calculate the value of the integral. I expressed concern in my anticipated learning outcomes but failed to properly prepare for what I knew could have happened. I must now take all that occurred with this task and truly resolve to change the objective of the task of not do it at all.

Task #4

The journey of identity construction for this study culminates with Task #4. This task revealed principles consistent with those of Task #1 and Task #2. I describe how I completed this quest for self understanding and professional growth.

The students enter and I instruct them to get into their groups. Previously, we have discussed finding the length of a vertical segment and horizontal segment without using absolute value symbols. For horizontal segments, we subtracted the left most x coordinate from the right most x coordinate. For vertical segments, we subtracted the bottom most y coordinate from the top most y coordinate. This task directs the students to find the area bounded by two curves given the equation of the curves. For example,

> Let R be the region bounded by $y = 2 - x^2$ and $y = -x$. Sketch the graph of R, set up the integral that represents the area of R, and evaluate the integral. SHOW ALL WORK.

The students must find the limits of integration, determine whether to integrate with respect to x or y, and decide whether to set up the integral by subtracting the top minus bottom or right minus left. Once the students can set up the integral, they can find the area bounded by the two curves by using the Fundamental Theorem of Calculus (FTC). I give them the setup.

Stinson: *Ok, now, keep in mind what we talked about yesterday as far as area is concerned. Ah, keep in mind with area you must find your limits of integration, you must find those. You must set up the limit, keep in mind how you are going to do that, whether you're dealing with vertical or horizontal and from there evaluate. Ok, turn over Task #4. And you don't need calculators with this.*

The students began the discourse as I employed agency as I joyfully observed their interactions.

Julius: *Sam, what did you guys get?*

Sam: $\frac{27}{6}$

Julius: *What's your integral?*

Sam: *What's our what?*

Julius: *What's your setup?*

Sam: *The integral of* $2-x^2$ *minus* $-x$ *from -1 to 2.*

Julius: *Cool, that's what we got too…*

I was elated at the sense of responsibility and confidence the students showed as they navigated through the task. I was learning as they were learning. I was finding comfort in my identity as a mathematics teacher. I accepted my role as facilitator rather than a "telling teacher". I loved the spirit of communication between student-student and facilitator-student. The discourse richness and dialogue once again provided assurance to me that requiring the students to critically think is within the scope of mathematical learning. The students can perform when questioned appropriately.

The Class Responds

Stinson: *Ok, now what did you get?*

Class: $\frac{9}{2}$

Stinson: *So, how did you find the limits of integration?*

Class: *Set the two equations equal to each other.*

Stinson: *You determined how to find the top and bottom. How did you find the top and bottom?*

Kelsey: *By substituting in a number between -1 and 2.*

Stinson: *Ok, by substituting a number between -1 and 2. Now, remember in finding the area between the two curves it's very important that you set up the integral correctly, as far as top minus bottom or right minus left because if your answer turns out to be negative what do you know?*

Class: *You did something wrong…*

Stinson: *It really means you did what?*

Class: *Bottom minus top…*

Stinson: *Do you need the graph?*

Class: *No!!!*

Stinson: *No, you don't need the graph, you might want to graph to look at what you are doing.*

The student commentary again contributes to my identity construction from a structural perspective. The questions for Task #4 were:

1. What happened in class to help in your understanding of area between two curves?
2. What happened in class to help in your understanding of setting up the integral to find the area? The comments were:

Our group discussions

Greater class participation

Fluent dialogue between all of us helped

In groups

Working in groups helped

Another student and I worked together

Being able to hear others' questions helps me assess what I understand

I also asked questions

Graphing the two curves visually helped me to see what region we were examining

Diagram drawn

It was helpful that we learned the material the day before because we had time to digest it

Identity Fosters Change

My coat of many colors identity fosters a deeper understanding of the unrest which resided in me earlier in my years of teaching. I felt a sense of unrest because I wanted to foster learning that was meaningful (deliberation) and engaging (discourse richness). I read about practitioners who were teaching mathematics differently and I thought, "Surely if they can change, so can I." Oh, I remember the days of strictly teaching using recitation, seatwork for the students, and a homework assignment for the next day. However, as I read about other methods of teaching, listened to other teachers talk about their practices and took an introspective glance at my mission as a teacher, I knew I wanted more for my students. As my identity changed, my practices changed. For example, I recall the days when all of my desks were in straight rows and I insisted that my students remain quiet for the entire class session. I compelled them to listen to me recite mathematical facts and gave them algorithms to solve problems, failing to determine if they had an intuitive understanding of the whys of the algorithm. I thought that if I allowed them to converse with each other, I would lose control of my class. However, I learned that discourse richness and openness cannot occur if the students do not communicate during the class session. Nor can there be questioning and reasoning by

the students. I realized that I had to change the way I facilitated learning. Akin to one of the recommendations of the standards-based classroom, I had to listen more and talk less. But that change also took time and effort on my part to consciously use metacognition in the process. It dawned on me that the straight rows do not produce any sense of a mathematical talk community where students could share ideas with each other. In promoting group work and discussion, I had to move away from the arrangement of the typical mathematics classroom. The adjustment had to be made by me. I had to acquaint myself with organized chaos. This meant that the authority was mine to make the environment of my classroom adaptable for different structures depending on the objective of the lesson. I should be able to have students arrange themselves in groups and then transition from that format to another without losing control of my class. That also took time.

Now, I understand why I wanted my students to interact with each other and why I did not want to just stand in front of them imparting knowledge. Why should I stand and tell students how to find the limits of integration when finding the area between two curves? If I pose the question to them, they will connect the mathematics previously learned to arrive at an answer. I now know that using my coat of many colors in my classroom can engage students in dialogue and discourse much richer than any recitation I could render.

I also have a better appreciation for the statement “change is not easy.” One of the difficult aspects of changing as a mathematics teacher, for me, was deviating from the status quo. When I began teaching, I noticed that many of my colleagues did ‘recitation’ teaching, gave the students some examples and assigned homework. These colleagues

were veteran and I thought they should be the experts in the field, so I thought I should do as they did. However, the unrest continued and I resolved that I was going to make the changes even if it was difficult. I shall never forget the first time I changed my classroom from the traditional straight rows. Other teachers looked in my room and asked me what was I doing? I simply told them I was trying something different. It took courage to do it but the color of discourse richness and openness dictated that I had to. When students first came to my class and I asked them to go to the board with a partner to explain a problem, they looked bewildered. When I first engaged the students in group work, they were apprehensive and so was I. But, it worked. My identity as a mathematics teacher did not occur overnight and is continuously developing, as evidenced by the lack of critical thought about the planning and implementation of Task #3. Changing my practices did not just happen. I started out teaching mathematics with the traditional methods in mind but I learned that change can occur because change was needed for increased student learning in my class. I changed because I saw a need to change. I changed because I thought that the students should come first. No, it was not easy and I probably went through more than my students in changing. But, I had to take the courage to look inside of me and say that I could do it and I did. I started with a coat of possibly one color but the identity that was forming within me dictated that I needed more colors in my coat. I had to consciously make a decision to change my practices for the sake of my professional growth and the growth of my students.

CHAPTER 5

THE JOURNEY: CONCLUSIONS AND IMPLICATIONS

Teachers' personal experiences and histories are the pieces that construct identity and therefore influence their teaching (Moore, 2008, p. 686)

I have taught secondary mathematics for twenty-eight years and having done this study, I could go for twenty-eight more, but with so much more insight and wisdom! I have heard many in my profession who are where I am in years of experience say, "I am ready to retire." This study has done the opposite for me. I am ready to teach and help others teach!!! Knowing my identity as a mathematics teacher does give me a location in the world of teaching (Danielwicz 2001). Knowing my identity helps me understand the experiences I have had and the histories I hold dear to my heart.

Writing my story has been the most difficult, yet rewarding endeavor I have encountered as an educator. I wanted to give voice to the classroom teacher. I wanted to tell my story of change and empowerment. Constructing my identity was for my growth. Telling my story was for readers who could take an active role in my world, feel my experiences and then reflect on, understand and cope with their own lives (Ellis 2004). I want to make a difference by telling my story.

This journey took me to depths of myself that I did not know existed. Never would I have thought that I would discover so much about myself and benefit from the discoveries when I began. I now understand why I do what I do as a teacher. Having taken this journey, I realize that my identity truly shapes my being as a mathematics teacher and drives all that I do from day to day as I facilitate student learning. This

chapter concludes the journey with a summary of my study, detailing the purpose, the design, methodology, and findings. I then discuss the implications of my study and future research endeavors relative to my study that should be done.

Summary of the Study

Despite some gains, improving secondary mathematics instruction is an area of concern of the National Council of Teachers of Mathematics (NCTM). Recitation, also known as lecture, prevails as the practice of choice of mathematics teacher in the United States (Kilpatrick, Martin et al. 2003). However, the report of the NCTM Research Advisory Committee 2000 indicates that the mathematical proficiency of students increases when the practice of choice includes more than recitation. Therefore, changes in instruction in the mathematics classroom should occur to improve student learning. My study presented a personalized account of the use of reflective teaching as an agent of identity construction and change. The intention was to illustrate the power of reflective teaching when constructing my identity as a mathematics teacher, and to show how my practices changed as my identity changed. My study was designed to answer to question: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change of practice?

The study was theoretically framed by identity theory as it relates to teacher identity construction. Constructivism and metacognition supported the theoretical framework. A qualitative research approach was used for the study. The study was conducted using autoethnography, a form of narrative writing that invites and engages the reader into the cultural experiences of the writer (Ellis and Bochner 2000). The reader is

invited to relive the writer's experiences, rather than interpret or analyze what the writer has written. The author writes in the first person.

The literature review focused on reflective teaching as a process of self-evaluation of one's practices. I also examined literature on identity construction as it relates to a teacher's better understanding of self. Finally, I investigated the literature on autoethnography, a burgeoning form of research that speaks to a reader from the personal perspective of the researcher. This study was conducted to contribute to the body of research where teachers/practitioners are the researchers who write about themselves and their work. This study was conducted to give "voice" to the classroom teacher and provide experiences that would resonate with the reader.

For this study, I situated myself inside the culture of my classroom. I reflected, observed and analyzed the supporting data to construct my identity as a mathematics teacher, and described how my practices have changed due to my identity. The supporting data consisted of videotaped lessons of my setup and implementation of four tasks in an advanced placement calculus class, my reflective journal about the planning and facilitation of the tasks, and student commentary relative to their perspectives while performing the tasks. Their perspectives provided insight concerning structural identity principles as outlined by Danielwicz (2001). The videotaped lessons, reflective journal and student commentary were archived data released from my local school system for my use in this study.

Findings

The research question which guided this study was: In what ways does a teacher's reflection on mathematics practice facilitate teacher identity construction and change of practices? My findings indicate that there are several ways reflective teaching aided in my identity construction and in describing how my practices changed due to my identity. Reflecting on my practices allowed me to use the theory of Danielewicz as a tool to critically sort through my practices for certain characteristics of my identity as a mathematics teacher. Reflection permitted me to give "voice" to the classroom teacher in describing the process of applying theory to practice. Critical reflection facilitated in constructing knowledge about my practices through a theoretical lens. Reflection facilitated in my identity construction through the use of multiple sources, e.g., videotaped lessons, student commentary, memory and my reflective journal. Reflection allowed me to delve into my memory to recall and describe how characteristics of my identity brought about changes in my practices. Reflection enabled me to utilize the opinions of those whom I teach. I think it almost impossible for a teacher to construct an identity without some type of feedback from the students. I do not think this study would have been as complete without the commentary from my students about their learning. If the purpose of facilitation is student learning, then I feel obligated to ask those I am facilitating how well they are learning.

Critical reflection has taken me deep into who I am as a teacher and who I am as an individual. Before embarking on this journey of reflection and identity construction, I really had no idea of my destination or the means of arriving there. This study has revealed the core of who I am as a mathematics teacher and has caused me to look closer

at myself and others in my profession. My journey has propelled me into a deeper commitment to the cause of facilitating learning in a more meaningful way. This study has strengthened my metacognitive abilities when facilitating learning. Now that I have constructed my identity as a mathematics teacher, I reflect more about my practices, endeavoring to improve student learning. This journey has affected me more than any I have taken in my career. Constructing my identity as a teacher has given me a deeper consciousness about teaching, even after twenty-eight years of teaching. I now think more about my techniques, plans, strategies and interactions. My quest for identity as a mathematics teacher navigated me to Danielwicz's (2001) work about teacher identity construction which provided the vehicle for traversing the terrain of the supporting data.

As I examined the videotapes, student commentary and reflective journal I compared the characteristics of each of the principles of teacher identity construction to each of the data sources to determine how each was present. Each of the supporting data sources provided elements of some of the principles and brought me to a greater appreciation for the availability of the sources and the worth of each source. Understanding the characteristics I possess as a mathematics teacher, helps me become a better teacher. If there are characteristics that I possess that prohibit student learning then I can work on changing those. If there are characteristics that I possess that contribute to student learning, then I should retain those.

Conclusions

In Chapter 1, I laid the foundation for my study by indicating that secondary mathematics teachers need to employ more pedagogical techniques than recitation

because research shows that students learn better with varied techniques. In this study, I have described how I progressed from a one dimensional teacher to a multi-dimensional one. I discussed the ten principles which constitute teacher identity development as proposed by Danielewicz (2002). The principles, a brief summary, and the color assigned to each are provided in Table 1. As I analyzed the videotaped lessons, my reflective journal and student commentary, I constructed my identity using the principle descriptions outlined by Danielwicz (2002). I color coded transcriptions from the videotaped lessons. I also color coded the student commentary and my reflective journal. I looked at the color coded data along with my memory in constructing my identity. After my analysis, I describe my identity as a mathematics teacher as a coat of many colors. I describe my identity as a coat of many colors because my practices now involve more than recitation as a means of facilitating learning. I now promote discourse. I remain quiet as my students converse with each other to reach conclusions and solutions. I question my students to engage them in critical self-analysis rather than simply telling them an answer. I now critically investigate the methods of subject delivery and the continuity in the delivery. I now ask the question, "Does the subject matter make sense and is it meaningful?" My identity now consists of these elements which are far distant from my beginning practices as a mathematics teacher. The many colors of my coat represent the multi-dimensional aspects of my pedagogical techniques. My study describes how I started as a teacher with a coat of one color but changed into a teacher with a coat of many colors through continual development and a conscious desire to improve as a teacher. My study reveals how I empowered myself to change as a mathematics teacher and articulates the process. The colors of my coat and the

characteristics represented are: red-discourse richness, pink-dialogue, orange-deliberation, yellow-reflexivity, green-theorizing, blue-agency, and purple-authority. My coat is made up of the colors of both structural and performative principles.

My identity speaks to how I facilitate learning, and my identity indicates the atmosphere of my classroom. My identity construction has shown me how my practices have changed since I began teaching. My approach to teaching shifted from teacher focused to student focused. I changed from the strictly telling approach to allowing the students to find their way. Had I not done this study, I would not have received comments from my students like "I prefer figuring it out myself rather than just being told." My practices have changed because I have improved in both content knowledge and pedagogical knowledge. I feel more comfortable engaging in mathematical dialogue with my students. I now possess the content knowledge to scaffold student learning that I did not possess earlier. This study showed me that my change of practices encourages learners to critically think more, which is not always easy. I have learned through this study that my students can think critically if given the proper question as a prompt. I am glad I have changed my practices because I feel that more conceptual learning is taking place in my classroom. By using autoethnography, I used the theoretical frame to construct my identity and was able to tell my story from a personal perspective. The process of delving into one's self is not an easy one but a most productive one.

Discussion

When I began this journey of identity construction, I had no idea how I would construct my identity but I wanted to construct it. The literature review provided details

of how other teachers constructed their identities. However, the context of their study was not the same as mine, so I researched more. In my search for a foundation, I read the book *Teaching Selves: Identity, Pedagogy and Teacher Education* by Danielewicz (2002). Her book presented a framework for which my study could be based.

When I videotaped the lessons of the setup and implementation of the tasks in advanced placement calculus, the intent was simply to provide examples of facilitating learning to other teachers for professional development. However, when deciding on my research topic, I chose to use the already videotaped lessons because I felt that my identity should be revealed regardless to the lesson being taught or to what class. I was overjoyed to find the book *Teaching Selves: Identity, Pedagogy and Teacher Education* because it indicated that others were also discussing teacher identity in conjunction with facilitating learning and the importance of knowing one's identity as a teacher.

Even after twenty-eight years of teaching, I am continuously seeking to improve my practices. But, I found validation in knowing that I possessed some of the identity characteristics discussed by Danielewicz (2002). I gained a sense of satisfaction on the one hand that I promoted some of the principles. However, I rejoiced only momentarily because other principles are not present in my identity such as collaboration and recursive representation. My coat is void of those colors.

I attribute the absence of these principles to the isolation that still prevails in the arena of some classroom teachers, including mine, particularly at the secondary level. In order to collaborate with other mathematics teachers, I have to remove myself from the confines of my domain and enter into the domain of others to gain knowledge and share knowledge with them. This is another area where vulnerability rears its head for

teachers. As teachers, we have been in isolation for so long that we have a defense wall up when any adult steps into our domain. We are afraid of the lens of bashing or finding fault. As a teacher who wants to improve, I have to be willing to share with other teachers and let them share with me. As I collaborate more, then I represent myself to other peers. They see me for my identity and I see them for theirs.

This study of identity construction makes me realize my strengths and weaknesses as a mathematics teacher. I can only hope that other teachers are willing to take the same steps that I have taken in an effort to improve instruction. This journey has really opened my eyes to my identity as well as to the identity of others. As department chairperson at my school, I am required to do observations of the teachers in the department. The findings of the NCTM Research Advisory Committee are true in my school. For the most part, when I observed I saw teachers doing "recitation", giving the students some problems at their seats and then make an assignment. The principles proposed by Danielewicz (2001) are so apropos for teachers who want to grow in facilitating student learning.

After this challenging but wonderful experience, I cannot fathom mathematics teachers desiring to improve their teaching practices without knowing who they are as teachers. Critical reflection and the viewing of their own teaching should be a component in the process of mathematics teachers finding their identity. I think when teachers view themselves teach, they are more accepting to a possible need for changing their practices.

Implications

The implications of my study are far reaching. Improving classroom teaching starts with the teacher's desire to improve. A teacher's desire to improve is predicated on the fact that the teacher wants to further develop as a teacher. I conducted my study because I saw the need for improvement in my teaching, and I wanted to give voice to the process. If given the opportunity to view themselves teach, I think most teachers will see a need to improve and my study provides a means for doing that. Therefore, I think mathematics teachers should be strongly encouraged to videotape themselves teach and critique their own pedagogy, even though the process requires vulnerability and is a humbling one. The opportunity to improve should then be given to those who want to construct their identity as mathematics teachers to improve their teaching.

My study beckons secondary mathematics teachers and mathematics educators to rethink the use of reflective teaching and the theory/practice construct relative to teaching mathematics. For my study, I took a theoretical frame to construct my identity as a mathematics teacher and conveyed how my identity brought about changes in my practices. The implication here is that other secondary mathematics teachers can take Danielewicz's theoretical frame or other theoretical frames to critically reflect on their practices for improvement and identity construction. From the research presented in my study, it is clear that there is a need to add to the traditional method (recitation) of teaching mathematics at the secondary level. Change will occur when mathematics teachers envision themselves as the caretakers of their practices and seek to examine/improve them. My study shows the empowerment of one's self to enact the examination and change of their practices. I utilized a theoretical frame to construct my

identity which I call a coat of many colors. Other mathematics teachers can too examine their practices to determine if their identity can be classified as a coat of one, two, three or many colors. My study has implications for changing the ways mathematics teachers take ownership of examining and changing their practices from teacher focused to student focused. My study has implications for mathematics teachers to develop a multi-dimensional pedagogical identity through the use of reflective teaching.

I think my study reaches out to teachers in all disciplines. This study was specifically about me, a secondary mathematics teacher. However, the ramifications extend to any teacher wanting to improve their craft. Critical reflection and identity construction should be done by all teachers to improve instruction thereby improving student learning in any discipline.

My study also has implications for education programs at colleges and universities. I did not receive any training about knowing who I was as a teacher in undergraduate school. I think it is critical that pre-service teachers understand their responsibility in learning about themselves as teachers. If I had known about constructing my identity as a mathematics teacher before entering the classroom, on that first day, I would have been more prepared. So, I would institute Danielewicz's work in the teacher education programs.

Another implication of my study reaches to entire departments in a particular discipline. Many times there is a great difference in the pedagogy of individual members of a department. If department members constructed their identity, I wonder if there would be extreme differences in the identities of the teachers within the department. In

so doing, students could be assigned to specific teachers because of the teaching identity of the teacher and the learning style of the student.

Another implication for my study deals with the difference in much of the pedagogy at the university level and the secondary level, especially in mathematics. I teach part-time at a local university and I now understand my desire to break from the standard way of instruction at the university. My identity does not match the identity of the majority of the instructors in the university department. I now know that my identity encourages interaction among the students. However, at the typical university, mathematics classes are taught in the traditional recitation manner. My study has implications for change even at the university level as to how mathematics is taught. I understand the constraints on time and material that needs to be covered, however, small increments of student interaction could be helpful in certain mathematics courses. Courses in which there are future mathematics teachers should greatly consider such modifications.

A last implication for my study relates to the new mathematics curriculum in my state. The entire focus of the curriculum is based on increasing student reasoning and mathematical communication. The pedagogy needed for implementing the curriculum centers around fostering the ten principles of my study. The traditional forms of instruction, recitation, will not suffice for the goals of the new curriculum. Having teachers use the procedures of my study will prove invaluable to the success of the new curriculum.

References

Alsup, J. (2006). *Teacher identity discourses.* Mahwah, NJ: Lawrence Erlbaum Associates.

Artzt, A. F., & Armour-Thomas, E. (2002). *Becoming a reflective mathematics teacher.* London, Lawrence Erlbaum Associates.

Ball, D. L. (2003). *Mathematical proficiency for all students: Toward a strategic research and development program in mathematics education.* Arlington: 93.

Bogdan, R., & Bicklen, S. (2007). *Qualitative research for education: An introduction to theories and methods.* Boston: Pearson.

Burisek, J. (2006). *And so it begins: The auto-ethnographic journey of one professional.* Aurora, Aurora University**:** 124.

Burrill, G., K. S. Hollweg, et al. (Eds.). (2003). *Investigating the influence of standards: A framework for research in mathematics, science, and technology education.* Washington, DC: National Academy Press.

Camacho, M. G. M. (1997). The use of reflective teaching with seventh-grade language minority students in an urban classroom setting**:** 124.

Chang, H. (2008). *Autoethnography as method.* Walnut Creek, CA: Left Coast Press.

Clarke, D. (1997). The changing role of the mathematics teacher. *Journal for Research in Mathematics Education, 28*(3), 278-308.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches.* Thousand Oaks, CA: Sage Publications.

Crotty, M. (2003). *The foundations of social research: Meaning and perspective in the research process.* Los Angeles: Sage Publications.

Danielewicz, J. (2001). *Teaching selves.* New York: State University of New York Press.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2000). *Handbook of qualitative research.* Thousand Oaks, CA: Sage Publications.

Denzin, N. K., & Lincoln, Y. S. (2005). The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Sage handbook of qualitative research* (pp. 1-32). Thousand Oaks, CA: Sage Publications.

Dewey, J. (1933). *How we think: A statement of the relation of reflective thinking to the educative process.* Boston: D.C. Heath.

Draper, D. (1994). Reflection on practice: Taking the time to think. *Elementary Education.* Berkeley, CA: San Francisco State University**:** 46.

Dyson, M. (2007). My story in a profession of stories: Auto ethnography--An empowering methodology for educators. *Australian Journal of Teacher Education, 32*(1), 20.

Ellis, C. (2004). *The ethnographic I: A methodological novel about autoethnography.* Walnut Creek: Rowman and Littlefield Publishers.

Ellis, C. & Bochner, A. P. (1996). *Composing ethnography*. London: Sage Publications.

Ellis, C. & Bochner, A. P. (2000). Autoethnography, personal narrative, reflexivity. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 733-68). Thousand Oaks, CA: Sage Publications.

Ernest, P. (1991). *The philosophy of mathematics education.* London: Falmer Press.

Feldman, A. (2003). Validity and quality in self-study. *Educational researcher, 32*(3), 26-28.

Fulton, C. L. (2006). *Gazing in the mirror: Reflections on educating preservice teachers for collaborative work with indigenous communities*. University of British Columbia**:** 312.

Gee, J. P. (1996). Social linguistics and literacies: Ideology in discourses. London, Taylor & Francis.

Griffiths, M., & Tann, S. (1992). Using reflective practice to link personal and public theories. *Journal of Education for Teaching, 18*(1), 69-85.

Herrera, T., & Owens, D. (2001). The "New New Math"? Two reform movements in mathematics education. *Theory Into Practice, 40*(2), 9.

Hiebert, J., Gallimore, R., & Stigler, J. W. (2002). A knowledge base for the teaching profession: What would it look like and how can we get one? *Educational Researcher, 31*(5), 3-15.

Houston, J. E. (1995). Thesaurus of ERIC descriptors. Phoenix, AZ: Orynx Press.

Janesick, V. J. (1998). *Journal writing as a qualitative research technique: History, issues, and reflections.* San Diego, CA.

Jaworski, B. (1994). *Investigating mathematics teaching: A constructivist enquiry*. London: The Falmer Press.

Jerome, R. (2006). *The apple: An autoethnography of experiences in education*. Lakehead University**:** 75.

Johnson, K. E., & Golombek, P. R. (2002). *Teachers' ways of knowing: Narrative inquiry as professional development.* Cambridge, MA: Cambridge University Press.

Jones, P. S. (Ed.). (2002). A history of mathematics education in the United States and Canada. Reston, VA: NCTM.

Kelchtermans, G. (1993). Getting the story, understanding the lives: From career stories to teachers' professional development. *Teaching and Teacher Education 9*(5/6), 443-456.

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding it up: Helping children learn mathematics.* Washington, DC: National Academy of Sciences.

Kilpatrick, J., Martin, W. G., & Schifter, D. (Eds.). (2003). A research companion to Principles and Standards for School Mathematics. Reston, VA: NCTM.

Kincheloe, J. L. (1991). Teachers as researchers: Qualitative inquiry as a path to empowerment. New York: The Falmer Press.

Klein, D. (2003). A brief history of American K-12 mathematics education in the 20th Century. *Mathematics Cognition*: 23.

LeCompte, M. D., & Schensul, J. J. (1999). *Designing and conducting ethnographic research.* London: AltaMira Press.

Liddell, J. (2007). *What's Black about it? An educator's autoethnography.* Arizona State University**:** 159.

Lampert, M. (2001). *Teaching problems and the problems of teaching.* New Haven, CT: Yale University Press.

Lewis, C. B. (2007). *Identity: Lost, found, and (re)constructed through healing narratives---an autoethnography of tragedy, travail, and triumph.* Columbus: Ohio University.

Lincoln, Y. S., & Guba, E. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage Publications.

Lipka, R. P., & Brinthaupt, T. M. (1999). *The role of self in teacher development.* New York: State University of New York Press.

Middleton, J. A., Dougherty, B., Heid, M. K., D'Ambrosio, B., Reys, R., de Loach-Johnson, I., Gutstein, E., & Hala, M. (2004). An agenda for research action in mathematics education: Beginning the discussion. *Journal for Research in Mathematics Education, 35*(2), 74-80.

Morgan, B. (2002). Critical practice in community-based ESL programs: A Canadian perspective. *Journal of Language, Identity, and Education, 1,* 141-162.

Morales, T. (2007). *Colliding sensibilities: Exhibition development and the pedagogy of period room interpretation.* The Pennsylvania State University**:** 396.

Osterman, K. F. (1990). Reflective practice: A new agenda for education. *Education and Urban Society, 22,* 133-152.

Park Han, E. (1995). Reflection is essential in teacher education. *Childhood Education, 71*(4), 228-230.

Phillips, D. C. (1987). Validity in qualitative research: Why the worry about warrant will not wane. *Education and Urban Society, 20*(1), 9-24.

Raudenbush, C. A. (1994). *Improvisation: An autoethnography of my first year as an administrator.* Lawrence, KS:

Reed-Danahay, D. (1997). *Auto/Ethnography: Rewriting the self and the social.* New York, Berg.

Remler, N. B. L. (2000). *Toward a scholarship of teaching: Four college English faculty examining their teaching selves.* Athens: University of Georgia**:** 242.

Richardson, L. (1995). Narrative and sociology. *Representation in Ethnography, 1*(2), 198-221.

Romberg, T. A. (2003). *Creating a research community in mathematics education.* Madison, WI**:** 42.

Ross, D. D. (1989). First steps in developing a reflective approach. *Journal of Teacher Education, 40*(2), 22-30.

Schoenfeld, A. H. (1987). *What's all the fuss about metacognition?* Hillsdale, NJ**:** 189-215.

Schon, D. A. (1983). *The reflective practitioner: How professionals think in action.* Basic Books Inc.

Schon, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* San Francisco: Jossey-Bass.

Shulman, L. (1989). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Schwandt, T. A. (2001). Dictionary of qualitative inquiry. Thousand Oaks, CA: Sage Publications.

Simon, M. A. (1995). Reconstructing mathematics pedagogy from a constructivist perspective. *Journal for Research in Mathematics Education, 26*(2), 114-145.

Sparks-Langer, G. M., & Colton, A. B. (1991). Synthesis of research on teachers' reflective thinking. *Educational Leadership*, 37-44.

Sprinkle, R. (2001). Written commentary and reflective teaching: A systematic, theory-based approach to response. *Graduate Division.* Bowling Green, KY: Bowling Green State University**:** 259.

Stein, M. K. (2000). *Implementing standards-based mathematics instruction*. New York, Teachers College Press.

Tisdale, K. (2004). Being vulnerable and being ethical with/in research. *Foundations for Research*, 13-30.

Varghese, M., Morgan, B., Johnston, B, & Johnson, K. A. (2005). Theorizing language teacher identity: Three perspectives and beyond. *Journal of Language, Identity, and Education, 4*(1), 21-44.

Van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pegagogy.* New York: State University of New York Press.

Vygotsky, L. (1962). *Thought and language.* Cambridge, MA, MIT Press.

Zeichner, K., & Liston, D. P. (1996). *Reflective teaching: An introduction.* Mahwah, NJ, Lawrence Erlbaum Associates Publisher.

APPENDIXES

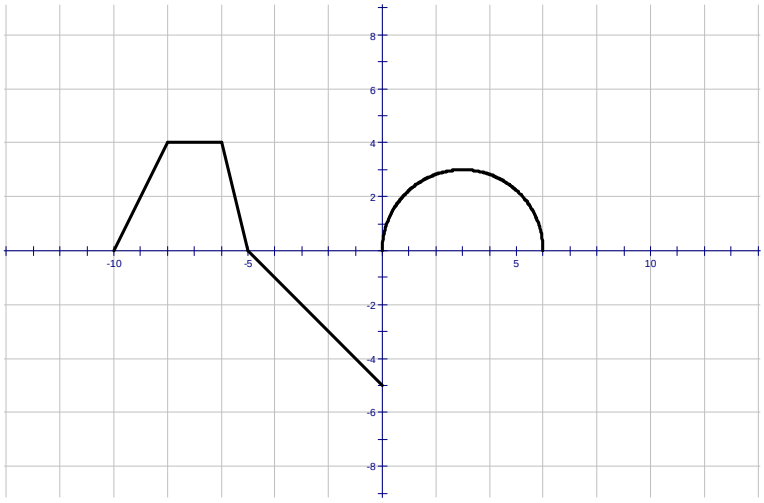
APPENDIX A

AP CALCULUS

TASK 1

Name_____

Given the graph of $\mathbf{f(x)}$, determine the value of $\int_{-10}^{6} \mathbf{f(x)dx}$. SHOW ALL WORK.

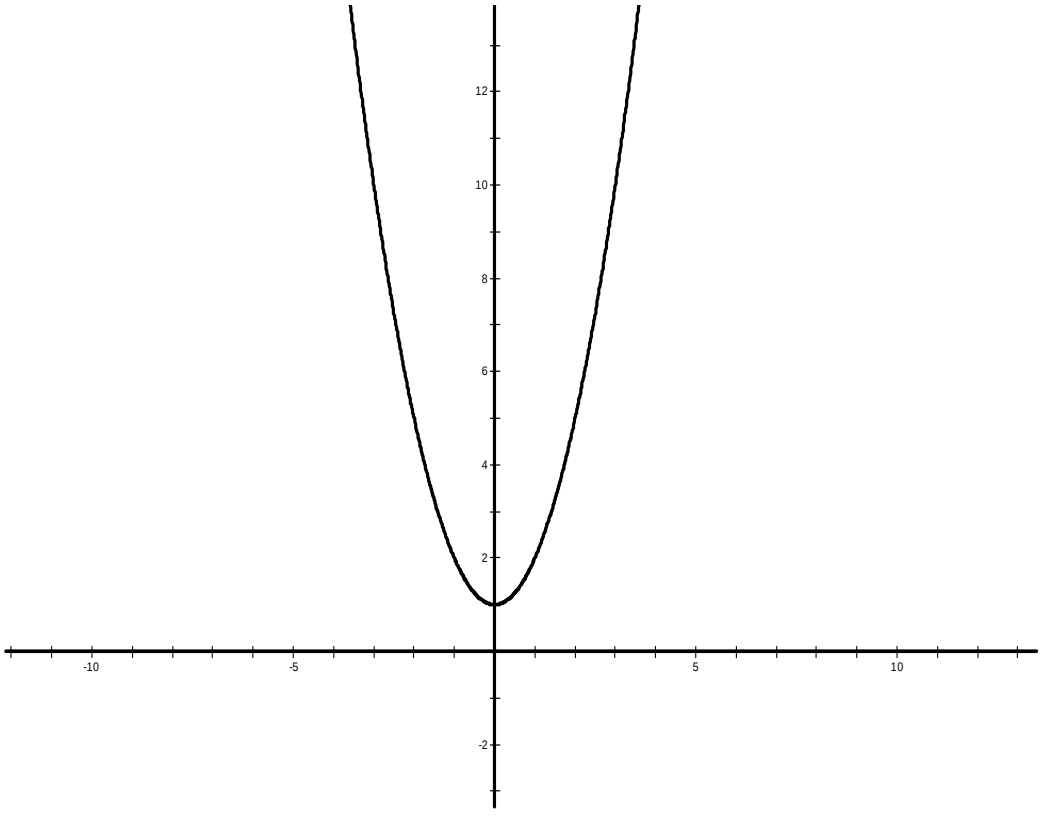


AP CALCULUS

TASK 2 (PART I)

Name_____

Given the function $\mathbf{f(x) = x^2 + 1}$, draw the inscribed rectangles with n = 8 on the interval $\mathbf{[-2, 2]}$ and use these rectangles to approximate the area under the curve. SHOW ALL WORK.

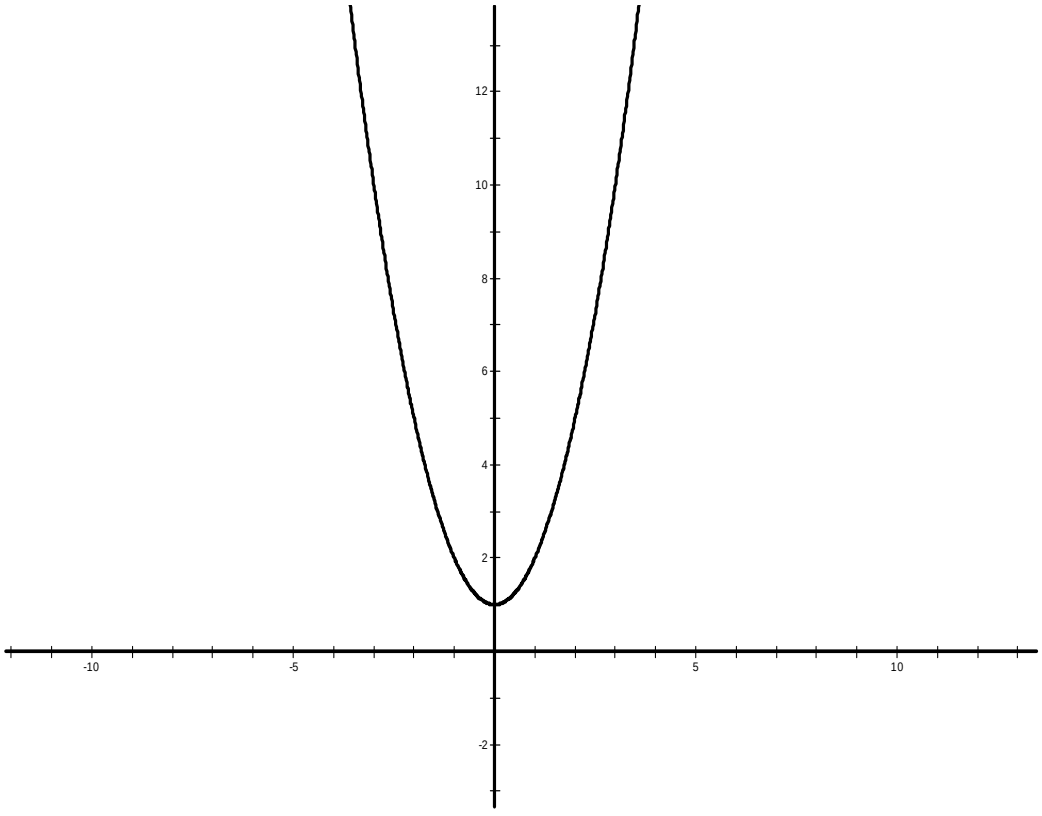


AP CALCULUS

TASK 2(PART 2)

Name_____

Given the function $f(x) = x^2 + 1$, draw the circumscribed rectangles with $n = 8$ on the inverval $[-2,2]$ and use the rectangles to approximate the area under the curve. SHOW ALL YOUR WORK.

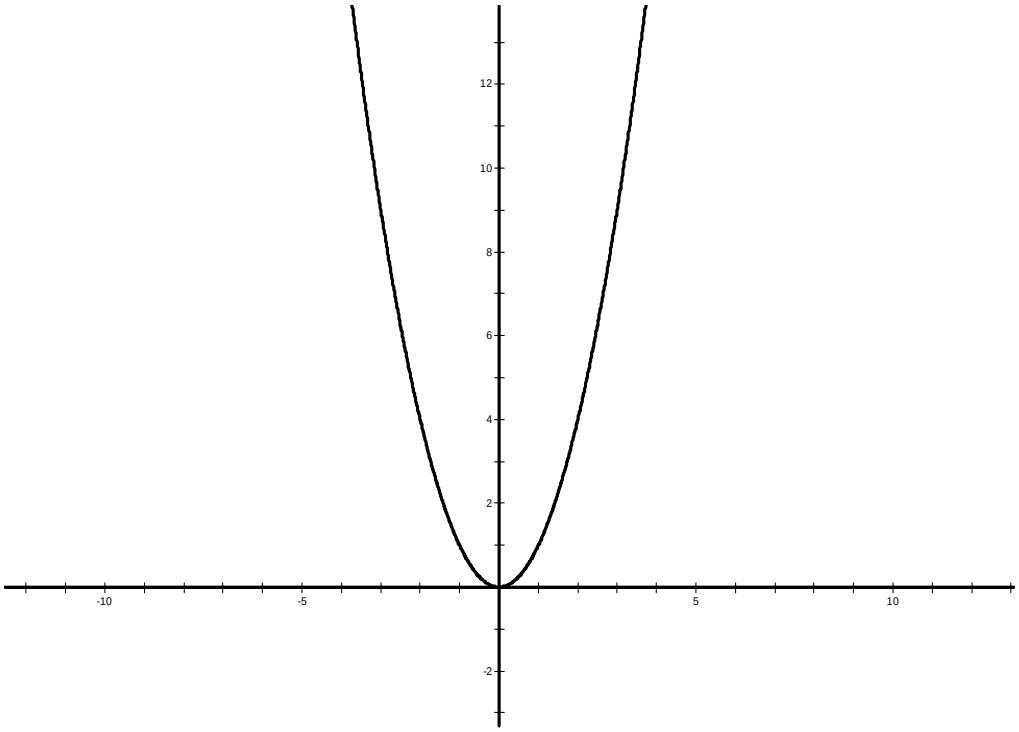


AP CALCULUS

TASK 3

Name_____

Given a function f(x) such that $\mathbf{f(x) \geq 0}$. Generate a formula, using sigma notation, that would find the exact area under the curve from *a* to *b*.



AP CALCULUS

TASK 4

Name_____

Let R be the region bounded by $y = 2 - x^2$ and $y = -x$. Sketch the graph of R, set up the integral that represents the area of R, and evaluate the integral. SHOW ALL WORK.

APPENDIX B

STUDENT QUESTIONNAIRE

TASK 1

1. What happened in class to help you understand the concept of integral?

2. What happened in class to help you understand when the integral is the total area under the curve?

3. What could have been used to help in your understanding of integral and area?

STUDENT QUESTIONNAIRE

TASK 2

1. What happened in class to help in your understanding of inscribed and circumscribed rectangles?

2. What happened in class to help in your understanding which point of the interval to use to find the height?

3. What could have been used to help in your understanding of inscribed and circumscribed rectangles?

STUDENT QUESTIONNAIRE

TASK 3

1. What happened in class to help in your understanding of the total area verses the approximate area?

2. What happened in class to help in your development of the formula for finding the area?

3. What could have been used to help in your understanding when generating the formula?

STUDENT QUESTIONNAIRE

TASK 4

1. What happened in class to help in your understanding of area between two curves?

2. What happened in class to help in your understanding of setting up the integral to find the area?

3. What could have been used to help in your understanding of finding the area between two curves?