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A Mixed Methods Study of How the Transition Process Impacts the Autonomy
of Pre-Service Secondary Mathematics Teachers

By

Linda Kasal Fusco

A DISSERTATION

Presented to the Faculty of
The Graduate College at the University of Nebraska
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Major: Educational Studies
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Under the Supervision of Professors Sheldon Stick and Brent Cejda

Lincoln, Nebraska

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A Mixed Methods Study of How the Transition Process Impacts the Autonomy
of Pre-Service Secondary Mathematics Teachers

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University of Nebraska, 2011

Advisers: Sheldon Stick and Brent Cejda

This mixed methods study sought to identify the impact that transition into the practice of teaching had on the autonomy of pre-service secondary teachers of Mathematics. It was based on the belief that a Mathematics teacher's autonomy depended on: beliefs about Mathematics and how it was learned, reflections on the teaching practice, and social constraints of a secondary school culture. Data was collected between January 2009 and March 2010.

In Phase I (Quantitative) the participants (N = 30), selected from ten State University of New York teacher preparation colleges and universities, completed five instruments to quantify the three factors of autonomy. The participants' answers to the items on each survey, inventory, and questionnaire were analyzed using descriptive statistics, frequency counts, and percentages. A series of ANOVAS were conducted with the Phase I participants' backgrounds as the independent variables and their beliefs about Mathematics and Mathematics teaching were the dependent variables.

In Phase II (Qualitative) seven case studies were purposefully selected by gender and their Mathematics learning styles from the thirty Phase I participants. Each participant was interviewed prior to and subsequent to their student teaching experiences and the data was secured via 14 one-hour interviews. Juxtaposing of information from

both phases occurred when Phase I artifacts were employed to support the analysis of autonomy for each of the multiple case studies. The results of the two phases were integrated in the discussion section of the study.

Major consideration was given to the Phase Two findings and it was determined that the seven multiple case study analyses provided in-verification of the instruments used in Phase One. Interpretations of the cross-case studies provided a more thorough understanding of the relationships between factors of autonomy among the participants.

The findings from this investigation hold implications for: postsecondary institutions preparing potential future professional practitioners who will be teaching Mathematics, collaborative arrangements between postsecondary training institutions and the cooperating schools willing to provide mentoring for future teachers of Mathematics, and departments of education within the 50 states responsible for implementing and ensuring compliance with the latest standards pertaining to Mathematics education.

Mission Acknowledgement

It is by choice that I wanted to create and complete this doctoral study as a cap to four decades of my experience as a secondary public school Mathematics teacher and supervisor. I am passionate about the study as to why persons who choose to teach Mathematics have the highest rate of attrition among school teachers. I often look back on my 36-plus-years as a classroom Science and Mathematics teacher and the 13-years I spent supervising secondary Science and Mathematics teachers in wonderment as to why I persisted in the field.

I started teaching secondary Mathematics in January 1970 at an urban school in Westchester, New York. My salary was at best \$3000 dollars to start. I had limited textbooks and supplies available with an opaque projector on loan from the library as the only technology I could use, as instructional resources for my five classes each containing 30 inner city eighth graders. The classes I inherited were out of control. The prior teacher of Mathematics left in the middle of the year suffering from a nervous breakdown.

My first order of business was to get classroom management under control. My pre-service training had not even addressed any of the issues that I encountered—ethnicity, drugs, child abuse, poverty, or the negative culture of colleagues that were dissatisfied with “climate” of the school system. During the five-years I taught Mathematics in an urban setting, I watched colleagues leave the profession to become successful business moguls. When they came back to visit most asked why I remained.

My desire to stay in the teaching practice was always challenged. My first year as a professional educator gave me a low salary, unsafe working conditions, disruptive

difficult students, and little or no supervision. Retrospectively I continue to be amazed that I persevered in that hell of humanity and continued engaged in the profession. I believe what kept me afloat was my ability to dig deep down and think about how to solve the myriad of instructional problems that confronted me, a 21-year-old new teacher. I measured success on a continuum of being able control the classes and create a climate where students could learn. But how was I able to know what to do? Where did the schema in my brain originate to deal with finding solutions to these first time problems that I encountered?

The acknowledgement for my ability to think on my feet and work in difficult situations is rooted in my father. He taught industrial arts at a local urban school. I remember, as a nine-year-old, I would go and stand next to him at school functions, whenever I could. I saw how he dealt with difficult students who highly respected him. I watched his students, many who had been given up by society and were marking time in “shop”, work diligently to create projects. I listened to my father explain how he counseled each student. Many of his students today are retired millionaires because they took his advice. Probably it was due to those formative years and watching my Dad teach that enabled me to cope with students from different cultures and difficult family situations.

As an administrator for the last 13-years of my professional practice, I saw ostensibly highly qualified Mathematics teachers enter the profession, give demonstration lessons that were rich in best practices, but after one-to-two –years not perform as expected. The change among those professionals was bewildering and I wanted to know what happened during their transition from pre-service teacher to professional teacher.

I want to dedicate this study to my father, Dr. Ludwig Kasal, who was my teaching coach, my inspiration, and thank him for providing my moral compass.

Acknowledgements

It has been an eight year quest to complete this study. It could not have been done without the support of my husband Ben, who championed my work; and my adviser Dr. Sheldon Stick, who was seminal in guiding me through this dissertation journey. I would also like to acknowledge: Matt Perini (Silver, Strong & Associates), Dr. Vicky Kouba (SUNY Albany); and the following SUNY post secondary institutions: Cortland, Fredonia, Geneseo, New Paltz, Oneonta, Oswego, Potsdam, Buffalo, Stony Brook providing the venue for my study.

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Chapter I

Introduction

Statement of the Problem

This study sought to describe the impact on pre-service teachers' autonomy as they transitioned through student teaching. The genesis for this research was based on the ongoing issue of Mathematics teaching reform and the need for highly qualified and effective Mathematics teachers. Teacher turnover (defined as the departure of teachers from their teaching jobs) data showed that 26% of the teachers that left the occupation stated dissatisfaction as a reason. The highest turnover was among Special Education, Mathematics, and Science teachers (Ingersoll, 2001).

The exodus from the teaching profession has been impacted by the changes demanded by the profession. The pedagogical paradigm of how students learn has shifted from the behaviorist perspective to cognitive learning. The cognitive revolution has been rooted "in the social nature of learning, the importance of context on understanding, the need for the domain specific knowledge in higher order thinking and problem solving, and the belief that learners construct their own meaning" (Danielson, 2000, p. 14). Pressure has been levied on Mathematics teachers to shift their instructional style from being teacher centered to learner centered. Ernest (1989) posited that teaching reforms cannot materialize unless teachers' deeply held beliefs about Mathematics and Mathematics teaching change.

Transition from traditional Mathematics instruction to a constructivist-based practice requires changes, not only in teachers' instructional practice, but also in the beliefs and understandings that ground and shape the practice itself (Fennema & Nelson,

1997). Goldsmith and Shifter (1997) stated that developing practice involves the teacher's ability to examine currently held beliefs and practices, deciding what elements no longer serve the practice well, and integrating the new ideas and methods into instructional prowess. Cooney and Shealy (1997) suggested that teacher change be viewed from the perspective of developing teachers' belief structures in such a way that autonomy in evaluating alternative practices in teaching Mathematics is commonplace.

Background to the Problem

Globalization. The demands on secondary education have broadened with the intent to prepare all students to have the opportunity to be educated beyond high school. Friedman (2006) pointed out that globalization has shifted the high-end research jobs abroad, such as the Microsoft research center in Beijing. Also suggested was that every American man or woman needs to be placed on a post-secondary campus. Concerns over the U.S. economy have fueled the changes in the knowledge students would need in order to be successful in the job market and to produce a shift in the study of teaching. The instructional objective is to have the skills of students focus on critical thinking, problem solving, life long learning, and deeper understanding of each content area, including Mathematics.

Adler, Ball, Krainer, Lin, and Novotna (2005) referred to the extensive move to make Mathematics accessible for all as "massification" of Mathematics as a school subject. Along with the U.S., many countries today view Mathematics as a necessary competency for critical citizenship. Internationally, the increasing demand for Mathematics proficiency for all increases the need for quality teaching (Adler et al., 2005). Quality instruction hinges on teachers.

Education reform legislation. The quest to improve the U.S. education system has been represented by four decades of legislation. In 1983, National Commission of Excellence in Education (1983) published *A Nation at Risk: The Imperative for Educational reform* that defined the education quality issue (Paige & Stroup, 2004). It was not until 1994, after failed attempts of both the Bush (41) and Clinton administrations to pass a standards-based reform bill, that the reauthorization of the 1965 Elementary and Secondary Education Act (ESEA) linked Title I funds to standards-based reform. In 2001, the second Bush administration passed the No Child Left Behind Act (PL 107-110) that strengthened the policy language in the ESEA to further support standards and testing (Paige & Stroup, 2004). Hoff (2007) reported that the proposed reauthorization of NCLB legislation revision called for authorization of all states to use the growth model methodology to track progress towards the NCLB's central goal; to have all students proficient in Mathematics and reading by the end of the 2013-14 school year.

The No Child Left Behind Act's (2002) requirement that schools be staffed with "highly qualified teachers" has required the American public school systems, especially those in inner city and poor rural areas, to meet more stringent requirements in hiring staff. NCLB's call for "highly qualified" teachers has impacted postsecondary teacher training programs across the country. The Higher Education Act of 1998 (PL 89-329) required states to use an accountability system to assess the performance of teacher preparation programs (Paige & Stroup, 2004). Collecting and reporting reliable and valid data is necessary to accurately quantify the quality of teachers.

National Council of Teachers of Mathematics (NCTM). The National Council of Teachers of Mathematics (NCTM) was responsible for the redirection of Mathematics education. In 1989 NCTM wrote national Mathematics standards based on the premise that Mathematics teachers need to develop instruction that fosters students constructing Mathematics concepts (National Council of Mathematics, 1989). As a result of the NCTM initiative, 42 states adopted the national Mathematics standards. At that time, New York State opted to create their own Mathematics standards, but met failure in 2003, when the majority of secondary Mathematics students failed the Mathematics A Regents exam. In March, 2005, New York State revised the Mathematics standards curriculum to reflect the NCTM Mathematics standards.

The ESEA and NCLB legislation resulted in New York State administering yearly standard Mathematics assessments at grade levels 3, 4, 5, 6, 7, 8, and 9. The results of those assessments are published in the local newspapers each year, and those results are interpreted by the public to reflect teacher effectiveness.

Trends in International Mathematics and Science Study (TIMSS). The Trends in International Mathematics and Science Study (TIMSS) in 2003 showed no significant difference between the average Mathematics score (504) of U.S. eighth grade students and average Mathematics score (502) of U.S. eighth grade students on the 1999 TIMSS (National Center for Education Statistics, 2004). The United States has remained 12th from the top of the list of the 44 nations that participated in the TIMSS 2003. The 2003 study revealed that U.S. eighth-graders in U.S. public schools with the highest poverty levels (75% or more of students eligible for free or reduced-price lunch) had

lower average Mathematics and science scores compared to their counterparts in public schools with lower poverty levels.

The Problem

Scope of the problem. Educational research during the past four decades has produced a science-based bevy of knowledge on how to teach. Research on the nature of the brain and how it affects learning have set a new standard for pedagogical approaches. However, the public school system across America is outdated.

The past 40 years has produced an ever- evolving understanding of good teaching. If we plunge into denial (“pretending not to know what we know”) or use excuses (“been there, done that” or “what goes around, comes around”), we will miss out on the knowledge accumulated through extensive reviews of best evidence and experience. (Danielson, 2000, p. 15)

Darling-Hammond (2003) posited that American colleges seem to produce a pool of qualified teachers, but the difficulty is retaining teachers in the education profession. Since the early 1990s the number of teachers exiting the profession is exceeding the number of teachers entering the profession, and at an increasing rate. About one-third of all new teachers leave the profession within five-years. Evidence also indicates that teachers who lack initial preparation in the subject area they teach are more likely to leave the profession, and it is an increasing phenomenon (Darling-Hammond, 2003).

It seems evident that the product (higher student achievement in Mathematics) of Mathematics reform is questionable. The goal of improving Mathematics achievement for students from low socio-economic environments has not been achieved. Teacher education programs aim to produce highly qualified teachers. To institute Mathematics reform, however, these teachers need to not only be highly qualified but, also highly effective.

Need to study this research problem. Mathematics teaching reform depends on teachers changing their approaches to the teaching of Mathematics (Ernest, 1989). Changes in beliefs, Ernest contended, were associated with the ability of the Mathematics teacher to increase their reflection and autonomy regarding their teaching practice. Thompson (1992) stated that a teacher's concept of the discipline should not be limited to an analysis of teachers' views. A more in-depth study should include an examination of the instructional setting and the practices characteristic of the teacher. Most important is to study the relationship between teachers' professed views and actual practices. Thompson's (1992) study of middle school Mathematics teachers revealed that teachers' conceptions of Mathematics are manifested in their classroom instructional practice (Carpenter, Dossey, & Joehler, 2004; Thompson, 1984, 1992). But those practices apparently are not sufficiently effective.

The primary focus of a Mathematics teacher has shifted from one of mastery of concepts and procedures as the ultimate goal of instruction to one with a student engaged in purposeful inquiry projects. The process of inquiry requires: data gathering, discovering, inventing, communicating, and testing findings using argumentation and creative thinking. At one time it was believed that creating a curriculum that addressed the instructional paradigm shift would make up for teacher inflexibility in instructional methods. But research on teachers' thinking and decision-making, however, has shown that how teachers implement curriculum is influenced markedly by their knowledge and beliefs (Thompson, 1992).

The literature was interpreted to mean that studies on teachers' beliefs studies have been done with in-service Mathematics teachers (Ernest, 1989; Thompson, 1984,

1992). Some studies on pre-service teachers' beliefs about Mathematics teacher and learning were conducted in the 1980s. The results of those early studies noted that teachers' beliefs about Mathematics and Mathematics teaching and learning were formed during a teacher's K-12 schooling years, and based on experiences as students in Mathematics classes. What they saw is what they emulated.

Thompson (1992) stated that the task of modifying deeply rooted conceptions of Mathematics has been difficult to achieve within the short period of students participating in post-secondary Mathematics methods courses. In 1994 a report was presented at the annual American Educational Research Association (New Orleans, LA) on research conducted at the University of Georgia focusing on the beliefs of pre-service secondary Mathematics teachers (Cooney & Shealy, 1997). That was a study on Mathematics education students during a sequence of four-quarters and then during their first year of teaching. The study employed qualitative methodology, anthropological in nature, using both structured and unstructured interviews, field activities, and observations of teaching. The findings were that teachers who embarked upon their first-year of teaching with reservations about their work oftentimes resulted in them blaming themselves for failures. To obviate such uncertainties about practice and knowledge, those teachers typically assumed pedagogical control of their classrooms and engaged in more of a rigid instructional paradigm. The anxiety created subsequently led them to become accusatory of their teacher educators for being unrealistic about what they were required to do as professional educators and for obscuring the realities of the job.

Robertson (2006) surveyed 53 novice teachers and 15 building principals on factors that presumably influenced novice teacher satisfaction or discontent with their

teaching jobs. The survey was followed up by small group and personal interviews of 35 teacher participants and 8 principal participants. Analysis of the survey data led to the conclusion that serious problems resulted from the contrast between what novice teachers envisioned teaching to be when they themselves were school children and what they learned about teaching when they experienced the actual teaching practice. Robertson (2006) posited that problems could not be blamed on post-secondary preparation. Instead, such problems stemmed from recollections of their own personal experiences at school that they assumed to be universal. Also noted was that novice teachers' perceptions of teaching were not influenced by their socio economic backgrounds.

There was no research available on the how the transition process from a pre-service to student teacher affected the autonomy of pre-service teachers. Qualitative belief studies on pre-service teachers, as they transitioned into practice, have focused on individuals. Adler and colleagues (2005) did a Meta study on 300 reports regarding research on Mathematics education between 1999 and 2003. Assisting with the interpretation of those studies was an international team of five Mathematics educators and researchers. One-hundred-sixty studies focused on teachers' learning in the context of reform programs, and 15 papers were theoretical or conceptual with no explicitly empirical base. The researchers observed that 70% (98 out of 145) of the papers were relatively small case studies (fewer than 20 participants).

According to Adler et al. (2005), a large number of pre-service Mathematics classes had fewer than 20 students. Those researchers reported a predominance of small scale studies and teacher educators engaged in studying their own contexts, and that there were few studies on how teachers learned from experiences.

We do not understand well enough how Mathematics and teaching, as inter-related objects, come to produce and constitute each other in teacher education practice. We lack adequate knowledge about what and how this happens inside teacher education, and then across ranging and contrasting programs, contexts and conditions. The field needs to understand better how Mathematics and teaching combine in teachers' development and identities. (Adler et al., 2005, p. 378)

Adler et al. (2005) acknowledged that small participant group studies might be suited for understanding particular cases and for providing a springboard for developing theoretical frameworks. Of importance, according to those authors, was a need to consider the lacuna that possibly could be addressed by three types of studies: large studies on understanding the larger landscape opportunities; cross case analyses; and longitudinal studies. Absent such information, those researchers voiced concerns about the balance between the theoretical and practical knowledge and the instructional skills required for future teachers to be effective at cultivating an understanding of Mathematics and then the application of its principles.

During the past 25-years, Mathematics teacher training programs have been revised to address an instructional paradigm change from memorizing formulas and concepts to understanding and application; cognitive learning. Despite pressure (state assessments, international competition, internal administrative) that has been levied on Mathematics teachers to shift their instructional style from being teacher-centered to learner-centered, the profession tends to maintain a status quo. Mathematics teacher reform remains stagnant; student achievement on international secondary Mathematics exams has not improved. Despite efforts to instill recognition and application of scientifically-based instructional practices at all educational levels, there continues to be an apparent disconnect between the reform movement and improving student achievement in Mathematics. Developing the ability of teachers to view themselves as

authorities able to evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence, is a skill predicated upon knowledge and confidence in the instructional area. Absent evidence of the novice and new teachers (between 1 – 5 years of experience) embracing the cognitive approach to providing instruction, it is appropriate to urge careful study on the notion of autonomy starting at the pre-service level.

The Study

Background to the study (Theoretical). Ernest (1989) posited that teaching reforms cannot materialize unless teachers' deeply held beliefs about Mathematics and Mathematics teaching change.

During their transformation into practice, two factors affect these beliefs: the constraints of the social context of teaching, and the level of the teachers thought. Higher level thought enables a teacher to reflect on the gap between beliefs and practice, and to narrow potential gaps. The autonomy of the Mathematics teacher depends on all three factors: beliefs, social context, and the level of thought. (p. 4)

Goldman and Shifter (1997) stated that teachers who sought external sources of authority and found comfort believing that someone else had the answer, might find it difficult to shift their locus of intellectual activity from a textbook or expert to an inquiring student, colleague, and most importantly to themselves.

Sykes (1999) supported the earlier work of Ernest (1989) and Thompson (1984, 1992) by stating that novice teachers often formulated teaching from watching their own teachers during their childhood years. Four-years of college preparation, he said, did little to change those ingrained perceptions and assumptions. "Further, few of those assumptions involve systematic thought about teaching; instead, they involve visions of what teaching should be like" (Robertson, 2006, p. 35).

Thompson (1992) reported that most research on teachers' beliefs and conceptions had been interpretive in nature, and employed qualitative methods of analysis. Typically such studies used small numbers of participants.

Numerous techniques for obtaining data have been used: Likert-scale questionnaires, interviews, classroom observations, stimulated recall interviews, linguistic analyses of teacher talk, paragraph completion tests, responses to simulation materials such as vignettes describing hypothetical students or classroom situations, and concept generation such as the Kelly Repertory Grid Techniques. (Thompson, 1992, p. 131)

Apparently little effort has been devoted to collating that information into a cohesive body of information, and there does not seem to be available research that critically examined those studies from a rigorous scientific perspective.

The analyses of available information have fostered a belief that there are marked inconsistencies of professed beliefs and instructional practice (Thompson, 1992).

Nancy, for example, was dependent on her teaching educators and other teachers she revered for making sense of her role as a Mathematics teacher. When she began teaching and experienced difficulty, she tended to place the blame on herself, and felt she let her students, her mother, and her instructors down. For Nancy, the world of teaching was perceived as relatively simple and unproblematic. Beliefs constructed during her teacher education program dissolved when she was faced with the problematic nature of the classroom. (Cooney & Shealy, 1997, p. 92)

Ernest (1989) used Thompson's (1984) research to assign interpretation of Mathematics into three distinct categories: (a) Problem solving view—Mathematics was a process of inquiry and coming to know that enabled a person to add to the sum of knowledge; (b) Platonist view—Mathematics was a static body of knowledge, a crystalline realm of interconnecting structures and truths, bound together by filaments of logic and meaning; and (c) Instrumentalist view—Mathematics was a set of unrelated utilitarian rules and facts.

Utilizing those three approaches, Ernest (1989) claimed that teachers likely would follow one of three instructional avenues with reasonably predictable outcomes:

(a) Instructor: Skills mastery with correct performance; (b) Explainer: Conceptual understanding with unified knowledge; and (c) Facilitator: Confident problem posing and solving. With each avenue there was a connection to the teaching roles; “The instrumental view of Mathematics (an unrelated but utilitarian set of rules and facts) is likely to be associated with the instructor model of teaching (skill mastery with correct performance)” (Ernest, 1989, p. 2). Working with the notion of roles and views being symbiotic, a Beliefs Survey (see Appendix A) was created to further study the issue undertaking in this research.

Thompson (1992) said that the study of teachers’ beliefs about their subject matter, and their subsequent instructional practices as adjusted by productive experiences was an uncharted area of research. Extending that thought was information from some studies that indicated teachers’ beliefs about Mathematics and its teaching played a significant role in shaping teachers’ characteristic patterns of instructional behavior (Ball, Hill, & Rowan, 2005; Kruse & Roehrig, 2005).

Purpose of the study. The purpose of this study was to explore the impact that student teaching had on the autonomy of pre-service secondary Mathematics teachers. The study focused on the three key factors of autonomy: systems of beliefs concerning Mathematics and its teaching and learning; constraints and opportunities provided by the social context of the practice of teaching; and the teachers’ level of thought processes and reflection (Ernest, 1989).

Significance of the study. The results of this study were expected to influence pre-service programs for Mathematics teaching. A particularly important issue was that this study would yield insights into how and why the reality of teaching in a classroom required reflective practice. “Research directed toward mapping the issues teachers confront as they enact new beliefs and understandings in the classroom will help create a fuller picture of how teachers move through the terrain creating a reformed Mathematics practice” (Goldman & Shifter, 1997, p. 38). This investigation aimed to uncover if selected pre-service teachers entered the teaching field of Mathematics with a sense of autonomy that allowed them to develop their practice toward a learner-centered critical thinking instructional setting. Thus it was ground-breaking work because it tied issues of pre-service teachers, having been exposed to presumably the latest ideas about learning and instructional practices, to how they subsequently acted as professional educators.

Teacher pre-service programs generally have embraced the research of authentic pedagogy, engaged teaching and learning, and teaching for understanding (Posamentier, Smith, & Stepelman, 2005). Using that platform as a point of departure meant that newly graduated teachers of Mathematics should be conversant with the latest research on how students of the 21st Century learn and best apply Mathematics to everyday living.

It seems axiomatic that teachers’ conceptions of Mathematics and cutting-edge instructional practices are pivotal in effecting best learning situations for students, and that translated into qualified Mathematics teachers practicing a learner-focused model of teaching. Mathematics needed to be a process of inquiry and application instead of rote learning and regurgitation. It needed to become a part of a student’s cognitive network

instead of information imposed and not truly connected to the totality of a student's development of cognition.

Definition of Terms.

Mathematics Reform—Refers to two approaches (a) Individual: The individual cognitive practices and the current focus as to how learners actively incorporate information into an existing set of understandings, often referred to as constructivism. (b) Social: View of Mathematics as a process of enculturation of a learner into the practices of an intellectual community (Stocks & Schofield, 1997).

Pre-service teacher—Secondary Mathematics education students that have met requirements necessary to engage in student teaching.

Autonomy—“The ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence” (Cooney & Shealy, 1997, p. 88).

Beliefs—Teachers conceptions of the nature and meaning of Mathematics, and on their mental models of teaching and learning Mathematics (Thompson, 1992).

Three conceptions of Mathematics proposed by Ernest (1989):

1. Problem solving view—Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product; a process of enquiry, and coming to know, not a finished product, for its results to remain open to revision.

2. Platonist view—Mathematics is a static unified body of knowledge, a crystalline realm of interconnecting structures and truths, bound together by filaments of logic and meaning. Mathematics is not discovered but created.
3. Instrumentalist view—Mathematics is a set of unrelated but utilitarian rules and facts; an accumulation of facts, rules, and skills to be used in the pursuance of some external end.

Three mental models depicting teachers' conceptions of the type and range of teaching roles, actions and classroom activities associated with the teaching of Mathematics (Ernest, 1989):

1. Instructor: Skills mastery with correct performance.
2. Explainer: Conceptual understanding with unified knowledge.
3. Facilitator: Confident problem posing and solving.

Social Context—The opportunities and constraints of the student teaching setting and environment (Ernest, 1989; Jones, 1997).

Reflection—The teacher's level of thought processes regarding self assessment, descriptions and commentaries about learning activities, and analysis of student work on what the teacher intended and whether the teacher's goals were achieved (Danielson, 2000).

Methodology. The purpose of this mixed methods study was to collect, analyze, and mix both quantitative and qualitative data in order to identify the phenomenon of teachers' autonomy as pre-service secondary Mathematics teachers. It was accomplished by examining the respective pre and immediate post student teaching experiences of a selected sample of participants representing a number of accredited training institutions

in the State of New York. The goal of the quantitative phase was to use numeric (survey and profile) data to determine the degree that New York State pre-service secondary Mathematics teachers' autonomy was dependent. The goal of the qualitative phase of the study was to use selected interviews (text) and artifacts to provide an in-depth understanding of the complex phenomenon of teacher autonomy as participants' transitioned into secondary Mathematics student teaching in New York State.

The rationale for conducting a mixed method study was to gain a better understanding of prior research inconsistencies. Reliance on a single design (quantitative or qualitative) limited the analyses. The emergence of constructivism research in Mathematics education has encouraged emphases that are central to the qualitative paradigm, including investigation into the beliefs and conceptions of knowledge of teachers' strategic self-regulative activities (Ernest, 1998). Quantitative data (e.g., Beliefs Survey, Teaching Styles Profiles, and Learning Styles Inventories) collected and analyzed by the researcher was used to assign teachers' profiles' dominance traits as numerical values, allowing the researcher to triangulate qualitative and quantitative results for interpreting the autonomy phenomenon. The juxtaposing of the two methodologies, quantitative and qualitative, allowed for obtaining a more robust understanding of the phenomenon under study.

Thompson (1992) pointed out that it was important that researchers

make it explicit to themselves as well as others, the theory or theories of teaching and learning, and the nature of Mathematics with which they are approaching the study of Mathematics teachers' beliefs. Without explicit attention to them, the significance of the study may be obscured, making it easy for readers to dismiss the research as inconsequential, albeit interesting. (p. 130)

Research questions. The central question for this proposed study was: How was the autonomy of pre-service teachers influenced after completing student teaching? To secure reasonable information the following three sub questions were addressed.

1. Do pre-service teachers' systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?
2. How does the social context of student teaching impact the ability to make instructional decisions?
3. How is the level of reflection on teaching practice impacted by the student teaching experience?

In pursuit of scientific answers to the above questions the researcher considered the following issues.

1. To what extent did the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers' autonomy prior to and after their student teaching experiences?
2. Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?
3. To what extent do the same types of data (belief, social context, reflection) confirm each other?
4. To what extent do the open ended themes of qualitative analysis support and clarify the quantitative survey results?
 - a. What similarities and differences exist across the levels of analysis?

- b. How do autonomy factors relate to pre-service teachers' perception of the practice of teaching?
- c. Do teachers restructure belief systems in practice?
- d. What factor (s) of pre-service teacher autonomy is (are) impacted the most by a student teaching experience?

Hypotheses.

1. H_0 : There will be no relationship between:

- a. Pre-service teachers' philosophies of Mathematics and conception of the role of teaching;
- b. Pre-service teachers' philosophies of Mathematics and the perceived use of curricular resources; and
- c. Pre-service teachers' conceptions of the role of teaching and the perceived uses of curricular materials.

H_A : There will be a positive relationship between:

- a. Pre-service teachers' philosophies of Mathematics and conception of the role of teaching;
- b. Pre-service teachers' philosophies of Mathematics and the perceived use of curricular resources; and
- c. Pre-service teachers' conceptions of the role of teaching and the perceived uses of curricular materials.

2. H_0 : There will be no relationship between pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

H_A : There will be a positive relationship between pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

3. H_0 : There will be no relationship between the number of post-secondary Mathematics courses completed by pre-service post-secondary Mathematics and their beliefs concerning the study of Mathematics.

H_A : There will be a positive relationship between the number of post-secondary Mathematics courses completed by pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

Assumptions. The underlying assumption of this study was that pre-service teachers' beliefs about Mathematics and how Mathematics was learned could be identified and understood using learning and teaching styles profiles (see Appendix A). The profiles were identified participants perceptions (not to be misconstrued as facts) about their beliefs.

Delimitations. The results of this study were based on data and analysis of New York State pre-service teachers selected from the State University of New York (City University of New York included). Results might be different for persons from other locales and from other state university post-secondary institutions.

Limitations. The limitation to this mixed method design was the inconsistency in the context of the teaching environment where the participants were placed to do their practice teaching. School districts where student teachers were placed varied in size, socioeconomics, school culture, and programs. Also of importance was that it had to be

presumed that the educational and instructional competencies and beliefs about Mathematics instructional practices varied among in-service teachers selected to supervise the student teachers.

Chapter II

Literature Review

One's conceptions of what Mathematics is affects one's conception on how it should be presented. One's manner of presenting it is an indication of what one believes to be most essential in it. . . . The issue, then, is not, What is the best way to teach? But, What is Mathematics really all about? (Hersh, 1986, p. 13). (Thompson, 1992)

Working with Hyman Bass, a Mathematician at the University of Michigan, Ball began to theorize that while teaching Mathematics obviously required subject knowledge, the knowledge seemed to be something distinct from what she learned in Mathematics class. (Green, 2010, p. 37)

This chapter presents the literature pertaining to the phenomenon of secondary Mathematics teachers' autonomy. The chapter begins with an introduction, followed by an overview of the nature of autonomy and an in-depth review of the research that has been done regarding the three factors that impact teacher autonomy: beliefs in the nature of Mathematics and how Mathematics is learned; social context of K-12 school systems; and reflective practice. The purpose of this chapter is to clarify the complexity of this study using the support of research.

Introduction

Background. The United States is entering the second decade of the 21st century, still lagging behind in student achievement on international Mathematics achievement tests, especially at the secondary level. Teacher education programs have been characterized as being a disconnected patchwork of academic and clinical instruction plagued by a "contentless" methods curriculum that emphasizes broad theories of learning rather than the particular work of a teacher (Green, 2010). Education schools traditionally divide their curriculums in to three parts: (a) regular academic subjects that ensure teachers know the basics of their chosen content area they selected to teach; (b) a

“foundations” course that provides the pre-service teacher with a sense of the history and philosophy of education; and (c) “methods” course(s) that offer ideas about how to teach a particular subject. “Many schools add a required stint as a student teacher in a more-experienced teacher’s class. Yet schools can’t always control for the quality of the experienced [cooperating] teachers, and education professors often have little contact with actual schools” (Green, 2010, p. 34).

On March 13, 2008, the National Mathematics Advisory Panel reported that research had yet to uncover the secrets of Mathematics instruction. The President of the United States created the Panel in 2006 via Executive Order 13398 and also assigned the appointment of members and oversight to the U.S. Secretary of Education. The principle message agreed on by the Panel was that the delivery system in Mathematics education – “the system that translates Mathematical knowledge into value and ability for the next generation – is broken and must be fixed” (p. xiii). The Panel reviewed 16,000 research publications, received public testimony from 160 organizations and individuals as a committee of the whole, and analyzed survey results from 743 active teachers of algebra. The Panel also received testimony from 110 individuals, 69 appeared of their own volition, and 41 invited on the basis of expertise to cover particular topics. Parents, teachers, school administrators, members of boards of education, educational researchers, textbook publishers were among the individuals who testified (Cavanagh, 2008a; NMAP 2008).

The Panel issued a report stating there was paucity of evidence on effective Mathematics instruction and of greater significance was that there had been no conclusions made pertaining to what college content and coursework was most essential

for preparing teachers to teach Mathematics. Absent from the research findings was the identification of what kinds of preservice, professional development, or alternative education programs best prepared Mathematics teacher to provide effective instruction (Cavanagh, 2008b).

The Panel's report claimed that more in-depth research had been reported regarding other areas of Mathematics, such as how students learned the subject, and student self-efficacy relating to persistence and engagement in Mathematics study (Adler et al., 2005; Cavanagh, 2008b). The report cited the recent "National Report Card" produced by the National Assessment of Education Progress (NAEP) showing that there was a positive improvement in scores trend for Grades 4 and 8, but only 32% of the students were on or at the "proficient level" in Grade 8 and 23% proficient at Grade 12. The Report also pointed to a vast and growing demand for remedial Mathematics education especially for students entering post-secondary institutions across the nation.

Dr. Deborah Ball, Dean of Education at the University of Michigan, Ann Arbor, and an advisory panelist stated, "Schools of education, ideally networks of them, must devise courses and tests, in partnership with Mathematics faculty, that provide 'instructionally relevant' content knowledge for teacher-candidates, rather than focusing on more Mathematics content" (Cavanagh, 2008b, p. 15). The working groups of the Panel placed the greatest value on "scientifically rigorous" research such as randomized controlled trials, but admitted there was difficulty conducting such rigorous studies in the area of teacher preparation and content knowledge (Cavanagh, 2008b).

Research Issues

Paradigm wars. One of the six essential elements identified in The Report (NMAP, 2008) has the potential to alter the direction of Mathematical reform in the United States;

instructional practice should be informed by high quality research, when available, and by the best professional judgment and experience of accomplished classroom teachers. High-quality research, defined by the Panels' standards, did not support the contention that instruction should be entirely 'student centered' or 'teacher directed.' The research reviewed by the Panel indicated that some forms of particular instructional practices can have positive impact under specified conditions. (p. xiv)

The National Mathematics Advisory Panel (2008) identified three levels of research evidence (high quality, moderate quality, and low quality) and presented the following format for identifying high quality evidence in research: "test hypotheses, highest methodological standards (internal validity), replication with diverse samples of students under conditions that warrant generalization (external validity)" (p. 81). Highest quality scientific evidence was based on considerations such as excellence of the design, the validity and reliability of measures, the size and diversity of student samples, and similar considerations of internal (scientific rigor and soundness) and external validity (generalizability to different circumstances and students). For example, for descriptive surveys high quality was considered probability sampling of a defined population; low nonresponders rate (< 20%) or evidence that nonresponders were not biasing the results; large sample (achieved sample size gives adequate error of estimate for the study purpose); and that the design and analyses were valid and reliable.

At the research level there have been conflicts, “Paradigm Wars,” between research methodologies, the scientific research paradigm, and the interpretive research paradigm. Ernest (2004) wrote,

Historically, in Mathematics education research, and in the wider educational research community, there has been conflict between supporters of these two outlooks and paradigms, as the newer interpretative research sought to establish itself as a field dominated by scientific research. . . . Such conflicts have been manifested by gatekeepers choosing what papers to accept for conferences and journals, and what projects to fund; and thus have involved the exercise of power, of considerable significance for researchers in Mathematics education. Although most of the researchers are by now aware of the validity of both approaches and styles, when conducted properly never the less conflicts in personal judgments about such validity still arise periodically. (p. 9)

Ernest (2004) attributed the conflicts to controversies surrounding different philosophies of Mathematics, learning theories, teaching approaches, and research paradigms in Mathematics education; i.e., the conflict rested with opposing philosophies and not in overt proposals and claims. Ernest (2004) suggested that awareness had to be raised about the multi-dimensional philosophical issues and assumptions underpinning Mathematics education research so prudence might forestall, minimize, and/or resolve conflicts and misunderstandings.

Philosophy of teaching Mathematics issues (Mathematics Wars). Throughout the March 13, 2008 report, the authors alluded to the continuing philosophical battles over how to teach Mathematics—commonly referred to as “the Mathematics wars.” There have been educators who argued that students should be grounded firmly in simple Mathematics procedures, while other educators have contended it was of greater importance to foster and ensure a more conceptual approach to teaching and learning of the subject matter (Cavanagh, 2008a; Ernest, 2004, 2007).

Ernest (2004) addressed the origins of the “Mathematics wars” in his paper “What is the Philosophy of Mathematics Education.” Mathematics education was explained as the activity or practice of teaching Mathematics. The “philosophy of education” related to the rationale behind the practice of teaching. Ernest purported that rationale belonged to people, and that teaching Mathematics was a “highly organized social activity” allowing for divergent rationales and multiple aims and goals among different persons. Essentially there was no one shoe that best fit everyone.

Ernest (2004) equated aims (for teaching Mathematics) as an expression of values, and that educational and social values were the platform upon which to build the practice of teaching Mathematics. “The philosophy of Mathematics is undoubtedly an important aspect of philosophy of education, especially in the way that philosophy of Mathematics impacts on Mathematics education” (p. 2).

The “Mathematics Wars” controversy (i.e., philosophy of Mathematics and teaching of Mathematics) addressed by Ernest (2004) exists between absolutists and fallibilists. The absolutists (foundationalists) maintain that Mathematics is certain, a cumulative process and untouched by social interests. Fallibilists (humanists, relativists and social constructivists) argue that Mathematics is historical and social, and that there are limitations induced by a culture to its claims of certainty, universality, and absoluteness.

Ernest (2004) posited that the aims of Mathematics education were most sensitive to conflict when education reforms touted a new curriculum, and expected it to be disseminated throughout a national education system. Instead of a top-down paradigm, Ernest urged educators to realize “These aims are best understood as part of an overall

ideological framework that includes views of knowledge, values society, human nature as well as education” (p. 8).

One’s conception of Mathematics influences how a teacher presents Mathematics instruction (Ernest, 2004; Hersh, 1986; Thom, 1973; Thompson, 1992). “It is unlikely that disagreement about what constitutes good Mathematics teaching can be resolved without addressing important issues about the nature of Mathematics” (Thompson, 1992, p. 127). Educated persons in general view Mathematics as a discipline characterized by accurate results and infallible procedures, based on arithmetic operations, algebraic step-by-step procedures, geometric shapes, proofs and theorems. This definition or “philosophy” of Mathematics is aligned with the conception of teaching Mathematics as one in which concepts and procedures are presented in a clear concise way followed by ‘skill and drill’ practice by students. The result of the skill and drill teaching instructional style is an emphasis placed on the manipulation of symbols whose meanings rarely are addressed (Boaler, 2008; Ernest, 2004; Thompson, 1992) [Thompson documented the research literature (1982, 1984)]. The aforementioned philosophy of Mathematics and style of Mathematics teaching have been linked to the “traditional” for this study are linked to the terms instrumentalist, absolutist, mastery, lecture, and step-by-step procedures.

In the 1980’s Mathematicians and philosophers of Mathematics posited an alternate account of the meaning and nature of Mathematics based on the ongoing practice of Mathematicians (Thompson 1992; Tymoczko, 1986), Mathematicians and philosophers of Mathematics depicted Mathematics as a kin for mental activity, a social construction involving conjectures, proofs, and refutations, whose results were subject to

revolutionary change and whose validity was judged in relation to a social-cultural setting (Hersh, 1986; Thompson, 1992). That 20th century depiction of Mathematics and style has been linked to a more problem-solving philosophy and student-centered teaching style. In this study they are linked to the terms fallibilist, understanding, self-expressive, and interpersonal. Hersh (1986) purported that Mathematics dealt with idea—not pencil or chalk marks or shapes, but ideas. Thompson (1992) claimed that the main priorities of Mathematical activity knowledge was known from daily experience; i.e., Mathematical objects were created by humans, not arbitrarily but from already existing Mathematical objects and from the needs of daily life. These created Mathematical objects had properties and were well—determined.

The point of view of the practicing Mathematician adopted by Hersh (1986) and other Mathematicians (Lakatos, 1986; Putnam, 1986) challenged the basic assumption that Mathematical knowledge was a priori and infallible. They posited that Mathematical knowledge was fallible and in respect similar to the knowledge in the natural sciences (Ernest, 2004; Thompson, 1992). The practicing Mathematicians' views of Mathematics as “in the making” also was held by other prominent Mathematicians (Halmos, 1975; Polya, 1963; Steen, 1988; Thom, 1973). This view was seminal in Mathematics educators crafting the following documents initiating Mathematics teaching reform: *Mathematics Counts: Report of Inquiry into the Teaching of Mathematics in School* (Cockcroft, 1982), the *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989), and *Everybody Counts* (National Research Council, 1989).

The result gleaned from these standards movement documents was that the new conception of Mathematics teaching proposed that students be engaged in purposeful activities that grow out of problem-solving situations, required student to critically think, gather and apply information, discover invents, and communicate ideas, and test those ideas through critical reflection and argumentation (Boaler, 2008; Ernest, 2004; Fenema& Nelson,1997;Thompson, 1992). This view of Mathematics teaching was the anti-thesis of the mastery of concepts and procedures as the ultimate goal of instruction. The proponents of the problem-solving view did not deny the value and place of concepts and step-by-step procedures in the Mathematics. But by acknowledging that creating changes in what goes on in Mathematics classrooms depended on individual teachers changing their approaches to teaching and that these approaches were influenced by teachers' conceptions (Thompson, 1992).

Research on beliefs. At the beginning of the 20th century there was considerable interest on how beliefs and social psychologists claimed such activities were manifested in people's actions (Bonnstetter & Suiter, 2004; Marston, 1928; Thompson, 1992). That was a marked change in psychological research, especially during the period of the 1930s through the 1960s when such research almost vanished due to the apparent difficulties accessing beliefs and to the emergence of associationism in the 1930's and then the strong profile of behaviorism during the middle of that century. Thompson (1992) posited that the advent of cognitive science in the 1970s created a venue for the study of belief systems in relation to other aspects of human cognition and human effect. By the 1980s there was a resurgence of interest in beliefs and belief systems among scholars from the disciplines of Psychology, Political Science, Anthropology, and

Education. During the 1990s and in to the beginning of the 21st century the Mathematics standards movement refocused the study of Mathematics education towards student performance in relation to teacher instruction (National Mathematics Advisory Panel, 2008).

Retrospectively, it appeared that research related to Mathematics education peaked in the decade of the 1980s. That was when studies focused on teachers' beliefs about Mathematics and Mathematics teaching and learning. However, Thompson (1992) noted that because there were close connections between beliefs and knowledge, the distinctions between them were unresolved. Further study led researchers to consider potential symbiotic ties between teachers' beliefs and knowledge of Mathematics (Grossman, Wilson, & Shulman, 1989). According to Thompson (1992), the nature of teachers' beliefs about Mathematics and about its teaching and learning as well as the influence of beliefs on teachers' instructional practices are relatively new topics of investigation. That avenue of interest has fostered inquiry (Dougherty, 1990; Grant, 1984; Kesler, 1985; Lerman, 1983; Marks, 1987; Thompson, 1984) on how teachers' beliefs about Mathematics and how it should be taught shaping a teacher's characteristic patterns of instructional behavior; i.e., autonomy.

Thompson (1992) stated that studies conducted about Mathematics teachers' beliefs have concentrated on beliefs about Mathematics, beliefs about Mathematics and learning, or both with some studies examining the apparent connection(s) between teachers' beliefs and their instructional practices. Such studies have involved elementary and secondary teachers, but with greater emphasis placed at the secondary level. Some of the studies involved pre-service teachers and others in-service teachers. Thompson

(1992) reported that her search of available literature led to a conclusion there was a lacuna in the area of such work. Most of the research on teachers' beliefs and conceptions about how to translate them into professional practices employed qualitative analysis (interviews, classroom observations, and stimulated recall interviews, linguistic analysis of teacher talk, paragraph completion tests, and responses to simulation materials such as vignettes describing hypothetical students in classroom situations). Likert scale questionnaires sometimes had been combined with the aforementioned research techniques but that there were no definitive directions emerging from the findings.

Studies on beliefs. Thompson (1992) divided the studies on beliefs into five sections:

1. Teachers conceptions of Mathematics, i.e., rudiments of the philosophy of Mathematics (Ernest, 1988; Jones, Henderson, & Cooney, 1986); beliefs across a range of curriculum areas (Clark & Peterson, 1986; Feiman-Nemser & Floden, 1986; Grossman et al., 1989); Mathematics (Ernest, 1985; Hersh, 1986; Lerman, 1983; Thom, 1973; Thompson, 1982, 1984) and, Ernest's (1989) three conceptions of Mathematics, Instrumental, Platonic, Problem Solving (Benacerraf & Putnam, 1964; Davis & Hersh, 1980; Lakatos, 1976).
2. Relationship between teachers' conceptions of Mathematics and their instructional practice. One strand was a strong relationship between a novice teacher's knowledge base and instructional practice (Steinberg, Haymore, & Marks, 1985; Thompson, 1984). A second was some degree of variability in the degree of consistency between teachers' conceptions of Mathematics and their teaching practices (Kesler, 1985; McGalliard, 1983).
3. Teachers' conceptions of Mathematics teaching and learning evidenced by how differences in conceptions of Mathematics appeared to be related to the respective teacher's views on Mathematics teaching (Copes, 1979; Lerman, 1983; Thompson, 1984) and their models for Mathematics teaching (Cobb & Steffe, 1983; Confrey, 1985; Kuhs & Ball, 1986; Thompson, 1985; von Glasersfeld, 1987).
4. The relationship of ideas on Mathematics teaching and learning to instructional practices. Some researchers reported a high degree of agreement (Grant, 1984; Shirk, 1973) and others voiced sharp differences (Cooney, 1985; Shaw, 1987; Thompson, 1982). The apparent influence of an existing

social context on secondary Mathematics teachers was documented by Brown (1985) in a single case study of Fred, a novice teacher.

5. Studies regarding the issue of difficulties changing prospective teachers' conceptions had been addressed (Collier, 1972; Meyerson, 1978; Schram & Wilcox, 1988; Shirk, 1973), and others have focused on the aspect of teachers modifying ideas (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Cobb, Wood, & Yackel, 1990; Lerman, 1987, cited in Ernest, 1988).

Studies on pre-service teachers. Lerman (1983) offered pre-service teachers a theoretical discussion regarding the absolutist and fallibilist views of Mathematics philosophy and how each approach could lead to different models of teaching. Using an instrument he designed to assess views ranging from absolutist to fallibilist, Lerman obtained data in support of the hypothesized correspondence between the two conceptions (absolutist and fallibilist) of Mathematics and alternative views of teaching. He identified four pre-service teachers, two at the absolutist extreme of the dimension and two at the fallibilist dimension.

The four pre-service teachers were asked to view a video recording of a Mathematics lesson. Lerman (1983) found that the reactions of the pre-service teachers were consistent with their assessed views about their philosophy of Mathematics. "The absolutist teachers were critical of the teacher in the video 'not directing students enough' with the content of the lesson. The fallibilists teachers were critical of the teacher in the video for being too directed" (Thompson, 1992, p. 132). Lerman posited that from an absolutist perspective Mathematics was based on universal, absolute foundations, was value free and abstract with connections to the real world more apt to be of a platonic nature. A fallibilist perspective meant that Mathematics developed through conjectures,

proofs, and refutations where uncertainty was accepted in the discipline (Thompson, 1992).

Copes (1979) earlier had suggested ways in which different teaching styles could communicate different conceptions about Mathematics. He provided the following example: a teaching style that emphasized the transmission of Mathematical facts, right versus wrong answers, step-by-step-procedures, and single approaches to solutions of problems probably would reflect an absolutist or dualist view of Mathematics. Skemp (1978) distinguished between “relational Mathematics” and “instrumental Mathematics” by saying that the distinction resided in the knowledge each reflected. He proposed different Mathematics knowledge impacted teachers in their instructional approaches to the teaching of the subject matter. According to Skemp, “instrumental knowledge of Mathematics” was disclosed as an approach that there was a set of “fixed plans” for performing a given task, characterized by step-by-step procedures to be followed, with each step determining the next. In contrast “relational knowledge of Mathematics” was characterized by having a grasp of conceptual structures that enabled the problem-solver to devise several plans for performing a given task. Skemp believed that teachers who taught with relational knowledge of Mathematics provided students with a markedly different Mathematics course than did teachers who held an instrumental knowledge of Mathematics. He attributed the root of the issues experienced in Mathematics education to the difference in the conceptions of instrumental Mathematics and relational Mathematics.

Thompson (1992) suggested that the inconsistencies between professed beliefs and instructional practice reported by McGalliard (1983) be considered in the research methodology.

Any serious attempt to characterize a teacher's conception of the discipline he or she teaches should not be limited to an analysis of the teacher's professed views. It should also include an examination of the instructional setting, the practices characteristic of that teacher, and the relationship between a teacher's professed views and actual practice.

At the very least, investigations of teachers' Mathematical beliefs should examine teachers' verbal data along with observational data of their instructional practice or Mathematical behavior; it will not suffice to rely on verbal data. In the case of pre-service teachers, data about their Mathematical behavior as they encounter tasks in training content courses would be useful. Information of this kind would be valuable to reform efforts in Mathematics teacher education. Furthermore, the examination and interpretation of verbal and observational data must be done in light of independently obtained information of the social context. (Thompson, 1992, pp. 134-135)

Clark (1988) noted that teachers' conceptions of Mathematics tended to be an eclectic collection of beliefs and views that appear to be the result of years of experience in a classroom. Research has been understood to mean that "teachers hold implicit theories" about their students (Bussis, Chittenden, & Amarel, 1976), about the subject matter they teach (Ball, 1986, 1988; Duffy, 1977; Elbaz, 1981; Kuhs, 1980), and about their roles and responsibilities and how they should act (Ignatovich, Cusick; & Ray, 1979; Olson, 1981). The claim was made that teachers' implicit theories tended to be eclectic aggregations of cause-effect propositions from many sources, rules of thumb, generalizations drawn from personal experience, beliefs, values, biases, and prejudices (Clark, 1988)

Thompson (1992) reported that researchers studying teachers' beliefs about Mathematics teaching and learning have noted that those beliefs mainly were formed during the teachers' schooling years and were shaped by their own experiences as

students of Mathematics (Ball, 1988; Bush, 1983; Owens, 1987). Thus attempts to modify long held, deeply rooted conceptions of Mathematics in a one semester long methods course remained a problem for those invested with reforming Mathematics education.

Four dominant and distinctive views on how Mathematics should be taught were identified by Kuhs and Ball (1986):

1. ***Learner focused:*** Mathematics that focuses on the learners personal construction of Mathematical knowledge;
2. ***Concept focused with an emphasis on conceptual understanding:*** Mathematics teaching that is driven by the content itself but emphasizes conceptual understanding;
3. ***Content-focused with an emphasis on performance:*** Mathematics teaching that emphasizes student performance and mastery of Mathematics; and
4. ***Classroom-focused:*** Mathematics teaching based on knowledge about effective classrooms. (p. 2)

In the Kuhs and Ball (1986) study the roles of teachers associated with the models of Mathematics instruction were: (a) facilitators provided learner-focused instruction; (b) explainers provided content-focused with the emphasis on conceptual understanding; and (c) lecturers provided content-focused with an emphasis on performance.

The philosophies in that study were aligned with the following models of Mathematics instructions:

1. Problem-Solving was aligned with the constructivist (learner focused) view of Mathematics (Cobb & Steffe, 1983; Confrey, 1985; Thompson, 1985; von Glasersfeld, 1987).

Because the learner-focused view centers around the students' active involvement in doing Mathematics-in exploring and formalizing ideas- it is the instructional model most likely to be advocated by those who have a problem solving view of Mathematics, who view Mathematics as a dynamic discipline, dealing with self- generated ideas and involving methods of inquiry (Ernest, 1988). From a learner focused perspective of

teaching, the teacher is viewed as the facilitator and stimulator of student learning, posing interesting questions and situations for investigation, challenging students to think, and helping them uncover inadequacy of their own thinking (Kuh & Ball, 1986). (Thompson, 1992, p. 136).

2. The Platonic philosophy was aligned with the content-focused with emphasis on understanding. Kuh and Ball (1986) believed this view of teaching followed from Ernest's (1988) Platonist philosophy, because instruction made Mathematical content the focus of classroom activity while placing emphasis on students' understanding of Mathematics ideas and processes. Thompson (1992) noted that the criteria for judging student knowledge in the content-focused emphasis on understanding was similar to those of the learner-focused model.
3. The Instrumentalist philosophy was aligned with the content focused with emphasis on a performance model of teaching. "The content-performance view of teaching is analogous to what Brownell (1935) described as 'drill theory.' It is the view of the teaching that would follow naturally from the instrumentalist view of Mathematics" (Thompson, 1992, p. 136). The instrumentalist view of the nature of Mathematics may be characterized as:
 - (a) Mathematical behavior that is rule-governed,
 - (b) Mathematical knowledge is considered the ability to get answers to problems by using the rules that have been learned,
 - (c) Mathematical computational procedures are automatic,
 - (d) further instruction rather than understanding the source of student errors was the appropriate way to learn Mathematics, and
 - (e) knowing Mathematics means students were able to demonstrate master of skills described by instructional objectives (Kuh & Ball, 1986).

It should be noted that the classroom focused model of teaching was not considered in this study. It did not focus on Mathematical content and does not provide for discussion specific to Mathematics. The classroom model of instruction was proposed by Madeline Hunter in the 1980's, and embraced by the teaching community. In the past three decades focus on the Madeline Hunter approach has waned and it is doubtful that pre-service teachers had enough classroom teaching experience to be able to discuss the pros and cons to that approach.

Changing beliefs. During the 1970's some researchers investigated how elementary teachers changed their beliefs about teaching and Mathematics (Collier, 1972; Shirk, 1973). "In his study of four pre-service elementary teachers enrolled in a Mathematics methods course Shirk (1973), unlike Collier, found no discernable change in teacher's conceptions" (Thompson, 1992, p. 139).

An interesting study was designed by Meyerson (1978). He created a methods course to effect change in how pre-service secondary Mathematics teachers focused on seven themes: Mathematical mistakes, surprise, doubt, reexamination of pedagogical truisms, feelings, individual differences, and problem-solving. The participants' conceptions of Mathematics were diagnosed according to their respective position on knowledge of Mathematics and Mathematics teaching. Meyerson noted that the key factor in moving teachers along the Perry scheme was doubt; i.e., doubt aroused in problem-solving situations that caused confusion for the teachers and created controversy. The greater the extent of doubt or frequency of occurrence the more likely was a participant to change views.

Brown and Borko (1992) reported on teacher socialization from an interpretive perspective, as conducted by Zeichner and his colleagues (Zeichner & Tabachnick, 1985; Zeichner, Tabachinck, & Densmore, 1987). The study examined socialization to teaching as manifested in changes in beginning teachers' teaching perspectives. "*Perspective* is used here as Becker, Geer, Hughes, and Strauss (1961) defined it: a coordinated set of ideas and actions a person uses dealing with a problematic situation. It is assumed that teacher behavior and teacher thinking are inseparable and that both reflect perspectives toward teaching" (p. 224).

Zeichner et al. (1985, 1987) studies were conducted in two phases. The first phase explored the ways by which student teaching impacted the development of teaching perspectives and the factors that influenced these changes. Four participants were selected from the 13 persons who participated in phase one. The study's second phase involved following the four participants into their first year of teaching with the intent of discovering how social constraints (particular characteristics, dispositions, and abilities of the novice teachers and school community) influenced the development of teaching perspectives. In Phase One the 13 participants were selected to create a group of pre-service teachers who appeared to have different beliefs within each category as measured by the *Teacher Belief Inventory* (TBI), a 47-item instrument that assessed student teacher beliefs related to six specific categories: (a) teacher's role; (b) teacher-pupil relationship; (c) knowledge and curriculum; (d) student diversity; (e) the role of the community in school affairs; and (f) the role of the community in school affairs. Brown and Borko (1992) noted that the last two of the TBI categories were not useful in the Zeichner's study.

The 13 participants were interviewed and observed during their student teaching experiences. In order to establish substance, dimensions, and the degree to which the student teachers perspectives changed during the course of their student teaching placement, Zeichner interviewed both the university supervisors and the cooperating teachers. With the exception of 3 of the 13 student teachers, Zeichner found no changes in the pre-service teachers teaching perspectives. Instead, it was determined that their original perspectives had become solidified. The three student teachers who had not consistent with the perspectives they brought to their student teaching experience employed “strategic compliance”; they experienced extreme social constraints in their school placements. Those student teachers acted publically in ways demanded by their situations, but privately held reservations about their actions. Brown and Borko (1992) noted that most of the pre-service teachers in Zeichner’s study had purposefully selected themselves into situations that corresponded with their teaching perspectives; therefore it was not surprising that the teaching perspectives of the student teachers showed no changes.

Ernest (2004) claimed that the absolutist view manifested itself in schools’ curriculum as unrelated routine tasks that involved the application of learned procedures, stressing that every task had unique, fixed answers, coupled with disapproval and criticism at the failure of students to obtain the correct answer. The Mathematics classroom climate harboring an absolutist tenor was credited by Ernest (2004) with producing a strongly negative response to Mathematics, and it was termed “Mathematics phobia.”

On the other hand, the fallibilist approach projected an image of Mathematics as being human, corrigible, historical and changing; an outgrowth of social processes Ernest (2004). In this approach Mathematical knowledge was regarded as always receptive to revision, both in terms of its proofs and its concepts.

Consequently this view embraces the practice of Mathematicians, its history and applications, the place of Mathematics in human culture, including issues of values and education as legitimate philosophical concerns. The fallibilist view does not reject the role of logic and the structure in Mathematics, just that there is a fixed and permanently enduring hierarchical structure. Instead it accepts the view that Mathematics is made up of many overlapping structures which, over the course of history, grow dissolve, and then grow anew, like trees in a forest. (Steen, 1988, p. 11)

Ernest (2004) purported that fallibilists cordoned Mathematics into a set of social practices (academic research Mathematics, ethnoMathematics, and school Mathematics), with each group having its history, persons, institutions and social locations, symbolic forms, purposes, and power relations. He posited that the absolutist and fallibilist were not mutually exclusive but connected in a complex manner. Despite the gulf between the absolutist and fallibilist lenses, Ernest described the interconnectedness between the epistemology of Mathematics, and the account of the nature of Mathematics for the two perspectives as follows:

The former is a strictly designed philosophical position concerning the epistemological foundation and justification of Mathematical knowledge. The latter is a looser descriptive account of Mathematics in a broader sense. Usually these are linked, but strictly speaking, it is possible for an epistemological absolutist to promote aspects of a fallibilist view of the nature of Mathematics: including, for example such view as: Mathematicians are liable to error and publish flawed proofs, humans can discover Mathematical knowledge through a variety of means, the concepts of Mathematics are historical constructs (but truths are objective), a humanized approach to the teaching and learning of Mathematics is advisable, etc. Likewise, an epistemological fallibilist might argue that although Mathematical knowledge is contingent on social construction, so long as it remains accepted by the Mathematical community it is fixed and should be transmitted to learners in this way, and that questions of school Mathematics are

uniquely decidable as right or wrong with reference to its conventional corpus of knowledge. My argument is that there is a strong analogy between epistemological absolutism, absolutist views of the nature of Mathematics, and the cold, objectivist popular image of Mathematics. But these three perspectives remain distinct and no logically necessary connection between them exists, even if the analogy is strong. (Ernest, 2004, p.11)

Ernest (2004) explained how the absolutist and fallibilist views of Mathematics impacted the image of Mathematics in schools. The image communicated in “enlightened” schools, K-16, is not the absolutist one. Influential inquiries into the teaching of Mathematics have propounded humanized and anti-absolutist (if not wholeheartedly fallibilist) views of school Mathematics (Cockcroft, 1982; NCTM, 2000). For the past three decades there have been Mathematics education reform initiatives that have embraced the anti-absolutist mode such as the constructivist, “discovery learning,” applied learning of Mathematics concepts. The standards movement added more support and validation for Mathematics instruction to focus on the fallibilist view of Mathematics. The goal of the standards based initiative was to reform Mathematics instruction so that students would internalize “understanding” of Mathematics concepts to improve students’ critical thinking skills and increase students’ achievement on state, U.S., and international Mathematics assessments.

The product of the “problem-solving” constructivist approach to teaching Mathematics has been evident in Mathematics curricula resources developed for K-12. For example, *Investigations in Numbers, Data, and Space* is K-4 a Mathematics curriculum that encourages students to reason mathematically, develop problem-solving strategies, and represent their thinking. *Connected Mathematics Project*, a problem-centered middle school Mathematics curriculum, was designed by the researchers at Michigan State University and funded by the National Science foundation. Two high

school Mathematics curricula programs (*Core-Plus Mathematics Project*; *The Interactive Mathematics Program* (IMP)) present Mathematics as interwoven strands of algebra and functions, statistics and probability, and geometry and trigonometry for the four-years of high school. The programs emphasize Mathematical modeling where students work in different areas of Mathematics together (as is done in some other nations). The IMP was designed to exemplify the Mathematics curriculum reform called for in the Curriculum and Evaluation Standards of the National Council of Teachers of Mathematics (NCTM) as supported by the National Science Foundation (Boaler, 2008).

The *integrated approach* has been defined as “one in which the topics of high school Mathematics are presented in some order other than the customary sequence in the United States of year-long courses in Algebra I, Geometry, Algebra II, and Pre Calculus (NMAP, 2008, p. 22). The NMAP (2008) found that the curricula employed by most-high achieving nations on the TIMSS had students following the integrated approach, which resulted in a “spiraling” curriculum and avoidance of Mathematics teachers having to revisit the same materials over several years.

The weight of informed educational opinion has supported the progressive reform of Mathematics in line with such views, although there has been a backlash from Mathematicians and more conservative thinkers (Boaler, 2008; Schoenfeld, 2004). The result has been a pendulum of views held by researchers, educators, and parents between viewing standard-based curricula and traditional skills-based as being the most effective approach for providing students with Mathematics instruction that improves their achievement levels on state and international assessments. The Panel Report (NMAP, 2008) reported that a search of the literature did not produce studies that clearly examined

whether the integrated approach or single subject sequence was more effective for either algebra or more advanced course work.

In that same Panel Report (NMAP, 2008) consideration was given to available research on whether classroom instruction should be more teacher-directed or more student-centered. It was noted that both views encompassed a wide array of meaning. Teacher-directed instruction ranged from direct instructional approaches to interactive lecture styles. Student-centered instruction ranged from students individually taking responsibility for their own learning of Mathematics to highly structure cooperative learning groups.

Schools and districts must make choices about curricular materials and instructional approaches that seem more aligned with one instructional orientation than another. This leaves teachers wondering about when to organize their instruction one way or the other, whether certain topics are taught more effectively with one approach or another, and whether certain students benefit from one approach or another. (NMAP, 2008, p. 45)

The Panel Report (NMAP, 2008) defined teacher-directed instruction as when a teacher was a prime communicator of Mathematics directly to a student, and that student-centered instruction was when students primarily were doing the instruction. Eight studies met criteria as high quality research for comparing teacher-directed and student-centered instruction when applying the Panel's definitions. Unfortunately those studies presented "a mixed and inconclusive" picture of the relative effect to the two (teacher-directed and student-centered) approaches for instruction.

It was noted (NMAP, 2008) that one of the major shifts in Mathematics education learning and teacher reform during the past three decades had been advocacy for increasing the use of cooperative learning groups and peer-to-peer learning (structured activities for students working in pairs), and the justification was that it served multiple

purposes uses (tutoring, enrichment, remediation, substitute for independent work, extension activities, initial brainstorming, etc.). High-quality studies addressing cooperative and collaborative learning were delineated as follows:

Team Assisted Individualization (four studies), Student Teams- Achievement Division (six studies), peer-to peer learning strategies (five studies), other cooperative learning strategies (five studies), studies combining cooperative learning with other instructional practices (three studies), and studies investigating cooperative learning in the context of computers (eight studies). (NMAP, 2008, p. 46)

Team Assisted Individualization (TAI) was touted as a cooperative learning strategy that improved student's computation skills. "This highly structured instructional approach involves heterogeneous groups of students helping each other, individualized problems based on student performance on a diagnostic test, specific teacher guidance, and rewards based on both group and individual performance" (National Mathematics Advisory Panel, 2008, p. 46). However, it was pointed out that the TAI did not have a marked impact on students' conceptual understanding of Mathematics or problem-solving skills.

It should be noted that the TAI was a self-paced program (Slavin, 1987) that was patterned after the instrumentalist view of Mathematics teaching. Thompson (1992) described the instrumentalist view of teaching as, "the content is organized according to a hierarchy of skills and concepts; it is presented sequentially to the whole class, to small groups, or to the individual, following a pre-assessment of students; master of prerequisite skills" (p. 136). According to Thompson (1992), a teacher who instructed from an instrumentalist perspective demonstrated, explained, and defined the materials in an expository style. Students who experienced instrumentalist teaching were to, "listen, participate in didactic interactions (for example, responding to teacher questions) and do

exercises or problems using procedures that have been modeled by the teacher or text” (Kuhs & Ball, 1986, p. 23).

Thompson (1992) reported that teaching Mathematics from an instrumentalist perspective had been subjected to criticism by Mathematics reform educators who objected to taking a student’s ability to obtain correct answers, perform algorithms and state definitions as evidence of “knowing” Mathematics. Those objections were based on reports of studies (Erlwanger, 1975; Leinhardt, 1985; Schoenfield, 1985) documenting adequate student performances on routine Mathematical tasks but manifesting poor understanding and misunderstandings of Mathematical ideas in those tasks. Thompson claimed instrumentalism did not help students understand the structure of Mathematics (Steffe & Blake, 1983) and, did not actively involve students in the process of exploring and investigating ideas, thus denying them opportunities to do “real” Mathematics.

Teaching approaches in Mathematics incorporated assumptions about the nature of Mathematics, and a teacher’s philosophy (views and preferences) had classroom consequences (Ernest, 2004; Hersh, 1986; Thompson, 1984). Pre-service teachers’ conceptions of Mathematics, therefore, would be subject to the constraints and opportunities of the prevailing social context of practice, and immersion in the actual practice reinforced or altered perceived conceptions (Ernest, 1989). Models of teaching practice thus became validated by empirical work.

Social Constraints

The research conducted by Ingersoll (2003) spanned a decade and ranged from field studies, involving in-depth interviews with teachers and administrators in a small number of secondary schools, to advanced statistical analyses of several large scale

surveys. Ingersoll (2003) acknowledged his research as combining statistical analysis of survey data (quantitative) with interpretive data of qualitative interview as unusual, but advantageous. Ingersoll (2003) presented the rationale for each genre of research as the quantitative allowed the researcher to discern with confidence levels; the qualitative allowed him to look more closely at the process by which school administrators did or did not coordinate the control of teachers' work in particular settings. The combination of data and methods allowed for detailed and simultaneous study of general patterns and processes.

Ingersoll (2003) addressed the social context of schools by saying that externally they reflected the formal and hierarchical organization commonly found at many large entities such as banks, agencies, corporations, and plants; a specialized division of labor accompanied by a formal structure of rules and regulations. Internally, schools did not seem to have the degree of control and coordination of other large organizations. The social context of the school environment, for some schools, was considered "loose" in structure and for others too much control was imposed upon teachers.

Ingersoll (2003) reported that organization theorists considered schools to be examples of "loosely coupled systems" and "organized anarchies." Schools that exerted little control over their staff and work processes created an inequality attitude toward satisfaction and benefits, with the outcome being inefficient organizational performance. A top down undemocratic controlled bureaucracy, "factory-like" schools tended to deprofessionalize, disempower, and demotivate teachers resulting in dissatisfaction leading to inefficiency and ineffectiveness; outgrowths of conflict over control and accountability. Control and accountability fueled the most significant educational reforms

of the 21st Century—school choice, education vouchers, charter schools, school restructuring, the standards movement, teacher and student testing, and teacher professionalization.

Ingersoll (2003) addressed the character and conditions of teaching by saying there were two major dichotomies in school organizational systems; a decentralized school where teachers and other staff held substantial control over their work, and a centralized school where administrators held a considerable amount of control over the work to be done by teachers and other staff. Transitioning into either a “loosely structured” or “factory-like” school environment meant that a pre-service teacher was exposed to a social context requiring that they learn how to “behave” as a teacher with students, faculty, administration and other personnel. In essence, teachers were employees and the school was the workplace.

Ingersoll (2003) drew his quantitative data from the Schools and Staffing Survey (SASS) conducted by the National Center for Education Statistics (NCES). Four cycles of SASS have been conducted (1987-88, 1990-91, 1993-94, and 1999-2000). He used data from the first three because the last set had not been released in time for consideration. SASS is the largest and most comprehensive data source available on teachers and schools (private and public), and each cycle gathered information from 5000 school districts, 11,000 schools and, 55,000 teachers. The data dealt with characteristics, work, and attitudes of teachers and administrators, and on characteristics and conditions of schools and districts across the United States. Notably, other relevant information was included in the analysis: School Assessment Survey conducted by Research for Better

schools; International Survey of the Locus of Decision-Making in Educational Research and Innovation.

Ingersoll (2003) selected four secondary schools (parochial, urban, suburban, and private) in Philadelphia, PA, to conduct the qualitative strand of his study. The field work included observations of school life in cafeterias, halls, meetings, and classrooms; conducting interviews with teachers and administrators; and examining artifacts (school documents, faculty manuals and policy handbooks). The goal was to study intra-organizational relations within schools, and embedded in the conclusion was a concise description of teachers' work within the social context of a school system.

Three measures of the character of school climate and of the relations among teachers, students, and principals were crafted:

1. Conflict between staff and students focused on the degree that students actively disrupted the manner of school operations;
2. Conflict among teachers focused on the degree of cooperation and collegiality among teachers using a scale that varied from cohesive teams to fragmented collections of individuals; and
3. Conflict between teachers and principals that was characterized by faculty-principal relationships varying along a scale from those exhibiting communication, cooperation, and support to those displaying distrust and friction. (Ingersoll, 2003)

Teacher's work.

Like other human-service occupations, teaching is inherently non-tangible. Fluid work; it requires flexibility, give and take, and making exceptions. This is all the more true, they argue [educational sociologists], because the clients of schools and adolescents- they are neither mature adults nor voluntary patients. (Ingersoll, 2003, p. 34)

Some educational sociologists claimed that the task of teaching required personal orientation and hierarchical orientation due to the large scale and mass character of schooling. In contrast to an apparent need for bureaucracy, the work of teaching

probably dictated the opposite position. One where teachers were in classrooms where they had total control and could act as needed in different situations. The notion of one size fitting everyone did not seem to be palatable.

Ingersoll (2003) used a classroom/school dichotomy of schools to separate teachers work into two “zones;” a school wide zone (allocation and coordination) that consisted of administrative activities (school coordination, management, planning, resource allocation); and a classroom zone (academic instruction) that consisted of teaching and educational activities. He claimed that most research on the organization of schools assumed that the core of what teachers did was academic instruction in classrooms, but that academic instruction was not the only part of teachers work. There was a social dimension that included the passing on of society’s ways and culture. He used the arguments of John Dewey (1902/1974) and Emile Durkheim (1925/1961) and said that schools essentially had the same purpose as religion, to emulate moral order. Ingersoll (2003) cited James Coleman’s and Thomas Hoffer’s (1987) arguments that the social role of schools was expanding to provide moral and social guidance once reserved for parents, churches and communities. The social activity of schools often referred to as the “Hidden Curriculum,” alluded to norms, behaviors, and roles transmitted to students.

Conveying and facilitating acceptable standards of behavioral growth, learning to students in addition to the transmission of norms and roles and the character of social relations were all equally important and considered a part of the work of teachers.

The emphasis on the academic and instructional aspects of the job of teachers has meant a deemphasize on the social dimensions of teaching in empirical research on control in schools. When it comes to examining the organization and control of the core educational activities in schools, researchers usually focus on decisions commonly associated with formal instruction, such as the selection of instructional texts and the choice of teaching methods. In contrast, researchers

less often examine who controls decisions surrounding behavioral, social, and normative activities in schools. (Ingersoll, 2003, p. 52)

Conceivably, the first time that a pre-service teacher gets immersed in a school system as a student teacher is when they experience tracking, rules and realities regarding student discipline, lack of respect for teachers, and improper behaviors in a classroom. Concomitantly, it is apt to be the first time pre-service teacher experiences parental pressure, and the associated expectations from parents to shape conduct, instill motivation, develop character, and impart values. Immersion in such politics and policies a student teacher might become overwhelmed or disoriented due to not having considered such demands and responsibilities as being inherent to the work of teachers. Ingersoll (2003) stated that social side of the teaching job included some of the most consequential processes taking place in schools.

Ingersoll (2003) summarized a typical workday for a secondary teacher in the United States as follows. It consisted of 7 periods averaging less than an hour each, separated by 5-minute breaks, and a 25-minute lunch period sandwiched into the middle of a day. The average teacher was expected to teach 5 classes out of the 7, with the remaining 2 periods distributed for a non-teaching duty (hall duty, study hall) and the other reserved for “prep” or “free.” Teachers usually were assigned to teach 2 different subjects (i.e., two algebra classes, three geometry classes), each with about 28 students, and were expected to remain in their school building for six-and-a-half-hours per day; a total of 33-hours a week. Conventionally it was expected they would spend 13-hours a week (after school, before school, weekends) on school related activities such as: coaching, tutoring, attending meetings, class preparation, and grading papers. On a typical day a teacher had the potential of making contact with 140 different students.

Class size and the actual number of students per day were deemed as impediments to teacher autonomy. For beginning teachers the management and instructional responsibilities oftentimes were considered to be insurmountable.

Autonomy and social constraints. Ernest (2004) illustrated the two basic philosophies of Mathematics to classroom practice, and the factors that impacted a teachers' autonomy (see Figure 1). Within the social context of the school setting, Ingersoll (2003) referred to autonomy in more general terms as “the case in which individuals hold a high degree of control over issues that are directly connected to their daily activities” (p. 18). The autonomy of a Mathematics teacher depended on three factors: teachers beliefs about Mathematics and how Mathematics is taught and learned, social context of the practice (school system), and reflective practice (higher level thought that allowed a teacher to critically think about the gaps between their beliefs and the reality of their teaching experience (Ernest, 1989, 2004).

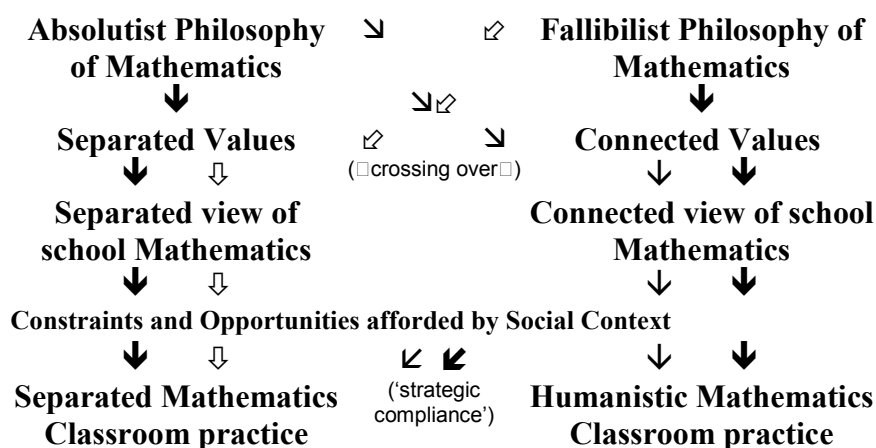


Figure 1. The simplified relations between personal philosophies of Mathematics, values and classroom image of Mathematics.

Ingersoll (2003) divided teachers work into social and academic work. A pre-service teacher, prior to embarking upon student teaching, usually harbors preconceived notions of teaching Mathematics. Upon commencement of student teaching, the person encounters the reality of teaching “social context.” Brown and Borko (1992) cited Lacey (1977) as being seminal in inspiring research on socialization of teachers. Lacey used participant observation and questionnaire data to craft an understanding of the experiences of student teachers from the perspective of student teachers. That research was credited with developing the concept of *social strategy* which was used to explain a beginning teacher’s socialization. According to Lacey, beginning teachers employed three distinct social strategies when dealing with the social constraints of their role. A social strategy was explained as “the selection of ideas and actions and working out their complex interrelationships (action-idea systems) in a given situation. The selection of these action-idea systems as a student (teacher) moves from situation to situation need not be consistent” (p. 68). The three social strategies were:

1. Internal adjustment—the teacher complies with the constraints of a situation, believing that the constraints are for the best. Thus the teacher takes on the characteristics expected of the teachers in that setting, conforming to their behavior and making a value commitment.
2. Strategic Compliance—refers to a response when the teacher complies with the constraints of a situation, but has reservations about complying and therefore acts inconsistent with their personal beliefs. They simply have adapted their behavior to the situation but do not change their values.
3. Strategic Redefinition—is a response in which the teacher is able to change the situation, even though he or she has not formal power to do so. “The change is achieved by causing those with formal power to change their definitions of what is appropriate for the situation. (Brown & Borko, 1992, p. 224)

Brown and Borko (1992) suggested that when using Lacey’s (1977) framework it was important to account for both constraints of the situation into which the teacher was

being socialized and the teacher's purposes within that situation. Lacey's (1977) theory, they contend, implied that ideas and actions of a teacher could be interpreted only in the context of specific situations.

An example of an academic constraint would students being prepared for taking Algebra I. The National Mathematics Advisory Panel (2008) sponsored a national survey of 743 randomly chosen Algebra I teachers designed to "elicit views on student preparation, work-related attitudes and challenges, and use of instructional materials" (p. 9) revealed that students' backgrounds for Algebra I was poor in rational numbers, word problems, and study habits. Reportedly, teachers did not regularly use technological tools; one-third of those studied never use graphing calculators; manipulative materials were used occasionally; 62% of the teachers claimed that "working with unmotivated students" as the "single most challenging aspect of teaching Algebra I successfully;" and the most frequently response given to teacher concerns was the difficulty handling different skill levels in a single classroom.

An example of a social constraint was a pre-service teacher placed in a student teaching situation where the cooperating teacher had an unruly class. The pre-service teacher might understand the reason(s) behind the students' disruptions but not be able, based on the constraints of the classroom rules, be able to control the class. Each scenario above depicted the social/academic dichotomy.

Reflective practice. Reflection was defined in Chapter I as a teacher's level of thought processes regarding self-assessment, descriptions and commentaries about learning activities, and analysis of student work on what the teacher intended and whether the teacher's goals were achieved (Danielson, 2000). The NMAP recommended that

“instructional practice should be informed by high-quality research, when available and by the best professional judgment and experience of accomplished classroom teachers” (NMAP, 2008, p. 11).

Thompson (1984) observed that the extent to which experienced teachers’ conceptions were consistent with their practice depended mainly on a teacher’s tendency to reflect on their actions—i.e., to think about their instruction vis-à-vis their beliefs, their students, the subject content, and the specific context of their instruction. By reflecting on their views and actions, teachers gained an awareness of their tacit assumptions, beliefs, and views, and how it all related to their practice.

It is through reflection that teachers develop coherent rationales for their views, assumptions, and their actions and become aware of their practice. Ernest (1988) also recognized the central role reflection plays on teaching when he noted that by reflecting on the effect of their actions on students, teachers develop sensitivity for context that enables them to select and implement situationally appropriate instruction in accordance with their own views and models. (Thompson, 1992, p. 139)

Rationale for Instrumentation

Beliefs and reflective practice. The three factors of autonomy (beliefs about Mathematics, and Mathematics teaching and learning; reflection the teaching practice; social constraints of the school environment) can be quantified using specific instrumentation. The rationale for the use of the instruments used by the researcher in this study to quantify beliefs about Mathematics, beliefs about learning Mathematics, reflection on teaching was the *Mathematics Beliefs Survey* (MBS), the *Mathematics Learning Style profile* (MLS), and *Teaching Styles Inventory* (TSI) respectively. All are explained relative to their applicability in Chapter III.

Measuring social constraints. Bonnstetter and Suiter (2004) developed the DISC (Dominance, Influence, Steadiness, Compliance) language of observable human behavior. Those researchers identified research that supported the contention that behaviors universally have similar characteristics. While not a measurement of a person's intelligence, values, skills and experience, or education and training. DISC does have a bearing on all of the four areas: intelligence, values, skills, and experience.

Research has consistently shown that behavioral characteristics can be grouped together in four different styles. People with similar styles tend to exhibit specific types of behavior common to that style- this is not acting. A person's behavior is a necessary and integral part of who they are. In other words, much of our behavior comes from "nature" (inherent), and much comes from "nurture" (our upbringing). The DISC model merely analyzes behavioral style; that is a person's manner of doing things. (Bonnstetter & Suiter, 2004, p. 6)

Those authors provided the following timeline of scientists and researchers who contributed to the lineage of the DISC language:

1. Empodocles 444 BC—founder of the school of medicine in Sicily stated that everything was made of four elements: earth, air, fire, water.
2. Hippocrates 400BC—was an observer of people and noticed that climate and terrain had an effect on individuals, i.e., climate and terrain affected people's behavior and appearance. He defined four types of climate and explained behavior and appearance of the people of those climates (Mountainous—many shapes and warlike; Low-lying places—broad and fleshy and short fused; High country—large in stature, gentle and unmanly; Thin, bare soils, ill watered—blonde, haughty and self-willed).
3. Galen 130-200 AD—considered the four body fluids (blood, yellow bile, black bile, and phlegm) affected human behavior and temperament.

4. C.G. Jung—identified and described four psychological types based on four psychological functions: thinking, feeling, sensation, intuition. He divided the four types into two divisions called “libido” and “energy” and labeled the two division “extroverted” and introverted” respectively.
5. William Moulton Marston 1893-1947—was the seminal developer of the DISC language. In 1928 Dr. Marston (A.B, 1915.; LL.B 1918. and Ph.D., 1921 from Harvard) published a book, *The Emotions of Normal People*, in which he identified the DISC theory used today.

He viewed people as behaving along two axes with their actions tending to be active or passive depending upon the individual’s perception of the environment as either antagonistic or favorable. By placing these axes at right angles, four quadrants were formed with each describing a behavioral pattern. (1) Dominance (D)- produces activity in a antagonistic environment, (2) Inducement (I) produces activity in a favorable environment (called influence in the system)(3) Steadiness(S) produces passivity in a favorable environment,(4) Compliance (C) produces passivity in an antagonistic environment. (Marston, 1928, p. 28)

Bonnstetter and Suiter (2004) identified the work of Walter Clark, in the 1950’s, as the first effort to build a psychological device based on Marston’s Theory. Clark’s instrument was called the “Activity Vector Analysis.” Since the early 1980s, Bonnstetter and Suiter worked to validate the DISC language and support the contention that there is a relationship between a person’s premises (personal or business) and their behavioral styles; sales people tend to sell to styles similar to their own.

The DISC language instrument, one of the three component instruments used in TTI TriMetrix Talent questionnaire was selected for this study because of its ability to

quantify the pre-service teachers' behaviors revealing strengths, weaknesses, and their actual behavior and tendencies toward certain behavior.

Behavioral research suggests that the most effective people are those who understand themselves and others. The more one understands personal strengths and weaknesses coupled with the ability to identify and understand the strengths and weaknesses of others, the better one will be able to meet the demands of the environment. The result will be success on the job, at home or in society at large” (Bonnstetter & Suiter, 2004, p. 30)

Summary

In summary, the complexity of establishing a level of autonomy experienced by a secondary Mathematics teacher was illustrated by Ernest (2004) who stated that classroom consequences of beliefs were not logical implications of philosophy because aims and other assumptions were required to reach conclusions. When linking a philosophy about Mathematics instruction to the actual practice of teaching it was theoretically possible to associate a philosophy with almost any educational practice and instructional approach. Despite having opposing epistemologies (absolutist or fallibilist), a teacher might be concerned with ascertaining what a child knew before the commencement of teaching, and such information could influence how the instructional process was provided.

Ernest (2004) attributed an observed philosophy as contingent upon the resonances and sympathies between different aspects of a person's philosophy, ideology, values and belief-systems. “These form links and associations and become restructured in moves towards maximum coherence and consistency, and ultimately towards integration of personality” (Ernest, 2004, p.13). Thus, Figure 1 identifies how the absolutist and fallibilist epistemologies are integrated when they are vetted in the social constraints of the school environment. An atmosphere of “strategic compliance” posited by Lacey

(1977) places the Mathematics instruction in the realm of the absolutist, status quo, instrumentalist-Platonic, constructs of the current traditional methods that dominate Mathematics instruction to date (Boaler, 2008; Ernest, 2004).

Figure 1 illustrates how the role of the value-position of a teacher (secondary Mathematics), curriculum development or school environment plays in mediating between personal philosophies of Mathematics, and the image of Mathematics communicated in the classroom, i.e.,

1. An absolutist philosophy combined with separated values and subject to the constraints of the social constraints of a school can create a separated Mathematics classroom practice. (↓ representing the most straight forward relationships between absolutist philosophy, values, and Mathematics practices)
2. A fallibilist philosophy combined with connected values and subject to the same social constraints can create a humanistic Mathematics classroom practice (↓ representing the most straight forward relationships between fallibilist philosophy, values, and Mathematics practices).
3. “Crossing over”—representing a deep commitment to the ideals of progressive Mathematics education [Mathematics reform] that can and does frequently coexist with the traditional belief in the objectivity and neutrality of Mathematics amongst Mathematics educators. Note: Fallibilism commonly is associated with progressive Mathematics education reform.

4. The absolutist philosophy if combined with the connected values can give rise to a connected view of school Mathematics and subjected to the social constraints give create a connected view of school Mathematics (↓).
5. The fallibilist philosophy if combined with separated values can give rise to a separated view of school Mathematics and subjected to the social constraints create a separated view of school Mathematics (↓).

Finally, it is possible for the various constraints of the social context of schooling to be so powerful that a teacher with connected values and a humanistic views of school Mathematics is forced into ‘strategic compliance’ (Lacey, 1977; Ingersoll, 2004), resulting in separated Mathematics classroom practice. This is indicated in Figure 1 by the bold thin arrows deviating left towards the separated classroom practice following the **impact of the social context** (↙ ↘). This practice may originate with either absolutist philosophy (thin arrows) or fallibilist philosophy (bold arrows), but in both cases “crosses over.” Empirical research has confirmed that teachers with very distinct personal philosophies of Mathematics (absolutist and fallibilist) have been constrained the social context of schooling to teach in a traditional, separated way (Ingersoll, 2004; Lerman 1986). (Ernest, 2004, pp. 14-15).

This chapter has reviewed selected and relevant literature pertaining to the nature of the phenomenon of autonomy. The salient findings are:

1. The factors of autonomy (Mathematics philosophy, beliefs in how Mathematics is learned and taught, social constraints of the school environment) have been researched and validated as impacting the transition of pre-service teachers into the teaching practice.
2. The research methodology has been both qualitative and quantitative and aligned with this study.
3. Research studies germane to the purpose of this study have spanned a half a century (1960-2010). Yet there remains the dilemma purported by the NMAP

(2008) as to how to improved Mathematics instruction to surpass the current status quo that has stagnated traditionally taught Mathematics programs.

4. The research has addressed the factors of autonomy for the most part separately: e.g., How a teacher's philosophy of Mathematics impacts their instruction; how teacher' instruction is impacted by the social constraints of the school environment; and how a teacher's belief's about teaching and learning Mathematics impacts their instruction.
5. There is a paucity of research involving a holistic view of a pre-service teacher's level of autonomy addressing their philosophy of Mathematics, beliefs on how Mathematics is learned and taught and their perceived impact of the social constraints of student teaching on their instruction.

The next chapter presents the methodology followed for this investigation.

Chapter III

Methodology

The purpose of this study was to explore how the transition into practice impacted the autonomy of pre-service secondary Mathematics teachers in New York State. This chapter describes the research design, population and sample, manner of data collection, and the analysis rationale.

Defining Research

A research design is a plan of action that linked the methodology, philosophical framework, and fundamental assumption of research to the methods (Creswell 2007; Creswell & Plano Clark, 2007) for data collection and subsequent analysis. Hatch (2002) had recommended that researchers consider methodological theory (placing the proposed study in a research paradigm and identifying what kind of study was being planned) as an element of research design, and write a paradigm declaration to provide a lens for examining their assumptions.

Mixed methods research follows the basic scientific inquiry method: statement of a problem; statement of the purpose; presentation of the research questions and hypothesis; manner for collection and analysis of the data pertinent to the hypothesis and research questions; and then the protocol for reporting the findings using a written structure that best fit the research problem and methods (Creswell, 2007; Johnson & Onwuegbuzie, 2004).

Justification of Mixed Methods Research

The major tenet of pragmatism (qualitative and quantitative methods are compatible) opened doors for researchers to use both paradigms in a single research study

(Tashakkori & Teddlie, 1998). The compatibility of both approaches is evident because of the similarities to the fundamental values inherent in each paradigm; beliefs: in the value-ladenness of inquiry; in the theory-ladenness of facts; that reality was multiple and constructed; in the fallibility of knowledge; and in the indetermination of theory by fact (i.e., any set of data can be explained by many theories).

The deconstructive nature (debunking of Metaphysical concepts such as truth) of pragmatic philosophy gives a mixed methods researcher license to integrate different theoretical perspectives when interpreting data (Tashakkori & Teddlie, 1998; Maxcy, 2003). Creswell (2007) claimed that the basic ideas of pragmatism allowed mixed methods researchers: not to be committed to any one system of philosophy and reality; a freedom of choice of methods, techniques and procedures of research that best meet their needs; and to look at the “what” and “how” to engage in research based on its intended consequences.

Pragmatism presents a practical and applied research philosophy that allows a researcher to use mixed method design to the fullest to study what interests him/her in different ways, and to use the results in ways that can bring about positive consequences with the value system of the researcher (Tashakkori & Teddlie, 1998; Maxcy, 2003). Adding to that position was Creswell’s (2007) statement that researchers who held the pragmatist worldview focused on the outcomes of the research (actions, situations, and consequences of inquiry) and were concerned with the application, “what works,” and with solutions to problems.

Pragmatism justifies mixed methods research, allowing a researcher to use multiple methods of data collection to best answer the research question. Scientists

holding a pragmatic worldview can elect to consider singular and multiple realities; hold multiple stances (biased and unbiased perspectives); collect qualitative and quantitative data; employ both formal and informal styles of writing (Creswell & Plano Clark, 2007). All such efforts contribute to creating a more comprehensive explanation of a phenomenon than either approach alone might allow

Role of the Researcher in Mixed Method Design

Using the aforementioned rationale it was determined that the pragmatism worldview was a design that best fit this study on the “notion of the autonomous Mathematics teacher.” The researcher harbored the pragmatic philosophy in order to experience the central premise that allowed employment of the qualitative and quantitative approaches in combination so as to better understand the anticipated answers to the stated research problem (Creswell & Plano Clark, 2007; Johnson & Onwuegbuzie, 2004).

The researcher who conducted this study had been a practicing secondary Mathematics and science educator for 36 ½ years in the New York State public school system. For 13 of those years the researcher held supervisory positions in three public school districts. As the supervisor of secondary Mathematics teachers, the researcher used the quantitative personal profiles (Myers-Briggs Type Indicator, Mathematics Learning Styles Inventory, Teaching Styles Inventory—see Appendix A) integrated with observations and discussions to assist secondary Mathematics teachers with reflection on their practice. It was noted that novice secondary Mathematics teachers had difficulty changing from their role as a teacher moving from the procedural “Sage on the Stage” to that of facilitator of instruction.

Reflection upon many mentoring experiences led to the researcher to believe that novice teachers of Mathematics easily expressed views reflective of prevailing best practices and were able to produce a constructivist lesson. Surprisingly, as those novice teachers moved through their first year of professional practice their displayed instructional styles became more procedural and teacher-centered. Of special note was that novice secondary Mathematics teachers almost universally digressed from innovative practices and it seemed that their post-secondary professional behaviors were at odds from applying best practices beliefs to their practice. That conundrum provided the impetus to this inquiry; how pre-service Mathematics teacher autonomy as a professional practitioner evidenced learned best practices and applied those beliefs and/or whether changes resulted as a consequence of continued exposure to the professional field of teaching Mathematics.

Available research on the three factors of autonomy beliefs as applied to the teaching of Mathematics, social context of the secondary schools, and the ability of teachers to reflect on practice supported the researcher's rationale for this investigation (Armstrong 2007; Ball & Forzani, 2007; Cady & Rearden, 2007; Harrison, Dymoke, & Pell, 2004; Tschannen-Moran & Hoy, 2005). Adding to those opinions was the fact novice secondary teachers of Mathematics researcher had evidenced differing levels of autonomy during their professional practice. Thus it was contended that that the level of autonomy among pre-service teachers impacted their instructional practice especially during their first practical teaching experience—student teaching. In this study the researcher considered the following philosophical assumptions:

1. *Ontology*: Creswell and Plano Clark (2007) depicted pragmatist ontology as “researchers testing hypotheses and providing multiple perspectives” (p. 24). Tashakkori and Teddlie (1998) viewed pragmatists as accepting external reality and choosing explanations that best produced desired outcomes. In this study the researcher accepted the external reality of hidden institutional sources of resistance to change such as: teacher and pupil ideologies, institutional structures, and so on that prevent progress (Ernest, 1989). To substantiate such biases it was planned to include explanations of participant constructed realities as the analyses unfolded.
2. *Epistemology*: The knower and the known are independent. Creswell and Plano Clark (2007) stated pragmatic researchers collect data by “what works” to address the research question. Tashakkori and Teddlie (1998) stated that pragmatists used both objective and subjective points of view in the mixed methods design. The researcher used survey instruments that identified belief systems (what is Mathematics; how do students learn Mathematics; how is Mathematics taught) to provide an objective view of participants’ beliefs (i.e., knower and known are independent). Participant interviews conducted to identify belief systems (i.e., knower and known are inseparable); social context of pre-service and in-service setting; and teachers’ levels of thought.
3. *Axiology*: Creswell (2007) stated that pragmatic researchers included both biased and unbiased perspectives. According to Tashakkori and Teddlie (1998), values play a major role in interpreting results for pragmatists. In this study inquiry focused on the indicators of autonomy that included biased and

unbiased lenses. Of importance, Ernest (1998) claimed that use of a given Mathematics text uncritically, or not, was to be considered as a key indicator of autonomy (Ernest, 1998). Also, social context was a definite constraint on a teacher's choice and action, restricting the ambit of a teacher's autonomy. Biased perspectives potentially could be a strong venue for explaining teachers' beliefs and the social context where they worked. Ernest (1998) also related teacher self-evaluation as an indicator of high thought level, and that critical reflection of personal performance probably could evolve from having an unbiased perspective. But the process of juxtaposing any or all of those variables might lead a person astray from being able to truly engage in critical self-reflection of professional practices

4. *Generalizations:* Quantitative data generated from participant surveys was generalized to the population of pre-service secondary Mathematics teachers. Data collected from the selected interviews was not generalized.
5. *Causal linkages:* A pragmatist believed that there might be unidentifiable causal relationships (Tashakkori & Teddlie, 1998), and that unknowns can and do impact novice teachers during their transition from pre-service to in-service. Consequently their respective beliefs about professional practice, especially best practices, become vulnerable and apt to modify, especially toward a course of least resistance.
6. *Deductive/Inductive logic:* Johnson and Onwuegbuzie (2004) referred to abduction (uncovering and relying on the best set of explanations for interpreting results) as the third logic of inquiry. Due to the multifaceted

nature of this research the researcher used abduction as the primary logic of inquiry. Results from the surveys were deductively analyzed and from the interviews they were analyzed inductively. Abduction was used to interpret the “mixing” of the qualitative and quantitative results.

Design of the Study

The purpose of this mixed methods study was to collect, analyze, and mix quantitative and qualitative data in the exploration of the phenomenon of pre-service New York State secondary Mathematics teachers’ autonomy as they transitioned through student teaching. An explanatory method was used, and involved collecting qualitative data after quantitative data to explain the quantitative data in more depth.

The goal of the quantitative strand was to collect numeric (survey and profile) data to determine the extent to which pre-service secondary Mathematics teachers’ autonomy was dependent on selected factors. The goal for the qualitative strand of the study was to better understand the complex phenomenon of teacher autonomy as the study participants transitioned into student teaching of Mathematics in New York State.

The sequential explanatory method design was selected to provide valid and well-substantiated conclusions about the nature of autonomy of pre-service teachers (Creswell & Plano Clark, 2007). The sequential explanatory study was conducted in two strands. In the first, the quantitative, numeric data was collected and analyzed and allowed for capturing a statistical picture of the attributes of autonomy reflected in pre-service secondary Mathematics teachers preparing to student teach. Correlational statistics enabled framing the relationship between participants’ beliefs in Mathematics and how Mathematics was learned. The quantitative data, second strand, was gathered from

purposefully selected the participants and qualified as a multiple case study approach.

As stated in Chapter I, the central question for this proposed study was: How is the autonomy of pre-service teachers influenced after completing student teaching? To secure reasonable information the following three sub questions will be addressed.

1. Do pre-service teachers' systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?
2. How does the social context of student teaching impact the ability to make instructional decisions?
3. How is the level of reflection on teaching practice impacted by the student teaching experience?

In pursuit of scientific answers to the above questions the researcher will consider the following issues.

1. To what extent do the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers' autonomy prior to and after their student teaching experience?
2. Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?
3. To what extent do the same types of data (belief, social context, reflection) confirm each other?
4. To what extent do the open ended themes of qualitative analysis support and clarify the quantitative survey results?
 - a. What similarities and differences exist across the levels of analysis?

- b. How do autonomy factors relate to pre-service teachers' perception of the practice of teaching?
- c. Do teachers restructure belief systems in practice?
- d. What factor (s) of pre-service teacher autonomy is (are) impacted the most by a student teaching experience?

Hypotheses.

1. H_0 : There will be no relationship between:

- a. Pre-service teachers' philosophies of Mathematics and conception of the role of teaching;
- b. Pre-service teachers' philosophies of Mathematics and the perceived use of curricular resources; and
- c. Pre-service teachers' conceptions of the role of teaching and the perceived uses of curricular materials.

H_A : There will be a positive relationship between:

- a. Pre-service teachers' philosophies of Mathematics and conception of the role of teaching;
- b. Pre-service teachers' philosophies of Mathematics and the perceived use of curricular resources; and
- c. Pre-service teachers' conceptions of the role of teaching and the perceived uses of curricular materials.

2. H_0 : There will be no relationship between pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

H_A : There will be a positive relationship between pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

3. H_0 : There will be no relationship between the number of post-secondary Mathematics courses completed by pre-service post-secondary Mathematics and their beliefs concerning the study of Mathematics.

H_A : There will be a positive relationship between the number of post-secondary Mathematics courses completed by pre-service post-secondary Mathematics course grade point averages and beliefs concerning the study of Mathematics.

Research Procedures

The quantitative and qualitative strands of the study focused on developing a description of the autonomy phenomenon in context with pre-service teachers' perceptions of the practice of teaching secondary Mathematics. Creating baseline information prior to the pre-service participant engagement in student teaching was critical to identifying the autonomy phenomenon *sans* practice. The quantitative data was collected the semester preceding the student teaching assignment for each pre-service teacher. Quantitative data provided the statistical foundation and theoretical support for the additional investigation of the autonomy phenomenon using qualitative methods.

The quantitative and qualitative methods had unequal weight in this study (Cresswell & Plano Clark, 2007). The design began with the collection and analysis of quantitative data (first strand), and was followed by the collection and analysis of

qualitative data (second strand), with the latter being predicated upon results from the first (quantitative strand). The priority in this study was given to the quantitative approach because the correlations between beliefs of Mathematics and teaching Mathematics were used to support the interview protocol and predict instructional styles of the participants as student teachers (Creswell & Plano Clark, 2007).

The study procedures, processes, and outcomes are presented as a visual diagram in Figure 2: The Visual Model for Mixed Methods Explanatory Design Procedures (Ivankova, Creswell, & Stick, 2006). The timeline for the study and the specific types of data collected are in Table 1: Collection of Data Time Frame. The study produced two views of the participants' autonomy; pre- and post-student teaching and both were searched for changes in beliefs about Mathematics and Mathematics learning, and reflective practice.

Quantitative instrumentation. The factors tied to the phenomenon of autonomy are synergized by the practice of teaching. The instrumentation for this study was developed to describe the in-practice learning behaviors and instructional decisions made by secondary Mathematics teachers. The three factors of autonomy (belief of Mathematics, social context, reflective practice) were quantified using the following instruments: *Mathematics Learning Style Inventory (MLSI)* (see Appendix A) used to decipher teacher perceptions concerning teaching and learning; *TTI TriMetric Talent questionnaire (TTI)* and *Myers – Briggs Type Indicator (MBTI)* (see Appendix A) used to decipher how teachers functioned in a social context; and, *Teaching Style Inventory (TSI)* (see Appendix A) used to identify level of thought process of teachers and their reflection about the practice of teaching Mathematics.

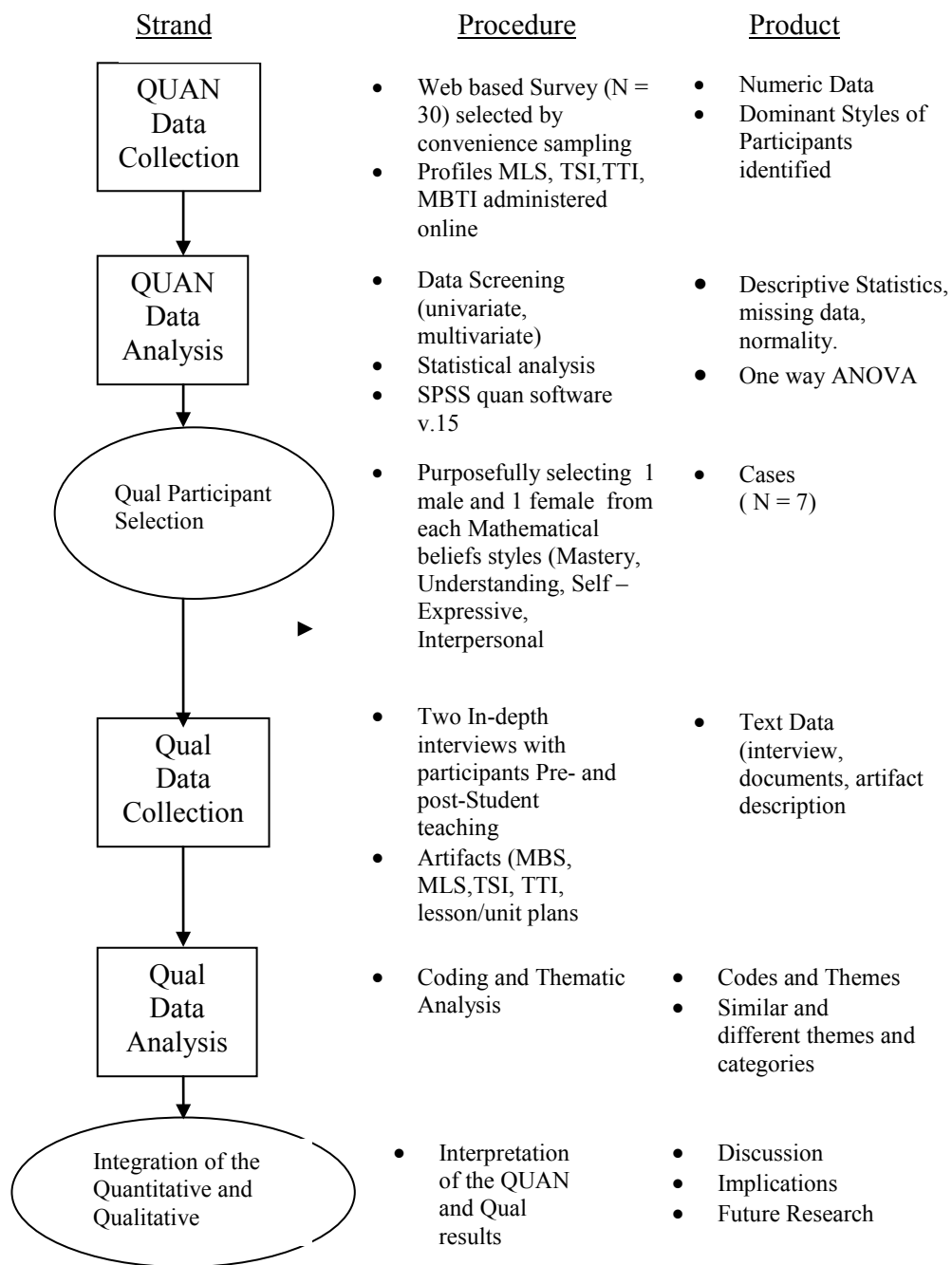


Figure 2. Visual models of mixed methods explanatory design procedures.

Table 1

Collection of Data Time Frame

Pre/Post Student Teaching	Quantitative (Numeric)	Qualitative (Text and Artifacts)	Intra-mixed	Time Frame
Pre Student Teaching	<ul style="list-style-type: none"> - Mathematics Learning Style Inventory (MLS) identifies how participants perceive they learn Mathematics) - TTI TriMetirx Talent questionnaire (TTI) and Myers-Briggs Type Indicator (MBTI) identifies how participants believe they integrate into a social context) Teaching Styles Inventory (TSI) identifies how a participant perceives their practice) 	Pre-Student Teaching Interview: <i>a priori</i> Artifacts: <ul style="list-style-type: none"> - MBS - MLS - TSI - MBTI - TTI (See Appendix A)	Demographics/ Mathematics Beliefs' Survey Questionnaire (MBS) (See Appendix A)	Pilot Study Dec, 2008 Quantitative Data Collection <ul style="list-style-type: none"> - March, 2009- July, 2009 - for participants who plan to student teach in September, 2009 - March, 2009- December 2009 – for participants who plan to student teach in January 2010 Qualitative Data Collection Pre Student Teaching Interviews Phase II Participants August, 2009,
Post Student Teaching		Post-Student Teaching Interview: <i>a priori</i> <ul style="list-style-type: none"> - Lesson and Unit plans submitted by Phase II Participants 		Post Student Teaching Interviews Phase II Participants January 2010

The Mathematics Beliefs Survey (MBS) (see Appendix A) provided demographic data and was used to identify participants' philosophies of Mathematics, how they envisioned themselves in the role of a secondary Mathematics teacher, and how they

planned to use curricular materials. Likert scaled items were the vehicle for data collection that allowed for making correlations between teachers' perceptions on how Mathematics was learned and how Mathematics should be taught, based on Ernest's (1989) conceptions of Mathematics (Problem solving view, Platonist view, Instrumentalist view) and mental models of teaching roles (Instructor, Explainer, Facilitator) introduced in Chapter I.

The Mathematics Beliefs Survey (MBS) and TTI TriMetrix Talent questionnaire were Web-based. The MLS, TSI, and MBTI instruments were separate instruments that were linked to the Beliefs Survey Web page. The Teaching Styles Inventory (TSI) (see Appendix A) was a self-described assessment of a person's instructional decision-making based on research of C.G. Jung (Silver, Hanson, & Strong, 2005). The rationale for selecting the TSI was to gain insight on how teachers made instructional planning and classroom decisions through conscious reflection.

The TSI identified four teaching styles (Mastery, Understanding, Self-Expressive and Interpersonal) and evaluated the following seven instructional categories; planning, implementing, setting, curriculum objectives, operations, roles, and assessment. No one teaching style was representative of teaching behavior. Instead, a teacher's perceived learning style was comprised of all four styles in descending order of access.

The dominant style is the most accessible because it is the most practiced. The secondary style is accessible with some additional effort. The third level and least developed styles are such because they are not routinely practiced and, therefore, are much less accessible. One's profile is always a hierarchy, but over time and with increasing consciousness, the tertiary, least developed styles, can become more accessible as a result of practice. (Silver et al., 2005, p. 6)

There were point values (5, 3, 1, and 0) assigned to each of the four responses for each of 56 questions (see Appendix A), with the maximum earned being 126 points.

The Mathematics Learning Style Inventory (MLSI) (see Appendix A) was a self-scoring tool for students to use when identifying their preferred style of learning Mathematics (Abrams, 2001; Silver et al., 2008). It identified four distinct learning styles as perceived by a respective student: Mastery, Understanding, Self- Expressive, and Interpersonal. No student perceived that they learned using just one style so a student's MLSI was comprised of all four learning styles. Point values (5, 3, 1, and 0) were given to each of the four responses for each of 22 questions (see Appendix A). The MLSI maximum total was 198 points.

The TTI TriMetrix Talent questionnaire (TTI) (Appendix A) was used to identify each participant's perception of how they integrated into the social context of their respective secondary school culture. The instrument was designed to identify the talents, personal skills, values, and behaviors an individual brought to a job.

The TTI was subdivided into three sections: Section 1—TTI Personal Talent Skills Inventory; Section 2—Motivation Insights; and Section 3—Style Insights. Each section measured an individual's cognitive structure, values that motivated behaviors and behaviors (natural and adaptive to the workplace) respectively (Bonnstetter & Suiter, 2004, 2008a, 2008b, 2008c). Analysis of the three components of the TTI provided a complete picture of an individual's talents when immersed in the social constraints of a work environment (i.e., secondary school culture as a practicing teacher).

The TTI Personal Talent Skills Inventory (PSTI) assessed an individual's cognitive structure by focusing on three dimensions of thought:

1. Systematic: The dimension of idea, thinking and structure. Systems judgment and self-direction are measured;
2. Extrinsic: The dimension of things, doing and events. Practical thinking and role awareness are measured; and

3. **Intrinsic:** The dimension of people, feelings and self awareness. Empathetic outlook and sense of self are measured. (Target Training International, Ltd., 2008b)

The Personal Talent Skills Inventory (PTSI) presented 23 key personal skills and ranked them from top to bottom, defining the major strengths that were deemed to be essential for an individual to reach their goals (Bonnstetter & Suiter, 2008b). The 23 personal talent skills are:

1. **Accountability for Others**—The ability to take responsibility for others' actions.
2. **Conceptual Thinking**—The ability to analyze hypothetical situations or abstract concepts.
3. **Conflict Management**—The ability to resolve different points of view constructively.
4. **Continuous Learning**—The ability to take personal responsibility and action toward learning and implementing new ideas, methods and technologies.
5. **Customer Focus**—A commitment to customer satisfaction.
6. **Decision Making**—The ability to analyze all aspects of a situation to gain thorough insight to make decisions.
7. **Developing Others**—The ability to contribute to the growth and development of others.
8. **Diplomacy and Tact**—The ability to treat others fairly, regardless of personal biases or beliefs.
9. **Empathetic Outlook**—The capacity to perceive and understand the feelings and attitudes of others.
10. **Flexibility**—The ability to readily modify, respond to and integrate change with minimal personal resistance.
11. **Goal Achievement**—The overall ability to set, pursue and attain achievable goals regardless of obstacles or circumstances.
12. **Influencing Others**—The ability to personally affect others' actions, decisions, opinions or thinking.

13. **Interpersonal Skills**—The ability to interact with others in positive manner.
14. **Leading Others**—The ability to organize and motivate people to accomplish goals while creating a sense of order and direction.
15. **Objective Listening**—The ability to listen to many point of view without bias.
16. **Personal Accountability**—A measure of the capacity to be answerable for personal actions.
17. **Planning and Organizing**—The ability to establish a process for activities that leads to the implementation of systems, procedures or outcomes.
18. **Problem Solving**—The ability to identify key components of a problem to formulate a solution or solutions.
19. **Resiliency**—The ability to quickly recover from adversity.
20. **Results Orientation**—The ability to identify the actions necessary to complete tasks and obtain results.
21. **Self Management**—The ability to prioritize and complete tasks in order to deliver desired outcomes within allotted time frames.
22. **Self Starting**—The ability to initiate and sustain momentum without external stimulation.
23. **Teamwork**—The ability to cooperate with others to meet objectives.

The composition of the PTSI appeared to be highly relevant to the subject of Mathematics and provided information on how a person thought about the subject. The web-based TTI TriMetrix Talent questionnaire analyzed each of the 23 aforementioned skills and represented the analysis as a bar graph plotting the populations mean, standard deviation, and the individuals' scores on scale of 1-10. It provided each person with their seven highest ranked skills, including four attributes for each skill, i.e., highlighting an individual's well-developed capabilities. "The PTSI has been validated in over 28 individual validation studies, conducted over 20-years by more than 19 examiners" (TTI Target Training International, personal communication, April 27, 2010).

The TTI Motivator Insights (MI) identified what motivated an individual to be successful and energized on the job. It was posited by TTI (Bonnstetter & Suiter, 2004, 2008a) that an individual's underlying values were satisfied through the nature of their work (i.e., an individual believes to have been personally rewarded by their work).

“Values are the drivers behind our behavior; what motivates our actions. Abstract concepts in themselves, values are principles or standards by which we act. However, it is not until we know an individual's values that we understand WHY they do what they do” (Bonnstetter & Suiter, 2008a; TTI Target Training International, personal communication, April 27, 2010).

The TTI MI identified the following six values that motivated an individual to take action:

1. **Theoretical**—A passion to discover systematize and analyze; a search for knowledge.
2. **Utilitarian**—A passion to gain return on investment of time, resource, and money.
3. **Aesthetic**—A passion to add balance and harmony in one's own life and protect our natural resources.
4. **Social**—A passion to eliminate hate and conflict in the world and to assist others.
5. **Individualistic**—A passion to achieve position and to use the position to influence others.
6. **Traditional**—A passion to pursue the higher meaning in life through a defined system of living). (Target Training International, Ltd, 2004, 2008)

The web-based TTI TriMetrix Talent questionnaire allowed for analyzing each of the above six skills and represented the analysis as a bar graph plotting the populations mean, standard deviation, and the individuals' scores on scale of 1-10. The individual

TTI TriMetrix Talent questionnaire report listed the three highest personal values and provided one attribute for each value.

The third section of the TTI TriMetrix Talent Questionnaire, the Style Insights (SI) ranked the traits that best described an individual's natural behavior. There were eight behavioral traits identified how individuals did things, i.e., "how they act":

1. **Frequent Interaction with Others**—"A strong people orientation, versus a task orientation—i.e., Dealing with multiple interruptions on a continual basis, always maintaining a friendly interface with others.
2. **Versatility**—Carrying a high level of optimism and a "can do" orientation. —i.e., Bringing together a multitude of talents and a willingness to adapt the talents to changing assignments as required.
3. **Frequent Change**—"Juggling many balls in the air at the same time." —i.e., Moving easily from task to task or being asked to leave several tasks unfinished and easily move on to the new task with little or no notice.
4. **Urgency**—Decisiveness, quick responses and fast action. Critical situations demanding on-the-spot decisions made in good judgment. Important deadlines met.
5. **Competiveness**—Tenacity, boldness, assertiveness and a "will to win" in all situations.
6. **Customer Oriented**—Maintaining a positive and constructive view of working with others. Spending a high percentage of time listening to, understanding and successively working with a wide range of people from diverse backgrounds to achieve "win-win" outcomes.
7. **Analysis of Data**—Analyzing and challenging details, data and facts prior to decision making and is viewed as an important part of decision making. Information is maintained accurately for repeated examination as required.
8. **Organized Workplace**—Systems and procedures followed for success, —i.e., Careful organization of activities, tasks and projects that require accuracy, record keeping and planning for success. (Bonnstetter & Suiter 2008c; Target Training International, Ltd, personal communication, April 27, 2010)

The Style Insights (SI) measured four dimensions of normal behavior:

- (a) Dominance (D)—Challenge—how an individual responded to problems and

challenges; (b) Influence (I)—Contacts—how an individual influenced others to their point of view; (c) Steadiness (S)—Consistency (C)—how an individual responded to the pace of the environment; and (d) Compliance—Constraints—how an individual responded to rules and procedures set by others. Each person exhibits all four dimensions of normal behavior in two types: Adaptive (identification of a person's responses to their environment—what behavior an individual believes they need to exhibit in order to survive and succeed at the job), and Natural (identification of an individual's basic behavior, the core, “the real you”) (Bonnstetter & Suiter, 2004).

Bonnstetter and Suiter (2004) posited that an individual's natural behavior emerged when they were under stress or when things were going favorably and thus could “let their hair down.” An individual's adaptive behavior was considered a “mask” and susceptible to change depending on how environmental factors impacted a person. To gain an understanding of how such “external” issues might alter behavior the following tools were employed. The natural and adapted behaviors were quantified by the Style Insights (SI) using the DISC language (Dominance (D), Influence (I), Steadiness (S), Compliance (C)) (Bonnstetter & Suiter, 2004).

The participants DISC scores (adapted and natural) were analyzed for the quantitative Phase I. The intent was to create patterns of overall behaviors for the participant group (N = 29). The DISC scores (adapted and natural) subsequently were used as artifacts for identifying behaviors of the seven participants selected in the multiple case studies, Phase II of the research design procedures.

The Researcher selected the Personal Style Inventory developed by Champagne & Hogan (1979), an abbreviated form of the Myers-Briggs Type Indicator (MBTI) that was

used to learn the participants' perceptions of how they integrated into their social contexts and to also provide construct support to the MLS and TSI (see Table 2) That instrument oftentimes is used in the areas of career counseling, pedagogy, group dynamics, employee training, and personal development because its results allow for classifying a person's ostensible personality type into one of four categories along a continuum between two poles:

1. Where a person focused their attention—Extraversion (E)—was on the outer world of people and things. Introversion (I)—on the inner world of ideas and impressions.
2. How a person absorbed information—Sensing (S)—through the five senses; with a focus on the here and now. Intuition (N)—from patterns and the big picture with a focus on future possibilities.
3. How a person made decisions—Thinking (T)—based primarily on logic and objective analysis of cause and effect. Feeling (F)—based primarily on values and on subjective evaluation of person-centered concerns.
4. How a person related to and coped with the outer world—Judging (J)—By having a planned and organized approach to life and preferring to have things settled. Perceiving (P)—by having a flexible and spontaneous approach to life and preferring to keep options open.

Each MBTI type was indicated by four letters representing a person's preferences with 16 possible variations based on combining personality types selected from each of the four categories. The Teacher (Idealist) was one of the 16 options and correlated with the ENFJ Myers Briggs type, and exhibited the following attributes: (a) They were

Table 2

Connection of MTBI Personality Preferences with MLS and TSI

MTBI	MLS	TSI
Sensing/Thinkers	Mastery	Mastery
Intuitive/Thinkers	Understanding	Understanding
Intuitive/Feelers	Self-Expressive	Self-Expressive
Sensing/Feelers	Interpersonal	Interpersonal

introspective, cooperative, directive, and expressive and looked for the very best out of those around them; (b) They liked to have things organized, settled, and planned out; (c) They had a highly developed intuition and were highly skilled at understanding what was going on inside themselves and with others; and (d) They considered people to be their highest priority, and their communication often asserted personal concern and willingness to help others (Champagne & Hogan, 1979). The total number of points that could have been accrued for each of the four attributes was 40.

Two of the four MBTI categories: how a person took in information (a) by sensing (S) or intuition (N); (b) how a person made decisions, thinking (T) and Feeling (F) were used by Silver et al. (2005) to create the TSI. In Table 2 is an illustration of how MLS and TSI relate to the MBTI. Of special note is that two of the four MBTI categories (how a person took in information by sensing (S) or intuition (N) and how a person made decisions, thinking (T) and Feeling (F) were used by Silver et al. to create the Mathematics Learning Styles described below.

Qualitative instrumentation. Two sets of qualitative interview questions (Appendix B—*Pre and Post Student Teaching Interview Protocols*) were developed for use with the pre-service teachers prior to and subsequent to their student teaching experiences. The interview protocol questions (see Appendix B—*Pre-Student Teaching Interview Protocol*) prior to the participants student teaching experiences were developed from the Mathematics Beliefs Survey (MBS) to provide in-depth information about each of the seven participants selected for the qualitative strand of the study, Phase II. The pre-student teaching interview (see Appendix B) questions focused on the participants rationale for becoming Mathematics teachers; their elementary, secondary, and post-secondary study of Mathematics; and their perceptions of their Mathematics beliefs, how Mathematics was learned, and their perceived role as teachers of Mathematics, and the participants perception of the public school culture. Questions on school culture were not included in the Mathematics Beliefs Survey (MBS) but were added to the interview protocol to address the social constraints factor of autonomy.

The post student teaching interview (Appendix B—*Post Student Teaching Interview Protocol*) questions were based on the Individual Performance Assessment (IPA); an instrument designed using the INTASC (Interstate New Teacher's Assessment Consortium Standards) Performance Standards Assessments. The INTASC identified researched based categories that were germane to the issues presented to novice teachers regarding their teaching practice and the social constraints of the school culture. The categories addressed by the IPA were: "1. Content Pedagogy, 2. Student development, 3. Diverse Learners, 4. Multiple Instructional Strategies, 5. Motivation and Management, 6. Communication and Technology, 7. Planning, 8. Assessment, 9. Reflective Practice

and Professional Development, and 10. School and Community Involvement” (Podsen, 2002, p. 129).

The Teaching Styles Inventory (TSI) (see Table 3) provided a rubric used to guide the qualitative analysis of the text data gathered from participant interviews prior to and post student teaching. The attribute categories were used to identify themes and sub themes and the qualifiers used for Master Sensing/Thinking . . . Interpersonal/Social Sensing/ Feels served as the codes.

Integration

Integration of the two phases took place after the analysis was completed separately for both the qualitative and quantitative data. The integration of the qualitative and quantitative data was related by using Erzberger and Kelle’s (2003) triangulation methodological Metaphor as a framework for the convergence of qualitative and quantitative results (see Figure 3).

The first step was to deductively establish a relationship between statements on the theoretical level and empirical observation statements.

Examples of theoretical level statements were:

1. There is a relationship between the views and the teaching roles, “The instrumental view of Mathematics (an unrelated but utilitarian set of rules and facts) is likely to be associated with the instructor model of teaching (skill mastery with correct performance” (Ernest, 1989, pp. 2, 5).
2. Changes in beliefs are associated with the ability of the Mathematics teacher to increase their reflection and autonomy regarding their teaching practices (Ernest, 1989).

Table 3

TSI Learning Behaviors and Activities by Styles

Attribute Categories	Mastery Sensing/Thinkers	Understanding Intuitive/Thinkers	Self-Expressive Intuitive/Feelers	Interpersonal/Social Sensing/Feelers
Teachers may be characterized as:	Trainers Information givers Instructional managers	- Intellectual challenges - Theoreticians - Inquires	- Facilitators - Stimulators - Creators/originators	Nurturers Supporters Empathizers
Learners may be characterized by:	Realistic Practical Pragmatic	Logical Intellectual Knowledge-oriented	Curious Insightful Imaginative	Sympathetic Friendly Interpersonal
Curriculum Objectives Emphasize:	Knowledge Skills	Concept development Critical Thinking	- Creative expression - Moral development	Positive self-concept Socialization
Settings (Learning Environments) emphasize:	Purposeful work Organization/ Competition	Discovery Inquiry/ Independence	Originality Flexibility/ imagination	Personal warmth Interaction/ collaboration
Operations (Thinking and Feeling Processes) include:	Observing Describing Memorizing Translating Categorizing	Classifying Applying Comparing/ contrasting Analyzing	Hypothesizing Synthesizing Metaphoric expression Divergent thinking Creating	Describing feelings Empathizing Responding Valuing

Table 3 continues

Attribute Categories	Mastery Sensing/Thinkers	Understanding Intuitive/Thinkers	Self-Expressive Intuitive/Feelers	Interpersonal/Social Sensing/Feelers
Teaching Strategies include:	<ul style="list-style-type: none"> - Command - Task - Graduated difficulty - Direct instruction - Interactive lecture 	<ul style="list-style-type: none"> - Concept attainment - Inquiry - Concept formations - Expository teaching - Problem Solving 	<ul style="list-style-type: none"> Creative problem solving Moral Dilemmas Metaphoric expression Divergent thinking Knowledge by design 	<ul style="list-style-type: none"> Circle Peer Tutoring Team Game Tournaments Group Investigation Role Playing
Student Activities include:	<ul style="list-style-type: none"> Workbooks Drill and repetition Demonstrations Dioramas Competition 	<ul style="list-style-type: none"> Independent study Essays Logic problems Debates Hypothesizing 	<ul style="list-style-type: none"> Creative art activities 	<ul style="list-style-type: none"> Group Projects “Show and Tell” Team Games Directed art activities Personal sharing
Assessment Tasks call for	<ul style="list-style-type: none"> Making charts/maps Developing sequences/timelines Repairing/debugging Reporting Constructing Defining/describing 	<ul style="list-style-type: none"> Comparing/contrasting Making a case Conducting an inquiry Explaining Conducting an inquiry Explaining Analyzing Classifying Debating Interpreting 	<ul style="list-style-type: none"> Speculating- What –if? Hypothesizing Creating Metaphors Inventing/designing Using artistic media to express ideas 	<ul style="list-style-type: none"> Performing community service Decision making Relating Reflecting Empathizing Keeping a journal

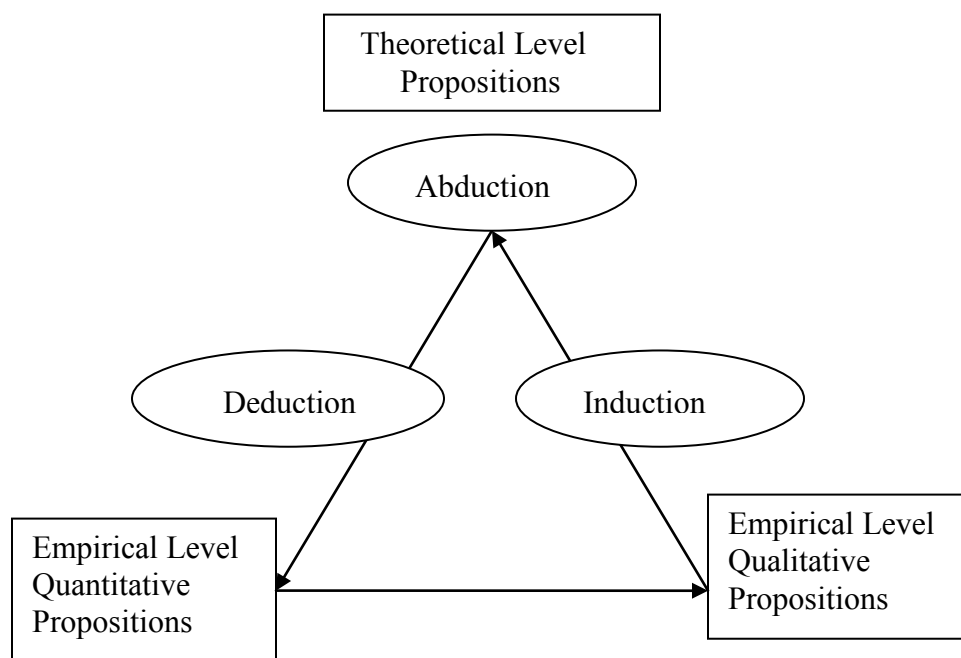


Figure 3. Integrating theoretical and empirical propositions.

3. Teacher autonomy is dependent on three factors: systems of beliefs concerning Mathematics and its teaching and learning; constraints and opportunities provided by the social context of the practice of teaching; and the teachers level of thought processes and reflection (Ernest, 1989).

Examples of Quantitative Empirical Level Statements:

1. Autonomy was quantified using the *Mathematics Learning Style Inventory (MLS)* to decipher teacher perceptions concerning teaching and learning; *TTI TriMetrix Talent questionnaire* and *Myers—Briggs Type Indicator (MBTI)* to decipher how teachers functioned in a social context; and, *Teaching Style*

Inventory (TSI) to identify teacher level of thought process and reflection about the practice of teaching.(see Appendix A)

2. A Math Beliefs Survey (Appendix A) provided demographic data (independent variables) and Likert scaled items that provided correlations between teachers' perceptions on how Mathematics was learned and how Mathematics should be taught.

Examples of Qualitative Empirical Level Statements:

1. Pre service teacher explanation of a lesson they designed revealed the teachers' ability to reflect on their practice.
2. Pre-student teaching interview analysis was used to corroborate pre-service teacher profile data analysis.

The quantitative data, instruments used to profile Mathematical beliefs, social context, and teacher practice, were used to examine the theoretical assumptions: Belief's drive instruction (Ball, 2002; Ernest, 1989; Thompson, 1992); and, Participants' learning and teaching styles as reflected by their respective profiles related to beliefs on how Mathematics should be taught (Silver, Hanson, & Strong, 2005).

Results from the analysis of the qualitative part of the study were used to further validate and explain the quantitative analysis. The process for establishing integration was sequenced as follows: (a) basic theoretical assumptions were formulated for exploring the phenomenon of autonomy; (b) the theoretical statements were tested deductively through quantitative empirical data; and (c) the second phase, qualitative, provided additional evidence for the theoretical hypotheses. "The goal will be to validate

the theoretical assumptions as well as the empirical observation propositions developed on the basis of the quantitative data” (Erzberger & Kelle, 2003, p. 469).

The overall interpretation of the autonomy of the teacher was based on the relationship between the analysis of the pre- and post-student teaching experiences. Quantitative data was used to predict participants teaching styles and the interviews provided in-depth information that clarified those predictions. How a participant made instructional decisions during the student teaching experience was compared to their perceptions of how Mathematics was to be taught prior to undertaking their student teaching.

The rationale for determining how the participants made their instructional decisions while teaching (e.g., the impact of the social context) reflected the extent of autonomy for a participant. The quantitative and qualitative data approaches were integrated using five procedures for relating mixed methods research with regards to research questions: unit of analysis, samples of the study, instrumentation, data collections methods, and analytic strategies (Yin, 2006).

1. The research questions addressed both processes (reflective practice, revising beliefs, engaging in the institutional social culture of the student teaching experience) and outcomes (correlation between beliefs and practice).
2. The unit of analysis was autonomy, i.e. “The ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence” (Cooney & Shealy, 1997, p. 88).

3. The samples of the study were nested. Participants for the qualitative data collection were a subset of the participants selected for the quantitative data collection.
4. The instrumentation and data collection methods were cross-walked, i.e., survey items were used to cover the same constructs as the profiles and interviews. Added to the cross-walk was the uniform relationship of profiles (MLS, MBTI, TSI based on the seminal research of C.G. Jung) (Silver et al., 2005; Silver et al., 2008).
5. Analytic Strategies: Deduction was used to test the theoretical level propositions using the empirical quantitative data. Induction was used to discover additional information (patterns connected to theoretical propositions) using empirical qualitative data. Abduction was determined using abduction, i.e., reasoning uncovering and relying on then best set of explanations for understanding one's results (Johnson & Onwuegbuzie, 2004).

Quantitative Data Collection and Analysis

Variables. The quantitative phase of the study was conducted prior to the participants engaging in student teaching. The dependent and independent variables (attained from the Math Beliefs Survey, Appendix A) were identified below in Table 4.

Table 4 represented the independent variables as three sections K-12 Educational Experience, College Educational Experience, and Demographic. The independent variables are defined as follows:

Table 4

Identification of Independent and Dependent Variables

Math Beliefs Survey Item Numbers	Independent Variable
Phase I Participant's K-12 Educational Experience	
3	- Level of education when participant became interested in studying Mathematics
4	- Most advanced level of Mathematics completed in High School
5	- Number of Science courses completed in High School
6	- Number of applied Mathematics courses completed in High School
8	- High School grade point average
Phase I Participants' College Educational Experience	
9	- Number of college Mathematics courses completed
10	- Number of college Science courses completed
11	- Grade point average in Mathematics courses
12	- Total grade point average
Phase I Participants' Demographic	
22	- Gender
Item #	Dependent Variables
14	- Phase I participants' Philosophy of Mathematics
15	- Phase I participants' conception of the types and range of roles envisioned as a Mathematics teacher
16	- Phase I participants' plan to use curricular materials in a particular order

- (1) The level of education when the participant became interested in studying Mathematics there were four choices on the Math Beliefs Survey item # 3 (see Appendix A): Elementary School, Middle School, High School, College.
- (2) Most advanced level of Mathematics completed in High School by the participants. There were six choices on the Math Beliefs Survey item #4: Algebra II/Trigonometry, Pre- Calculus, AP Statistics, AP Calculus AB, AP Calculus C , Others.

- (3) The number of Science courses completed in High School were to be checked off by the participants on Math Beliefs Survey item # 5: Earth Science, Biology, Chemistry, Physics, AP Physics B, AP Physics C, AP Biology, AP Chemistry, AP Environmental Science, Science Research, Others.
- (4) The number of applied Mathematics courses that the participants completed in High School (item #6 on the Math Beliefs Survey) included: Engineering, Graphic Design, AP Computer Science, Computer Programming, AP Economics, Business, Music, AP Psychology, Others.
- (5) High School GPA (item # 8 on the Math Beliefs Survey) was divided into five ranges: (2.1-2.5), (2.6-3.0), (3.1-3.5), (3.6-4.0), other. The participants were to select the range into which their GPA fell.
- (6) The number of college Math Courses completed by the participants. The selection (item # 9 on the Math Beliefs Survey) included: Calculus I, Calculus II, Calculus III, Calculus IV, Advanced Calculus, Linear Algebra, Abstract Algebra, College Geometry, Statistics, Topology, Logic, Set Theory, Non- Euclidean Geometry, Number Theory, Computer Science, Other.
- (7) The number of college Science courses completed by the participants. The selection (item # 10 on the Math Beliefs Survey) included: Physics, Biology, Chemistry, Geology, Meteorology, Astronomy, Oceanography, Other .
- (8) The GPA for the Mathematics courses that the participants completed. There were six Mathematics GPA ranges (item # 11 on the Math Beliefs Survey): (below 2.0), (2.1-2.5), (2.6-3.0), (3.1-3.5), (3.6-4.0), other.

- (9) The total GPA for each participant. There were five GPA ranges (item #12 on the Math Beliefs Survey): (below 2.0), (2.1-2.5), (2.6-3.0), (3.1-3.5), (3.6-4.0).
- (10) The participant gender (Item # 22 on the Math Beliefs Survey): male, female.

Table 4 identified three dependent variables as follows:

- (1) The participant's philosophy of Mathematics (item # 14 on the Math Beliefs Survey) represented as three choices: 1-Instrumentalist (Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end); 2- Platonic (Mathematics is a static but unified body of knowledge, discovered, not created); and, 3-Problem Solving (Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.
- (2) The participant's conception of their role as a Mathematics teacher (item # 15 on the Math Beliefs Survey) represented as three choices: 1- Instructor placing the main emphasis on Mathematics skills mastery with the correct performance; 2- Explainer emphasizing conceptual understanding with unified knowledge of mathematics; and, 3- Facilitator emphasizing confident problem posing and solving.
- (3) How the participant plans, as a Mathematics teacher (item #16 on the Math Beliefs Survey), to use curricular materials: 1- A strict following of a text or scheme; 2- Modification of the textbook approach, enriched with additional problems and activities; and, 3-A teacher or school construction of the Mathematics curriculum.

Reliability and validity. Reliability, according to Thorndike (2005), is defined as the accuracy or precision of a measurement procedure. “Indices of reliability give an indication of the extent to which the scores produced are consistent and reproducible” (p. 110). Reliability of the test instrument is a necessary condition for validity to exist (Thorndike, 2005). It will be necessary to pilot test the survey crafted by the researcher to determine the reliability of the Beliefs’ Survey Questionnaire (see Appendix A).

Creswell (2007a) referred to validity as the ability of a researcher to draw meaningful and useful inferences from scores on instruments. Thorndike (2005) stated that “a test does not have validity in any absolute sense. Rather the scores produced by a test are valid for some uses and not valid for other” (p. 145).

Sampling procedures. Participants for the first strand of this study (quantitative) were selected by convenience sampling from the State University of New York (SUNY) post-secondary institutions. SUNY post-secondary institutions that offer secondary Mathematics teacher preparation were contacted by the researcher. As an inducement to the respective institutions to become engaged in this research the Investigator offered to provide written analyses of the survey results that pertained to the teaching practices.

Pilot survey. The Mathematics Beliefs’ Survey was piloted during December 2008 by 13 SUNY Albany graduate students. That tool had been designed by the researcher as an on-line instrument, and the pilot was done to determine if there were administration issues that might negate use of SurveyMonkey.com. The pilot survey participant group was homogeneous in that all were pre-service Mathematics students transitioning from Science, Technology, Engineering, and Mathematics (STEM). Of note

was that all persons in that pilot study had taken at least 11 college and graduate-level Mathematics courses.

Content validity for the Mathematics Beliefs Survey (MBS) was established prior to the pilot survey administration. An acknowledged expert Matt Perini, Thoughtful Education Press, in psychometric academic research was provided with a copy of the survey objectives, a table of specifications, and the instrument. That person judged whether the content domain had been adequately assessed (Benson & Clark, 1982). For example, the Mathematics courses' demographics were reviewed to identify courses that might have been omitted or were not part of a Mathematics education curriculum.

Survey administration. The revised web-based beliefs survey was administered to the study participants during August 2009 following Dillman's (2007) procedure for implementing Internet surveys: (a) A pre-notice letter sent via email three days prior to the web survey; the emails were personalized, and included multiple contacts for clarification or resolution of concerns; (b) a survey cover letter including an individual PIN number; (c) after one-week a reminder email #1 was sent to non-responders; (d) three-weeks after the first reminder, a second reminder email #2 was sent to non-responders offering alternate options for completing the survey (see Appendix D). A thank you was sent to each respondent and was generated at the web site upon completion of the survey. The web design included a feature that identified the PIN numbers that had responded. Those PIN numbers were compared to the sample frame PIN number list in order to identify non-responders. The list of email addresses of participants and their PIN numbers were recorded in a secure file.

Data analysis. Cross tabulation and frequency counts were used to analyze the demographic information submitted by the participants. Participant answers to separate items on the survey scales were analyzed using descriptive statistics, and frequency counts, which allowed for creating descriptive statistics for all composite variables (mean, standard deviation, skewness, and kurtosis).

The participants were placed into four groups (Mastery, Understanding, Self-Expressive, and Interpersonal) based on their dominant MSLI style. Ten one-way ANOVA's were conducted to evaluate the mean differences between the students (a) education background and their beliefs on their philosophy of Mathematics; (b) perception of teaching roles; and (c) opinion on selection of curriculum materials (Gravetter & Wallnau, 2007).

Reliability analysis was conducted on the survey data for survey items 17a -21d, and internal consistency reliability analysis was used to correct item- total correlations, coefficient alpha for each subscale, and alpha—if-an item was deleted on the subscale. The aforementioned values then were calculated using the Statistical Package for Social Sciences Software (SPSS) version 15.0 data analysis software.

Cronbach's alpha was used to determine if the reliability of the attitude scale, items 17a-21d, reached an alpha level of at least .70 (Gliem, & Gliem, 2003). Items that scored a negative alpha coefficient were recoded, one at a time, until the reliability was positive for each item. An alpha-if-item deleted index was used to obtain the coefficient if an item was deleted from the scale. The index then was used to remove items that affected the reliability of the scale.

Descriptive statistics for each item was examined (mean score standard deviation, skewness, and kurtosis) and the descriptive statistics were used to determine if the data analysis produced a normal distribution.

Construct validity was obtained by correlating the attitude scale scores (Belief Survey questions 17a-21d) for each participant with their Mathematics Learning Styles Inventory scores. The constructs used for the web-based survey's attitude scale, questions 17a-21d, addressed the respondents' perceptions on how students' best learned Mathematics: by mastery, constructing understanding, self-expressed creativity, or interpersonal dialogue. If a survey item was valid the respondents' scores were expected to vary as the theory underlying the construct predicted. The dominant belief as to how students' best learned Mathematics was expected to mirror the belief of how a participant perceived he/she learned Mathematics. If a participant believed that students learned Mathematics best thorough procedural methods (mastery) then the participant perception of his/her learning style was expected to be reflected by the MLSI as mastery.

Criterion validity of the survey instrument was defined as the predictor of future performance (Benson & Clark, 1982).

The basic procedure is to give the test to a group that is entering some job or training program, to follow up later, to get from each one a specified measure of success on the job or the training program, known as the criterion, and then to compute the correlation between the test scores and the criterion measures of success. (Thorndike, 2005, p. 157)

For example, a pre-service Mathematics teacher who believed that the role of a teacher was that of a facilitator was expected to meet with success when designing and executing inquiry based lessons. A teacher who perceived his/her role as a facilitator allowed the students to construct their understanding by developing student-originated questions.

Credibility and verification. In order to develop a plan to establish the credibility and trustworthiness for this study, Creswell's (2007) recommendation of having at least three verification procedures were followed, as indicated earlier. There were four procedures: triangulation, member checking, peer-review, and rich, thick description. Other validation strategies—spending prolonged time in the field; persistent observations, referential adequacy, and using an external auditor were not germane to the study.

Creswell (2007) considered triangulation to include the use of multiple and different sources, methods, and investigators to provide corroborating evidence. Such a process involved corroborating evidence from different sources, i.e., Mathematics Learning Styles Inventory, Teacher Styles Inventory, written artifacts (lesson plans, curricular unit designs, and reflective practice statement).

Creswell (2007) suggested that a researcher engaged in this type of study solicit participants' verification of the preliminary analysis, consisting of description of themes, as gleaned from their interviews. That was done; participants were asked for their views as well as what information possibly was missing from a respective transcription.

Peer-review was used to check the research process (Creswell, 2007). The peer debriefer was an individual that asked 'hard questions' of the researcher about the methods employed, meanings and interpretations made, and continuously sought to ensure the researcher's activities, interpretations, and protocols were above reproach.

Rich, thick description of all qualitative information was given so as to provide readers with decision-making information regarding transferability (Creswell, 2007). For

example, a participants' in-depth description of a favorite Mathematics teacher helped in explaining her/his choice of teaching role.

Ethical considerations. In all qualitative research, protecting the research participants should be of paramount concern. A researcher has a responsibility to prevent harming participants. In the beginning of this investigation, the researcher was proactive in explaining to the participants the purpose and objectives of the research. Every attempt was made to preserve participant anonymity and the only information that potentially can be reported to a professional community is data in aggregate form or as themes. All data was manipulated so as to present it in a manner that protects individual and place identities. In this study, the anonymity of the participants also was protected by assigning aliases (initials or numbers as requested by participants) to individuals, and the developed case studies of each interviewee (Creswell, 2007).

Creswell (2007) said that when studying sensitive material a researcher should offer general information instead of specifics. Consequently the participants interviewed were allowed to view any and all information, no information was considered revealing.

In addition, all participants were made aware that they would be informed if there were any concerns of breach of confidentiality. Also, the participants were informed that any documents retrieved for this study would be locked in a steel file cabinet, and a data collection matrix developed as a visual means of locating and identifying information for the study. Prior to initiation of this proposed investigation the researcher submitted a comprehensive application to the UNL IRB and secured approval to proceed.

Integration of Quantitative and Qualitative Data Analysis

The goal of integrating the qualitative and quantitative data was to create a picture of a pre-teachers' autonomy. The basic practical application was to provide a perspective of developing teachers' belief structures and to identify their abilities to evaluate (autonomy) alternative practices when teaching Mathematics.

The qualitative analysis, conducted after the student teaching experience, provided a real-life environment data pool from where a teacher's autonomy met its first test in the practice of teaching. The following is an example of a Meta-inference possibly derived from the study: a teacher who viewed Mathematics as a set of procedures; considered the role of teaching as an instructor; and had a judging profile on the MBTI. Such an individual would experience difficulties adapting if placed in a teaching environment of contrary factors (facilitated inquiry based instruction). How such a participant evaluated the experience was an indicator of the ability to be autonomous in practice.

Legitimation. Johnson and Onwuegbuzie (2006) posited that assessing the validity of mixed methods research findings was complex. Those authors recommended that "validity" be termed legitimation when combining inferences from the quantitative to qualitative components of the study into formation of Meta-inferences. They said the term "legitimation" should be used when discussing the overall criteria for assessment of mixed research studies; i.e., quantitative legitimation and qualitative legitimation.

The following legitimation types were identified as justified when clarifying the validity of a mixed methods study (Johnson & Onwuegbuzie, 2006):

1. Sample Integration—the extent to which the relationships between the qualitative and quantitative sampling designs yield quality Meta- inferences.
2. Inside-Outside—extent to which the researcher accurately presents and utilizes the views of both the insider and observer for descriptive purpose.
3. Weakness Minimization—the extent to which weaknesses from one approach are compensated by strengths from the other approach.
4. Conversion—the extent to which converting quantitative to qualitative (or vice versa) yields quality Meta inferences.
5. Paradigmatic mixing—the extent to which the researchers beliefs support the quantitative and qualitative approaches to produce a “usable” package.
6. Multiple Validities—extent to with legitimation of the mixed methods processes yield high quality Meta-inferences.
7. Political—the extent to which the practicing researchers value the Meta-inferences stem from both the quantitative and qualitative components of the study.

The goal of the mixed methods study integration was to identify a pre-service teachers' autonomy prior to practice and identify changes, if any, as a result of the participants' student teaching experiences. For example, the integration of quantitative and qualitative analysis could have produced a picture of a participant's autonomy to have a mastery belief in how Mathematics was learned, a perceived view that the role of the Mathematics teacher was that of instructor, and a view that curricular materials should be followed as written. After such participant completed the student teaching, the researcher evaluated how the teacher reflected on his/her practice by comparing the

experience of the teacher pre- and post-student teaching. If the student teaching experience required the participant to be a facilitator, the participant might have recognized the difference of the roles and either decided to incorporate or reject a style that was different.

Phase I—Methods and Procedures

Instruments. Five instruments were administered to the participants and used to define the three factors impacting the level of autonomy. The Mathematics Beliefs' Survey was used to collect participant demographic, dependent and independent variable data, and instrument construct data.

The Mathematics Learning Style Inventory, Teaching Styles Inventory, and the TTI TriMetrix Talent questionnaire were used to collect data on each participant's belief on how they learned Mathematics, how they viewed teaching practice, and how they behaved in the social constraints of a workplace environment (secondary schools). The Myers-Briggs Type Indicator identified the dominant two personality types (how a person takes in information, how a person makes decisions) to validate the MLS and TSI results.

Variables in the quantitative analysis. The Mathematics Beliefs' Survey dependent variables were: (a) philosophy of Mathematics, (b) envisioned roles of Mathematics teacher; and (c) planning to use curricular materials. The independent variables were: (a) when participants became interested in studying Mathematics; (b) most advanced Mathematics course taken in high school; (c) the number of science courses taken in high school, (d) the number of applied Mathematics courses taken in high school; (e) high school GPA; (f) number of science courses taken in college; (g)

college Mathematics GPA; (h) college overall GPA; (i) the number of Mathematics courses taken in college; and (j) gender.

Quantitative data collection.

Sampling. During the spring and fall, 2009, participants for Phase I of the study were recruited from nine SUNY colleges and universities. Separate IRB approval was required by each SUNY institution. The researcher recruited the participants via campus visits (two SUNY), video conferencing (two SUNY), and email (five SUNY). The recruitment letter was circulated to 102 potential participants.

Thirty-three pre-service secondary Mathematics students from eight of the nine SUNY institutions consented to participate in Phase I of the research. Upon receipt of the consent forms, the researcher sent out 33 sets of research materials. Thirty of the 33 consenting participants completed the research documents Mathematics Belief's Survey, Mathematics Learning Style Inventory, Teaching Style Inventory and the Myers Briggs Type Indicator Profile for a 90.9% response rate. One participant did not want to take the TTI-TriMetrix Talent questionnaire producing a response rate of 89.9%.

Reliability and validity. In quantitative research, reliability and validity of the instruments are important for creation of baseline information. That was done prior to the pre-service participants' engagement in student teaching for the purpose of mitigating and/or decreasing potential errors that could have evolved from measurement problems in the study. Indices of reliability demonstrate the extent to whether the measurement procedure is consistent and reproducible (Thorndike, 2005).

Reliability.

Internal consistency reliability. The Mathematics Beliefs Survey (items 17a-21d) was designed to identify the reliability of the MLS instrument. The dual construct approach was developed by rewriting each construct of the MLS instrument in a Likert Scale response format that appeared on the MBS as items 17a-21d. The objective for creating the dual construct design was to establish the internal consistency reliability of the MLS specific to the participants (N = 10) in this study.

The Cronbach's alpha (.71) for questions 17-21 provided an estimate of the internal consistency of the instrument's scores with a single administration (Gliem, & Gliem, 2003). Reliability of a test instrument is a necessary condition for validity to exist (Thorndike, 2005).

Validity. Creswell (2003) referred to validity as the ability of a researcher to draw meaningful and useful inferences from scores on instruments. Thorndike (2005) stated that, "a test does not have validity in any absolute sense, Rather the scores produced by a test are valid for some uses and not for others" (p. 145). In the quantitative phase of this study the content and construct validity of the Mathematics Beliefs Survey, MLS, TSI were established as follows:

Content validity. The content validity of the Mathematics Beliefs Survey instrument was established prior to the survey administration. The wording of the Mathematics Beliefs' Survey was reviewed by Dr. Vicki Kouba, Director of Mathematics and Education Research at SUNY Albany and associates at the Thoughtful Education Press LLC, who developed the MLS and the TLS. The initial survey had the twenty items 17a-21d listed separately. After review by Thoughtful Education Press, LLC, personnel

the researcher rearranged the questions into five construct questions 17-21. Thoughtful Education Press LLC suggested that the participants would provide a better response to the four Mathematics learning styles if a lead question were developed for each of the five MLS constructs

1. Item 17 MBS—Students learn Mathematics best when instruction
2. Item 18 MBS—The best Mathematics students approach problems
3. Item 19 MBS—The best way to assess students' Mathematics understanding is with
4. Item 20 MBS—The most effective teachers of Mathematics
5. Item 21 MBS—A good Mathematics classroom is like.

Construct validity. Construct validity for the Mathematics Beliefs Survey was designed to demonstrate the agreement between the Mathematics Beliefs Survey items 17-21 theoretical concepts and the MLS. The latter tool assigned a score to a participants' perception on learning Mathematics. An internal reliability correlation alpha of .71 (20 items) was used as evidence for validating the constructs. Mathematics Beliefs Survey items 17-21 were associated in the following manner to the MLS.

The constructs of the MLS and the Mathematics Beliefs' Survey items 17-21 aligned as follows:

1. MLS Mathematics students want to. . . (item 17)
2. MLS Mathematics students approach problem solving. . . (item 18)
3. MLS Mathematics students like problems that. . . (item 19)
4. MLS Mathematics students learn best when. . . (item 20)
5. MLS Mathematics students may experience difficulty when. . . (item 21)

The four MLS categories were represented by the following responses:

1. Mastery Style (items 17a, 18b, 19a, 20b, 21d)
2. Interpersonal (items 17b, 18c, 19b, 20c, 21a)
3. Understanding (items 17c, 18d, 19d, 20d, 21c)
4. Self-Expressive (items 17d, 18a, 19c, 20a, 21b)

The MLS dominant scores (mastery, understanding, self-expressive, interpersonal) were used to select the participants for the qualitative Phase II of this study.

Criterion validity. Criterion validity of an instrument is defined as the predictor of future performance, which involved comparing it to another measure that had been demonstrated to be valid (Benson & Clark, 1982; Thorndike, 2005). The TSI instrument was based on the Myers-Briggs Type Indicator (MBTI) personality categories of perception (how a person takes in information) and judgment (how a person makes decisions) (Silver, Hanson, & Strong, 2003). Mastery teaching styles were identified as MBTI Sensing/Thinkers (ST).

Instrument administration. The quantitative instruments were administered in two ways. The participants were given on-line links and individual PIN numbers for the Mathematics Beliefs Survey via SurveyMonkey.com, and the TTI TriMetrix Talent questionnaire was administered online via Target Training International, Ltd. The Mathematics Learning Style (MLS), Teaching Learning Styles (TSI) and Myers Briggs Type Indicator (MBTI) instruments were sent to the participants via FedEx and U.S. mail. Each person asked to complete the three instruments and mail them back to the researcher in a prepaid envelope.

The Mathematics Learning Style Inventory, Teaching Styles Inventory, and Myers Briggs Type Indicator Profile, were scored by the researcher; scores were cross checked using the addition totals for each instrument (i.e., MLS score total was 198 points, the numbers 5,3,1, and 0 could not be repeated in the row analysis; TSI score was total was 126 points, the numbers 5,3,1, and 0 could not be repeated in the row; MNBTI

there were four domains each domain totaling 40 points). The researcher used the excel spreadsheet summation feature to check column and row additions for each instrument.

Target Training International, Ltd scored the TTI TriMetrix Talent questionnaire and the results were sent to the researcher with an explanation of each participant. The researcher sent the scores for the MLS, TSI, MBTI and the TTI TriMetrix Talent questionnaire to respective participants with an explanation on how to interpret the scores.

Phase II—Methods and Procedures

Connecting quantitative and qualitative data in mixed methods. The second part, qualitative phase, of the study focused on using qualitative analysis to explain in depth the three factors that impacted autonomy (beliefs in Mathematics and learning and teaching Mathematics, reflection on practice, and the social constraints of the schools) of pre-service teachers as they transitioned into practice. The quantitative data from Phase I was used to describe the level of autonomy of the participants.

In this study the quantitative and qualitative methods were connected when the MLS data was used as the criteria for selecting the participants for the multiple case studies in Phase II. The researcher had found that the Mathematics Learning Styles (MLS) inventory accurately identified Mathematics teachers' Mathematics beliefs about how the teachers believed they learned Mathematics best. The teachers were able to identify how their personal learning Mathematics style impacted their instructional decisions.

The selection of the MLS was not only based on researchers' practice but also because of the theoretical claim that that beliefs about Mathematics are at the root of

instructional decisions made by secondary Mathematics teachers (Ernest, 1989), and the desire for equal gender representation in each of the four MLS styles (Ernest, 1989).

A second connection that was made between the qualitative and quantitative data was the stipulation that only participants that were eligible for a student teaching placement in the fall, 2009, were purposely selected for the multiple case studies. The rationale for basing the selection of the participants on their student teaching placement date was drawn from the researchers' experience as a supervisor of Mathematics, i.e., a student teaching assignment that has been scheduled in the fall provided a classroom climate that is least influenced by the cooperating teachers' teaching style. The pre-service Mathematics teacher who has been assigned a fall placement has the opportunity to experience how the start of the school year impacts the teaching practice. For example, the student teacher experiences how the cooperating teacher arranges the classroom for instruction, sets up discipline and classroom management strategies, and establishes relationships with their students. Student teachers that are placed in schools in the second semester of the school year (i.e., January) are not privy to how the learning environment has been constructed.

Case selection. Seven of the 30 participants in the quantitative component were purposefully selected to represent a male and female using the MLS dominant style scores: 2 for Mastery, 2 for Understanding, 2 for Self-Expressive, and 1 male for Interpersonal. There were no females with MLS interpersonal dominant style available to student teach in the fall, 2009.

Prior to sending the recruiting letter and consent form to the participants for Phase II, the researcher contacted the participants via email asking if they were interested

in participating in Phase II of the study. The first round of contacts was successful in recruiting all of the needed participants for the Phase II. The recruitment letter described the goals of the second phase of the study and assured the participant that the study would not interfere with their student teaching experiences.

In August, 2009, one-hour interviews with each participant were conducted via audio-taped telephone. In December, 2009, the seven participants were contacted and one-hour interviews were scheduled for January, 2010.

Qualitative data collection and analysis.

Qualitative research design. A multiple case study design was used to collect and analyze data (Creswell, 2005). The data was collected through in-depth telephone interviews. The artifacts used were lessons and units submitted by the respective participants, MLS, TSI, TTI TriMetrix Talent questionnaire, MBTI narratives, and each participant's Mathematics Beliefs Survey responses. The researcher did not want to interview participants in person, so as to eradicate any bias judgments of a participant based on physical attributes, sartorial display, and any other visual stimuli that might influence data analysis. The researcher designed the interview questions to elicit maximal unguided responses from the participants' regarding their perceptions of their pre- and post-student teaching experiences.

Data collection and analysis. The researcher audio recorded the participant phone interviews. The interviews were conducted for one hour. As part of the interview protocol, the participants were asked if they agreed to be audio taped. The audio interviews were downloaded to a jump drive. Each interview was transcribed verbatim (Creswell, 2005). The researcher checked the transcriptions for accuracy by re-listening

to the audio tape and comparing it with the transcribed text. The texts for each of the participants' interview were sent to the participant to check for accuracy of the interview. The participants responded with approval and/or corrections that needed to be made to the script

The researcher performed the following steps when engaged in the qualitative analysis: (a) reading through the transcripts and writing memos; (b) re-reading the transcripts and segmenting and labeling the text; (c) using the left margin of the transcripts to develop codes and the right side to develop themes; (d) themes were connected and interrelated; (e) a case study narrative was crafted using descriptions and themes; and (f) cross case thematic analysis was performed (Creswell, 1998). The analysis was performed at two levels, within and across each case.

Verification. In this study the following verification procedures were used to determine the credibility of the information matched the reality of the participants' perception:

1. Triangulation—several sources converged to support the information gleaned from the interviews: (a) selected survey responses; (b) MLS, TSI, TTI, MBTI and TriMetrix Talent questionnaire characteristics; and (c) submitted lessons and unit plans.
2. Using Member Checking—participants were asked to review the interview transcripts and provide feedback.
3. Providing rich thick descriptions to convey findings.

This chapter has presented the methodology employed to identify and select participants for both phases of this mixed methods investigation. In the next chapter are the results from the analyses.

Chapter IV

Quantitative Results

This chapter reports the Phase I (quantitative) data analysis for the cohort of pre-service teachers who sought secondary Mathematics teaching positions in the 2010-2011 school year. The three factors that impacted autonomy were: beliefs on learning and teaching Mathematics, social context of the secondary schools, and the ability of the teachers to reflect on their practice.

In many instances throughout this chapter descriptive information is juxtaposed with relevant analytical material and summary paragraphs are provided to clarify the contents of related tables and identify aspects of either or both that hold special importance. As appropriate, the information was related to the issues studied, and at the end of each major section a short summary was placed.

Phase I—Quantitative

There were 102 students invited to participate in this study. Thirty (29.4%) of the 102 participated. The data gleaned from the Mathematics Learning Style, Teaching Style Inventory, Myers Briggs Type Indicator Profile, and the TTI TriMetrix Talent questionnaire was entered into an excel spread sheet. The Statistical Package for Social Sciences software (SPSS) version 15.0 was used to analyze the data.

Missing data. The following items on the Mathematics Beliefs Survey (MBS) were missed by the Phase I participants (N = 30): item 15a, only 29 students responded (96.7%); item 18a, only 28 students responded (93.3%); item 18b, only 27 students responded (90%); item 18c, only 26 students responded (86.7%); and item 20c, only 29 students responded (96.7%). There was no missing data on any of the following study

instruments: Mathematics Learning Style profile (MLS), Teaching Style Inventory (TSI), or the Myers Briggs Type Indicator (MBTI).

Research questions. The central question for this proposed study was: How was the autonomy of pre-service teachers influenced after completing student teaching? To secure reasonable information the following three sub questions were addressed:

1. Do pre-service teachers' systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?
2. How does the social context of student teaching impact the ability to make instructional decisions?
3. How is the level of reflection on teaching practice impacted by the student teaching experience?

The central question and three sub-questions were a result of the integration of the quantitative and qualitative results and were addressed in Chapter VI.

In pursuit of scientific answers to the above questions the researcher considered the following research issue questions:

1. Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching? Research issue question #1 was addressed in this chapter.
2. To what extent do the same types of data (belief, social context, reflection) confirm each other? Research issue question #2 was addressed in this chapter.
3. To what extent did the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers'?

autonomy prior to and after their student teaching experiences? Research issues question #3 was addressed in Chapter V.

4. To what extent do the open-ended themes of qualitative analysis support and clarify the quantitative survey results? Research question #4 was addressed in Chapter V.
 - a. What similarities and differences exist across the levels of analysis?
 - b. How do autonomy factors relate to pre-service teachers' perception of the practice of teaching?
 - c. Do teachers restructure belief systems in practice?
 - d. What factor (s) of pre-service teacher autonomy is (are) impacted the most by a student teaching experience?

In preparation for the integration of the quantitative results, the following research issues questions were addressed in this chapter:

1. Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?
2. To what extent do the same types of data (belief, social context, reflection) confirm each other?

Univariate analysis. Seven tables (Tables 5-11) reported the univariate analysis of the Mathematics Belief's Survey (MBS), Mathematics Learning Style (MLS) profile, Teaching Style Inventory (TSI), Myers- Briggs Type Indicator (MBTI), and the TTI TriMetrix Talent questionnaire. Tables 5-7 reported the frequency counts (N) and percentages (%) that were used to analyze the Phase I participants' (N = 30) demographic

information from the Mathematics Beliefs Survey (MBS) [Items # 3,4,8, 11-22]. Table 8 reported the frequency counts (N) and percentages (%) of the Phase I participants' Mathematics Learning Style profiles (MLS), Teaching Style Inventories (TLS) and the Myers Briggs Type Indicators (MBTI). Table 9 provided the descriptive statistics (mean, standard deviation, kurtosis, and skewness) for the Phase I participants' MLS, TSI, and MBTI scores. Table 10 reported the descriptive statistics for the MBS related to the Phase I participants' academic background (course work and honor societies) [Items #5-7, 9, and 10]. Table 11 provided the descriptive statistics for the Phase I participants' (N = 29) TTI TriMetrix talent questionnaire scores.

Table 5 reported the background information needed to answer the following research issue question #1: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?* The gender balance of the Phase I participants (N = 30) was reflected in the data. It should be noted that the data reflected answers based on the participants' perceptions. There was no corroborating data that validated true reported GPAs, most advanced level of Mathematics courses taken, or gender of the participant. The results reported in Table 5 were important for making generalizations about the SUNY pre-service teacher cohort (represented by the Phase I participants) that were eligible to teach in the fall, 2010.

Of the 30 participants in the study, the gender breakdown was 14 (46.7%) female and 16 (53.3%) male. Twelve (40%) participants became interested in studying Mathematics during the time they were in high school. Twenty-seven (90%) had taken either an introduction to calculus or a calculus level class in high school. Twenty-seven

Table 5

Frequencies (N) and Percentages (%) from Selected Demographic Items on the Mathematics Beliefs Survey (MBS items #'s 3, 4, 8, 11-13, 22)

MBS Item #	N	%
<i>Item #3 When did you become interested in studying Mathematics?</i>		
Elementary school	6	20.0
Middle school	3	10.0
High School	12	40.0
Total	30	100.0
<i>Item #4 What was the most advanced level of coursework you studied in high school?</i>		
Other	3	10.0
AP Calculus AB	14	46.7
Pre Calculus	13	43.3
Total	30	100.0
<i>Item #8 High School GPA Range</i>		
Other	1	3.3
2.6 – 3.0	2	6.7
3.1 – 3.5	7	23.3
3.6 – 4.0	20	66.7
Total	30	100.0
<i>Item #11 College Mathematics Courses GPA Range</i>		
2.1 – 2.5	2	6.7
2.6 – 3.0	8	26.7
3.1 – 3.5	8	26.7
3.6 – 4.0	12	40.0
Total	30	100.0
<i>Item #12 All College Courses GPA Range</i>		
2.1 – 2.5	1	3.3
2.6 – 3.0	2	6.7
3.1 – 3.5	16	53.3
3.6 – 4.0	11	36.7
Total	30	100.0

Table 5 continues

MBS Item #	N	%
<i>Item #13 Do you plan to continue your Mathematics studies in graduate school?</i>		
Other	2	6.7
No	5	16.7
Yes	8	26.7
Not sure	13	43.3
NA	2	6.7
Total	30	100.0
<i>Item #22 Gender</i>		
Male	16	53.3
Female	14	46.7
Total	30	100.0

(90%) had earned a grade mark of B or above average in high school, and 20 (66.7%) kept a B or better average in their college Mathematics courses. Eight (26.7%) planned to continue the study of Mathematics in graduate school. All of the participants in the study had completed Mathematics courses beyond the level required by the New York State Education Department (NYSED) and were considered high achievers in their major content area (Mathematics) and general courses of studied.

Table 6 reported the frequencies and percentages used to answer question #1: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?* The MBS item #14 gave information on the beliefs of the Phase I participants' (N = 30) philosophy of the Mathematics factor of autonomy; items #15 and #16 gave information on the Phase I participants' reflections on the role of a teacher and developing of instructional materials representative of the reflective factor of autonomy. The results for items #14, 15, and 16 were used as the dependent variables in the ANOVA analysis.

Table 6

Frequencies (N) and Percentages (%) Results for the Mathematics Beliefs Survey (MBS, item #s 14, 15, 16) Philosophy of Mathematics, Role of Teacher, and Use of Curricular Materials

MBS Item #	N	%
<i>Item #14 Assign a number to each statement below to indicate your philosophy of Mathematics.</i>		
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.		
Strongest	11	36.7
Moderate	14	46.7
Weakest	5	16.7
Total	30	100.0
Mathematics is a static but unified body of knowledge, discovered, not created.		
Strongest	3	10.0
Moderate	14	46.7
Weakest	13	43.3
Total	30	100.0
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.		
Strongest	16	53.3
Moderate	2	6.7
Weakest	12	40
Total	30	100.0
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.		
Most important	6	20.7
Moderate	5	17.2
Least important	18	62.1
Total	29	100.0
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.		
Most important	12	40.0
Moderate	12	40.0
Least important	6	20.0
Total	30	100.0

Table 6 continues

MBS Item #	N	%
Facilitator emphasizing confident problem posing and solving.		
Most important	12	40.0
Moderate	13	43.3
Least important	5	16.7
Total	30	100.0
<i>Item #16 As a Mathematics teacher I plan to use curricular materials in the following order.</i>		
A strict following of a text or scheme.		
First	1	3.3
Second	3	10.0
Third	26	86.7
Total	30	100.0
Modification of the textbook approach, enriched with additional problems and activities.		
First	22	73.3
Second	8	26.7
Total	30	100.0
A teacher or school construction of the Mathematics curriculum.		
First	7	23.3
Second	19	63.3
Third	4	13.3
Total	30	100.0

Three philosophical conceptions of Mathematics, as proposed by Ernest (1989), were represented in item 14 of the Mathematics Beliefs Survey: (a) Problem-solving view—Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product; (b) Platonic view—Mathematics is a static but unified body of knowledge, discovered, not created; and (c) Instrumentalist view—Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end. Sixteen (53.3%) participants held that the problem-solving philosophy was their strongest view of Mathematics. Twelve (40%) contended that the problem-solving philosophy

held the weakest view. That difference in views of the problem-solving philosophical view was addressed in Chapter VI of this dissertation.

The Mathematics Beliefs Survey represented the three mental models depicting a teacher's conceptions of the type and range of teaching roles, actions, and classroom activities associated with the teaching of Mathematics as espoused by Ernest (1989), represented in item #15: (a) Instructor, (b) Explainer, and (c) Facilitator. Eighteen (60%) of the participants considered the role of instructor as least important (the instructor's role of placing the main emphasis on Mathematics skills mastery with correct performance). Twelve (40%) cited the role of explainer (emphasizing conceptual with a unified knowledge of Mathematics) as most important. Twelve (40%) identified the role of explainer as being of moderate importance. Twelve (40%) selected the role of facilitator (emphasizing confident problem-solver) as being of the greatest importance. Finally, 12 (40%) of the participants selected the role of facilitator as being moderately important. It is important for a reader to recognize that the participants were able to make multiple selections to the various items on the survey and that explains the differing percentages associated with the choices made.

Ernest (1989) claimed that a teacher with a low level of autonomy was apt to be quite rigid on following a textbook or instructional scheme. The Mathematics Beliefs' Survey provided information representing three levels of proposed use of curricular materials as: (a) a strict following of a text or scheme; (b) modification of the textbook approach, enriched with additional problems and activities; and (c) a teacher or school construction of the Mathematics curriculum. Twenty six (86.7%) of the persons studied placed a strict following of the text as least important in their choice of curricular

materials; 22 (73.3%) placed “modification of the textbook approach” as their first choice; and 19 (63.3%) placed a teacher or school construction of Mathematics curriculum as a second choice for instructional resources. The trend for the pre-service teachers was toward choosing resources based on instructional decisions, rather than subscribing to a prescribed set of materials or textbook.

Table 7 reported frequencies and percentages used to answer the research issue question #2: *To what extent do the same types of data (belief, social context, reflection) confirm each other?* Items #17-22 represented the constructs of the Mathematics Learning Profile (MLS). The Mathematics Beliefs Survey (MBS), items 17-21, sought to identify the participants’ view of how Mathematics was best learned and best taught. The results from the data were used to calculate the reliability of the MLS instrument for the Phase I participants (N = 30). The Cronbach’s Alpha (.71) was calculated for items 17-21, and provided an estimate of the internal consistency of the instrument’s scores with a single administration.

Table 7
Frequencies (N) and Percentages (%) Results for Mathematics Beliefs Survey (MBS Items # 17-#21) Representing the Constructs of the Mathematics Learning Style Inventory (MLS)

MBS Item #	N	%
<i>Item #17 Students learn Mathematics best when instruction focuses on. . . .</i>		
(a) Mastering set procedures		
Strongly agree	3	10.0
Agree	12	40.0
Slightly agree	10	33.3
Slightly disagree	2	6.7

Table 7 continues

MBS Item #	N	%
Disagree	2	6.7
Strongly Disagree	1	3.3
Total	29	100.0
(b) Dialogue, collaboration, and working in teams.		
Strongly agree	16	53.3
Agree	11	36.7
Slightly agree	2	6.7
Disagree	1	3.3
Total	30	100.0
(c) Helping students understand why the Mathematics they learn works.		
Strongly agree	15	50.0
Agree	12	40.0
Slightly agree	3	10.0
Total	30	100.0
(d) Exploring Mathematical ideas using the imagination.		
Strongly agree	5	16.7
Agree	17	56.7
Slightly agree	6	20.0
Slightly disagree	1	3.3
Disagree	1	3.3
Total	30	100.0
<i>Item #18 The best Mathematics students approach problems. . . .</i>		
(a) By visualizing the problem, generating possible solutions, and exploring among the alternatives.		
Strongly agree	21	75.0
Agree	4	14.3
Slightly agree	2	7.1
Slightly disagree	1	3.6
Total	28	100.0
(b) In a step-by-step manner.		
Strongly agree	4	14.8
Agree	7	25.9
Slightly agree	7	25.9
Slightly disagree	7	25.9
Disagree	2	7.4
Total	27	100.0

Table 7 continued

MBS Item #	N	%
(c) As an open discussion among a community of problem solvers.		
Strongly agree	2	7.7
Agree	11	42.3
Slightly agree	10	38.5
Slightly disagree	2	7.7
Disagree	1	3.8
Total	26	100.0
(d) As an open discussion among a community of problem solvers.		
Strongly agree	2	7.7
Agree	8	30.8
Slightly agree	8	30.8
Slightly disagree	8	30.8
Total	26	100.0
<i>Item #19 The best way to assess students' Mathematical understanding is with. . .</i>		
(a) Problems that are similar to problems students have already solved and that require students to use a procedure to obtain a solution.		
Strongly agree	3	10.0
Agree	8	26.7
Slightly agree	11	36.7
Slightly disagree	4	13.3
Disagree	3	10.0
Strongly disagree	1	3.3
Total	30	100.0
(b) Problems that focus on real-world applications and how Mathematics helps people.		
Strongly agree	9	30.0
Agree	14	46.7
Slightly agree	6	20.0
Slightly disagree	1	3.3
Total	30	100.0
(c) Non-routine problems that are project-like in nature.		
Strongly agree	3	10.0
Agree	17	56.7
Slightly agree	4	13.3
Slightly disagree	6	20.0
Total	30	100.0

Table 7 continued

MBS Item #	N	%
<i>(d) Problems that require students to analyze and explain Mathematical data.</i>		
Strongly agree	11	36.7
Agree	13	43.3
Slightly agree	6	20.0
Total	30	100.0
<i>Item #20 The most effective teachers of Mathematics. . . .</i>		
<i>(a) Engage students in creative thinking and problem solving.</i>		
Strongly agree	22	73.3
Agree	7	23.3
Slightly agree	1	3.3
Total	30	100.0
<i>(b) Model new skills and allow ample time for practice.</i>		
Strongly agree	14	46.7
Agree	12	40.0
Slightly agree	2	6.7
Slightly disagree	1	3.3
Disagree	1	3.3
Total	30	100.0
<i>(c) Pay close attention to students' successes and struggles in Mathematics.</i>		
Strongly agree	21	70.0
Agree	9	30.0
Total	30	100.0
<i>(d) Challenge students to think "on their feet" and explain their ideas.</i>		
Strongly agree	18	60.0
Agree	7	23.3
Slightly agree	5	16.7
Total	30	100.0
<i>Item #21 A good Mathematics classroom is like. . . .</i>		
<i>(a) A book club, where students discuss their learning with their teacher and classmates.</i>		
Strongly agree	10	33.3
Agree	13	43.3
Slightly agree	5	16.7
Slightly disagree	2	6.7
Total	30	100.0

Table 7 continued

MBS Item #	N	%
(b) A laboratory, where students experiment with ideas and try out new procedures.		
Strongly agree	7	23.3
Agree	17	56.7
Slightly agree	3	10.0
Slightly disagree	2	6.7
Disagree	1	3.3
Total	30	100.0
(c) A courtroom, where students have to explain and defend their ideas.		
Strongly agree	6	20.7
Agree	15	51.7
Slightly agree	7	24.1
Disagree	1	3.4
Total	29	100.0
(d) A sports practice, where students fine tune their skills before they count.		
Strongly agree	11	36.7
Agree	5	16.7
Slightly agree	8	26.7
Slightly disagree	4	13.3
Disagree	2	6.7
Total	30	100.0

The four Mathematics learning styles (Mastery, Understanding, Self-Expressive, Interpersonal) were imbedded in five lead questions that were developed for each of the five MLS' constructs as follows: The constructs of the MLS were aligned with the Mathematics Beliefs' Survey items 17-21. The four categories contained within each item are shown below.

1. Item 17—Students learn Mathematics best when instruction focuses on:
 - a. mastering set procedures (Mastery).
 - b. dialogues, collaboration, working in teams (Interpersonal).
 - c. helping students understand why the Mathematics they learn works (Understanding).

- d. exploring Mathematics ideas using the imagination (Self Expressive).
2. Item 18—Understanding (by the pre-service teacher) how the best students approach problem-solving:
 - a. by visualizing the problem, generating possible solutions, and exploring among alternatives (Self Expressive).
 - b. in a step-by-step manner (Mastery).
 - c. as an open discussion (Interpersonal).
 - d. by looking for patterns and identifying hidden problems (Understanding).
 3. Item 19—The best way for assessing a student’s Mathematical understanding:
 - a. problems that are similar to problems students have already solved and that require students to use a procedure to obtain a solution (Mastery).
 - b. problems that focus on real world applications and how Mathematics helps people (Interpersonal).
 - c. non-routine problems that is project-like in nature (Self Expressive).
 - d. problems that require students to analyze and explain Mathematical data (Understanding).
 4. Item 20—How the most effective Mathematics teachers approached instruction:
 - a. engaged students in creative thinking and problem solving (Self-Expressive).
 - b. modeled new skills and allowed ample time for practice (Mastery).
 - c. paid close attention to students’ successes and struggles in Mathematics (Interpersonal).

- d. challenged students to think “on their feet” and explain their ideas (Understanding).
5. Item 21—How teachers envisioned their Mathematics classroom is like:
- a. a book club, where students discuss their learning with their teacher and classmates (Interpersonal).
 - b. a laboratory, where students experiment with ideas and try out new procedures (Self- Expressive).
 - c. a courtroom, where students have to explain and defend their ideas (Understanding).
 - d. a sports practice, where students fine tune their skills before they count (Mastery).

The 30 participants selected options reflecting “strongly agreed ”and “agreed” on all choices in the 17-21 items with the exception of:

- 17a students learn Mathematics best when instruction focuses on mastering set procedures [12 (40%) agreed; 10 (30%) slightly agreed];
- 18a the best Mathematics students approach problems in a step-by- step manner [7(25.9%) agreed; 7(25.9%) slightly agreed; 7(25.9%) slightly disagreed];
- 18d the best Mathematics students approach problems as an open discussion among a community of problem-solvers [8 (30.8%) agree; 8(30.8%) slightly agree; 8(80.8%) slightly disagree]; and
- 19a the best way to assess student’s Mathematical understanding is with problems students have already solved, and that required students to use a procedure to obtain a solution. [8(26.7 %) agree; 11(36.7%) slightly agree].

Table 8 reported frequencies and percentages used to answer research issue question #3: *To what extent do the same types of data (belief, social context, reflection) confirm each other?* The MLS was used to quantify the Phase I participants' beliefs about how Mathematics is best learned and taught. The MLS identified four learning styles: Mastery (M), Self-Expressive (SE), Understanding (U), and Interpersonal (I).

Each participant in this study earned scores in all four learning styles, but with one style having a higher score being identified as the dominant style. For example, a participant with a dominant Mastery learning style probably would want to learn practical information and procedures about Mathematics; preferred Mathematics problems that had been solved previously, and used set procedures to produce single solutions; approached problem-solving in a step-by-step manner; experienced difficulty learning Mathematics when it was too abstract or when faced with open-ended problems; and learned Mathematics best when instruction was focused on modeling new skills, practicing, and receiving feedback and coaching sessions (Silver, Thomas, & Perini, 2008).

The Mathematics Learning Styles (MLS) profile results allowed for identifying 11 (36.7%) participants as perceiving they had a dominant mastery style, 9 (30%) as having a dominant self-expressive style, 6 (20%) as having a dominant understanding style, and 4 (13.3%) as having a dominant interpersonal style.

The Teacher Style Inventory (TSI) was used to quantify the Phase I participants' perceptions of the role of teaching. Like the MLS, the participants' produced scores in all four teaching styles [Mastery (M), Understanding (U), Self-Expressive (SE), and Interpersonal (I)]. For each participant there was usually one dominant style (the highest

Table 8

Frequencies(N) and Percentages (%) Results for the Dominant (DOM) MLS, TSI and Myers-Briggs Type Indicator (MBTI) Styles and Types

Style/Type	N	%
DOM Mathematics Learning Style (MLS)		
I	4	13.3
M	11	36.7
Se	9	30.0
U	6	20.0
Total	30	100.0
DOM Teaching Style Inventory (TSI)		
I	4	13.3
I (M)	2	6.6
M	17	56.7
M (I)	1	3.3
SE	3	10.0
U	3	10.0
Total	30	100.0
Myers-Briggs Type Indicator (MBTI)		
ENFJ	3	10.0
ENFJ/ENFP	1	3.3
ENTJ	1	3.3
ENTP	1	3.3
ESFJ	2	6.7
ESTJ	4	13.3
ESTJ/ESFJ	1	3.3
ESTJ/ISTJ	3	10.0
INTJ	1	3.3
INTP	1	3.3
INTP/INFP	1	3.3
INTP/INTJ	1	3.3
ISFJ	1	3.3
ISTJ	8	26.7
ISTP	1	3.3
Total	30	100.0

score), and subsequently it was reflected in the TSI scores. For example, 17 Phase I participants perceived they had a mastery teaching style.

There were instances where a participant had the same score for two or more styles, i.e., Mastery (40), Interpersonal (40), Self-expressive (21), Understanding (25). There were two participants whose dominant teaching style scores were equal (mastery and interpersonal) whose results were identified on Table 8 as M (I). There were instances where a participant's score differed by one point in styles, i.e., Interpersonal (41), Mastery (40), Self-expressive (24), and Understanding (21); indicating dominance in both styles. There were two participants whose styles differed by one point (interpersonal was one point higher than mastery) whose results were identified on Table 8 as I (M).

The Teacher Styles Inventory (TSI) identified the perception of the participants' dominant teaching style. Seventeen (56.7 %) of the participants perceived themselves as having a mastery style; four (13.3%) as having an interpersonal style; three (10 %) as having a self-expressive style; and three (10%) as having an understanding style. Rounding out the 30 participants were two (6.7%), I (M), whose interpersonal score was one point greater than their mastery score as a dominant teaching style, and one (3.3%), M (I), whose interpersonal score equaled their mastery score as a dominant style.

The MLS and TSI are based on the Myers-Briggs Type Indicator S (Sensing), N (Intuitive), T (Thinking), and F (Feeling) dimensions. The MBTI scores were used to confirm the MLS and TSI results. Represented by the following chart (see Figure 4):

ISTJ (Intuitive, Sensing, Thinker, and Feeler) was the Myers-Briggs Type Indicator (MBTI) most represented in 11 participants (36.7%). ISTJs were characterized

MTBI	MLS	TSI
Sensing (S)/Thinkers (T) (ST)	Mastery	Mastery
Intuitive (N)/Thinker (T) (NT)	Understanding	Understanding
Intuitive (N)/Feeler (F) (NF)	Self Expressive	Self Expressive
Sensing (S)/Feeler (F) (SF)	Interpersonal	Interpersonal

Figure 4. Support of Mathematics Learning Style Inventory (MLS) and Teaching Style Inventory (TSI) by the Myers-Briggs Type Indicator Dimensions (Sensing, Intuition, Thinking, Feeling).

by decisiveness in practical affairs, were considered as guardians of time-honored institutions, and best described as “dependable” (Champagne & Hogan, 1979). Such participants usually integrate into the social context of a school environment supporting the existing traditions (i.e., instructional practices). ESTJ (Extrovert, Sensing, Thinker, and Feeler) was the second most represented MBTI in 4 participants (13.3%). ESTJs were characterized as loyal and steadfast by Champagne and Hogen (1979), and will support the “status quo” of school environments. The ISTJs and ESTJs were listed in tandem with other MBTIs, e.g., ISTJ/ESTJ resulted from the participant scoring 20 points for both I and E.

Seventeen participants had “ST” imbedded in their Myers-Briggs Type Indicator (MBTI), and 17 participants had a dominant mastery teaching style (TSI). The Mathematics Learning Style (MLS) profile and the Teaching Style Inventory (SI) were based on the Myers-Briggs Type Indicator (MBTI) as evidenced in the ST support for the TSI instrument (Silver, Thomas, Perini, 2008).

Table 9 reported the descriptive statistics used to answer research issue question #2: *To what extent do the same types of data (belief, social context, reflection) confirm each other?* Each participant in Phase I had an MLS and TSI that was composed of all four styles [Mastery, Interpersonal, Understanding, Self-Expressive], but with these participants there was just one dominant style (see Table 8).

Notably, each participant in Phase I had scores for all eight MBTI personality types [Extrovert (E), Introvert (I), Sensing (S), Thinking (T), Perceiving (P), Judging (J)]. Table 9 provided the descriptive data for the MLS, TSI, and MBTI scores. The results were used to illustrate the distribution of the data. The distributions were normal for the each MLS, TSI, and MBTI style/indicator. The kurtosis for each distribution was $< +/- 2.0$, with the MBTI extrovert kurtosis just under the accepted value.

Table 10 reported the descriptive statistics used to answer the Research question #1: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?* The results were used to identify how close the distributions were to reported norms. The Mathematics Beliefs Survey (MBS) items 5, 7, and 10 exhibited a normal distribution. MBS items 6 and 10 exhibited a kurtosis greater than the acceptable value (< 2.0) that was not a normal distribution.

Table 11 reported the descriptive statistics for the TTI TriMetrix Talent questionnaire. The results were used to identify the DISC behaviors (Dominance, Influence, Steadiness, Compliance), behavioral hierarchy, personal values, and personal skill of the Phase I participants ($N = 29$). The TTI TriMetrix results were used to identify behavior in the social context of the school environment.

Table 9

Descriptive Statistics [Frequency (N), Minimum Score (Min), Maximum Score (Max), Mean (M), Standard Deviation (SD), Kurtosis, Skewness] for the MLS, TSI, and MBTI Profiles

MLS/TSI/MBTI Style	N	Min	Max	M	SD	Kurtosis	Skewness
MLS Mastery	30	6	92	49.70	22.49	-0.96	0.02
MLS Understanding	30	25	87	49.63	15.18	0.19	0.93
MLS Self Expressive	30	25	72	52.23	14.04	-0.90	-0.20
MLS Interpersonal	30	19	82	46.43	14.75	0.32	0.06
TSI Mastery	30	8	66	40.17	16.42	-0.79	-0.36
TSI Understanding	30	16	58	32.27	9.18	0.79	0.36
TSI Self Expressive	30	5	49	21.30	11.65	0.17	0.82
TSI Interpersonal	30	11	47	32.20	10.07	-0.79	-0.36
MBTI Introvert	30	11	31	19.97	4.76	-0.22	0.23
MBTI Extrovert	30	1	29	19.40	5.89	1.99	-1.02
MBTI Intuitive	30	5	28	17.27	5.02	0.13	-0.06
MBTI Sensing	30	15	35	23.07	4.60	0.20	0.31
MBTI Thinking	30	12	32	22.23	4.70	0.10	-0.22
MBTI Feeling	30	8	28	17.77	4.70	0.10	0.22
MBTI Perceiving	30	8	32	17.10	5.28	1.33	0.85
MBTI Judging	30	14	32	23.60	4.11	0.01	-0.03

Table 10

*Descriptive Statistics for the Mathematics Beliefs Survey (MBS Items #'s 5-7, 9, 10)
Regarding Participant Academic Background*

MBS Item	N	Min	Max	M	SD	Kurtosis	Skewness
Item 5 # of science courses	30	2	6	4.00	0.78	1.28	0.00
Item 6 # of applied Mathematics courses	30	0	7	1.20	1.37	10.48	2.68
Item 7# of honor societies	30	0	3	0.77	0.77	0.92	0.92
Item 9# Mathematics courses take in college	30	6	15	9.63	1.95	-2.12	-1.41
Item 10 #of college science courses	30	0	4	1.60	0.81	1.45	0.88

Table 11

TTI TriMetrix Descriptive Statistics Representing the Natural and Adaptive DISC (Dominance, Influence, Steadiness, Compliance) Dimensions, Behavioral Hierarchy, Personal Skills, and Personal Values

Dimension/Hierarchy Personal Values/Skills	N	Min	Max	M	SD	Skewness	Kurtosis
Four Dimensions Adaptive							
D Adapted (%)	29	5	89	32.52	25.233	1.233	0.547
I Adapted (%)	29	5	95	57.34	31.460	-0.533	-1.240
S Adapted (%)	29	16	98	66.76	25.433	-0.628	-0.765
C Adapted (%)	29	5	94	58.34	24.725	-0.379	-0.648
Four Dimensions Natural							
D Natural (%)	29	5	92	33.86	26.165	0.871	-0.252
I Natural (%)	29	10	100	61.21	25.350	-0.251	-0.797
S Natural (%)	29	2	100	66.03	30.598	-0.627	-0.795
C Natural (%)	29	7	100	60.03	27.930	-0.200	-0.801
Behavioral Hierarchy							
Urgency	29	10	100	37.41	27.471	0.838	-0.424
Frequent interaction with others	29	10	90	63.79	24.700	-0.578	-0.925

Table 11 continues

Dimension/Hierarchy	N	Min	Max	M	SD	Skewness	Kurtosis
Personal Values/Skills							
Competitiveness	29	10	100	37.93	26.374	1.056	0.426
Versatility	29	10	90	51.90	21.688	-0.277	-0.838
Customer Oriented	29	40	100	71.55	16.909	-0.020	-0.627
Frequent Change	29	13	80	47.00	21.262	-0.142	-1.208
Analysis of Data	29	20	100	57.41	25.726	0.258	-1.148
Personal Values							
Theoretical	29	3.2	9.2	6.424	1.6494	-0.402	-0.755
Utilitarian	29	1.8	7.7	4.679	1.7670	-0.204	-1.242
Aesthetic	29	1.3	6.3	3.676	1.2337	-0.066	-0.381
Social	29	3.2	9.2	6.645	1.5470	-0.547	-0.80
Individualistic	29	3.5	7.2	5.145	1.0439	0.317	-0.482
Traditional	29	1.0	8.5	3.441	1.6696	1.075	1.454
Customer Focus	29	2.9	9.4	8.062	1.1694	-3.189	13.717
Decision Making	29	3.0	9.0	7.490	1.0670	-3.062	10.816
Developing Others	29	4.0	9.0	7.680	1.0110	-2.145	6.944
Diplomacy and Tact	29	2.6	8.9	7.734	1.1254	-3.504	16.020
Empathetic Outlook	29	2.8	9.6	8.255	1.2034	-3.488	15.558
Flexibility	29	3.5	9.2	7.821	1.3214	-2.404	6.144
Goals Achievement	29	3.4	8.8	7.297	1.1201	-1.942	5.080
Influencing Others	29	3.3	8.8	7.697	0.9796	-3.393	14.860
Interpersonal Skills	29	2.7	9.2	7.931	1.1465	-3.524	16.042
Leading Others	29	3.6	9.3	7.883	1.1668	-1.919	5.435
Objective Listening	29	3.6	9.5	7.959	1.1957	-2.121	5.884
Personal Accountability	29	4.4	8.8	7.231	0.8384	-1.678	4.679
Planning and Organizing	29	3.8	8.9	7.666	1.2016	-2.439	6.317
Problem Solving	29	1.1	9.2	7.552	1.6004	-2.928	10.158
Resiliency	29	3.0	9.0	6.990	1.1650	-1.023	1.965
Results Orientation	29	4	9	7.300	1.1550	-1.770	4.263
Self-Management	29	3.3	8.7	7.197	1.0755	-1.867	5.246
Self-Starting Ability	29	5.1	8.4	6.841	0.8420	-0.237	-0.348
Teamwork	29	3.3	8.9	7.790	0.9883	-3.506	15.779

The TTI TriMetrix Talent questionnaire was used to quantify social behaviors of the Phase I participants, i.e., to identify behaviors, values, and a person's manner of doing things within a social environment. The four styles were: (a) Dominance (D)—Challenge (how a person responded to problems and challenges); (b) Influence (I)—Contacts (how a person influences others to change their point of view); (c) Steadiness (S)—Consistency (how a person responded to the pace of an environment); and (d) Compliance (C)—Constraints (how a person responded to rules and procedures set by others). People with similar styles tended to exhibit specific types of behaviors common to that style. DISC was used as an acronym for the social behavior styles: Dominance (D); Influence (I); Steadiness (S); and Compliance (C). There were two sets of DISC scores for each participant: Natural- how a person naturally behaved and Adaptive—how a person behaved in a work environment.

Twenty-nine (96.7%) of the participants completed the TTI TriMetrix Talent questionnaire. Mean values (see Table 11) above 50 were considered “high,” and mean values below 50 were considered “low.” The results from the 29 participants were understood to evidence a low D adapted (32.52) and a D natural (33.86); high S adapted (66.76) and an S natural (66.03); high C adapted (58.34) and high C natural (60.03). I natural (61.21) and I adapted (57.63) also were in the high range, indicating that the 29 participants would be able to respond to the pace of a typical work environment (i.e., school) and would be able to comply with the rules and procedures set by others (school teachers, administrators). The 29 participants were expected to “go with the flow,” and not challenge the social context of a school environment.

Mean scores for the TTI TriMetrix Talent questionnaire were used to identify the top 3 (out of 23) personal skills from the 29 participants as: (a) empathetic outlook, (b) customer focus, and (c) conflict management. The bottom three personal skills were: (a) self-starting ability, (b) resiliency, and (c) self-management. The personal skill outcomes for the 29 participants indicated that they were people-oriented, but apt to exhibit resilience to education reform or a change in the social context of a school culture.

The participants' natural and adaptive DISC scores were used to generalize the potential for how the cohort of pre-service secondary Mathematics teachers would integrate into the social context of their respective student teaching experiences. Recognition was made that each participant brought idiosyncratic behavioral hierarchy, personal skills, and personal values that influenced how they made instructional decisions. In general, the majority of the Phase I participants would comply with the rules of the school and the current curriculum taught, and be empathetic toward the needs of their students and their colleagues.

Multivariate analysis. Research question #2 was: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?* To address that question a series of ANOVAs were conducted with the teachers' educational backgrounds as the independent variables and their beliefs about Mathematics and Mathematics teaching as the dependent variables (MBS items #14-16; Tables 12-70, Means and Standard Deviations and ANOVAs).

The continuous variable data of academic background (i.e., the number of science courses, number of applied Mathematics courses, number of Mathematics courses taken in college, and the number of college science courses (see Table 10) formed the basis for addressing the fourth question. Allowing for the relatively small sample size ($N = 30$), a median split was used resulting in two categories. The median of the continuous variable was found, and the sample size ($N=30$) was split into two categories: 2-4 and 5-6 for the number of completed high school science courses (median = 4); 0-1 and 2-7 for the number of completed high school applied Mathematics courses (median = 1); 6-9 and 10-15 for number of Mathematics courses studied in college (median = 9); 0-1 and 2-4 for the number of science courses completed in college (median = 1). The respective ANOVAs were reported in the next section below, and encompassed Tables 12-70.

Relationship between the dependent variables and when participants became interested in studying Mathematics. Means and standard deviations for philosophy of Mathematics, according to when the participants became interested in studying Mathematics, were reported in Table 12. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by when participants became interested in studying Mathematics.

On the Mathematics Beliefs Survey (MBS) the Phase I participants ($N = 30$) had to rate three Mathematics philosophies: (a) Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end; (b) Mathematics is a static but unified body of knowledge, discovered, not created; and (c) Mathematics is a dynamic, continually expanding field of human creation and invention a cultural product;

Table 12

Descriptive Statistics for Participants' Philosophy of Mathematics and When Participants Realized Interest in Mathematics (Elementary, Middle, High Schools, College)

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Elementary School	6	1.33	.51	1	2
Middle School	3	2.00	.00	2	2
High School	12	1.75	.86	1	3
College	9	2.11	.60	1	3
Total	30	1.80	.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
Elementary School	6	2.33	.51	2	3
Middle School	3	3.00	.00	3	3
High School	12	2.25	.62	1	3
College	9	2.22	.83	1	3
Total	30	2.33	.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Elementary School	6	2.33	1.03	1	3
Middle School	3	1.00	.00	1	
High School	12	2.00	.95	1	3
College	9	1.67	1.00	1	3
Total	30	1.87	.97	1	3

by identifying their first choice (strongest view), to third choice (weakest view). The participants' philosophy of Mathematics was the dependent variable.

On the Mathematics Beliefs Survey (MBS), the participants selected the level of their schooling when they first became interested in studying Mathematics (elementary, middle, high school, college). The level of schooling was considered in this study as an independent variable. Table 12 reported the number of participants that selected their

philosophy based on the school level categories (elementary, middle, high, college) when they first realized their interest in studying Mathematics. The mean value, standard deviation, maximum and minimum, were reported for each school level category.

Table 13 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify if significant differences in philosophy existed and when participants became interested in Mathematics. For all three ANOVAs, at $p > .05$ there were no statistically significant differences in philosophy of Mathematics by when participants became interested in studying Mathematics (Table 13).

Means and standard deviations for conception of types and range or roles envisioned as a Mathematics teacher according to when participants became interested in studying Mathematics were reported in Table 14. Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range or roles envisioned as a Mathematics teacher by when participants became interested in studying Mathematics.

On the Mathematics Beliefs Survey (MBS), the phase I participants had to place in order, (1) most important to (3) least important, their conception of the type and range or roles in which they envisioned themselves as a Mathematics teacher [Instructor..., Explainer..., Facilitator...]. That was a dependent variable.

Table 13

ANOVAs Testing the Differences between Participants' Philosophy of Mathematics and When Participants Realized Interest in Mathematics by School Level (Elementary, Middle, High Schools, College)

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	2.32	3	.77	1.61	.20
Within Groups	12.47	26	.48		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	1.52	3	.50	1.18	.33
Within Groups	11.13	26	.42		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	4.13	3	1.37	1.53	.22
Within Groups	23.33	26	.89		
Total	27.46	29			

Table 14 reported the number of participants that selected their role as a Mathematics teacher based on the school level categories (elementary, middle, high, college) when they first realized their interest in studying Mathematics. The mean value, standard deviation, and maximum and minimum, were reported for each school level category.

Table 15 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences in conceived role as a Mathematics teacher, and when participants became interested in Mathematics. For all three ANOVAs, at $p > .05$ there were no statistically significant differences (Table 15).

Table 14

Descriptive Statistics for Participants' Conception of Roles Envisioned as a Mathematics Teacher According to When Participants Became Interested in Studying Mathematics (Elementary, Middle, High Schools, College)

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Elementary School	5	2.40	0.89	1	3
Middle School	3	2.33	1.15	1	3
High School	12	2.50	0.90	1	3
College	9	2.33	0.70	1	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Elementary School	6	1.83	0.98	1	3
Middle School	3	2.00	1.00	1	3
High School	12	1.92	0.66	1	3
College	9	1.56	0.72	1	3
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
Elementary School	6	1.67	0.51	1	2
Middle School	3	1.67	0.57	1	2
High School	12	1.58	0.66	1	3
College	9	2.11	0.92	1	3
Total	30	1.77	0.72	1	3

Table 15

ANOVAs Testing the Differences between Participants' Conception of Role Envisioned as a Mathematics Teacher and When Participants Realized Interest in Mathematics by School Level (Elementary, Middle, High School, College)

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.16	3	0.05	0.07	0.97
Within Groups	18.86	25	0.75		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.82	3	0.27	0.44	
Within Groups	15.97	26	0.61		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	1.56	3	0.52	0.98	0.41
Within Groups	13.80	26	0.53		
Total	15.36	29			

Means and standard deviations for plans to use curricular materials according to when the participants became interested in studying Mathematics were reported in Table 16. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by when participants became interested in studying Mathematics.

Table 16

Descriptive Statistics for How Participants Planned to Use Curricular Materials According to When the Participants Became Interested in Studying Mathematics (Elementary, Middle, High Schools, College)

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
Elementary School	6	2.67	0.51	2	3
Middle School	3	3.00	0.00	3	3
High School	12	2.75	0.62	1	3
College	9	3.00	0.00	3	3
Total	30	2.83	0.46	1	2
Modification of the textbook approach, enriched with additional problems and activities.					
Elementary School	6	1.17	0.40	1	2
Middle School	3	1.00	0.00	1	1
High School	12	1.42	0.51	1	2
College	9	1.22	0.44	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
Elementary School	6	2.17	0.75	1	3
Middle School	3	2.00	0.00	2	2
High School	12	1.83	0.71	1	3
College	9	1.78	0.44	1	2
Total	30	1.90	0.60	1	3

On the Mathematics Beliefs Survey (MBS), the Phase I participants had to place in order, (1) first to (3) last, how they would use curricular materials [A strict following of a text . . . , Modification of the textbook . . . , A teacher or school construction of Mathematics curriculum]. Table 16 reported the number of participants that selected the order of how they would use curricular materials as a Mathematics teachers based on the school level categories (elementary, middle, high, college) when they first realized their

interest in studying Mathematics. The mean value, standard deviation, maximum and minimum for the dependent variable (plan to use curricular materials) were reported for each school level category.

Table 17 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences in what order the participants would use curricular as a Mathematics teacher, and when participants became interested in Mathematics. For all three ANOVAs, at $p > .05$ there were no statistically significant differences in plans to use curricular materials by when participants became interested in studying Mathematics (Table 17).

Table 17

ANOVAs Testing the Differences between Participants' Plan to Use Curricular Materials According to When the Participants Became Interested in Studying Mathematics (Elementary, Middle, High Schools, College)

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.58	3	0.19	0.90	0.45
Within Groups	5.58	26	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.56	3	0.18	0.91	0.44
Within Groups	5.30	26	0.20		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.64	3	0.21	0.55	0.64
Within Groups	10.05	26	0.38		
Total	10.70	29			

Relationship between the dependent variables and most advanced

Mathematics course taken in high school. Means and standard deviations for philosophy of Mathematics according to the most advanced Mathematics course taken in high school were reported in Table 18. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by most advanced Mathematics course taken in high school.

Table 18

Descriptive Statistics for Participant's Philosophy of Mathematics According to the Most Advanced Mathematics Coursework Studied in High School

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Other	3	2.00	0.00	2	2
Pre-Calculus	14	1.79	0.69	1	3
AP Calculus AB	13	1.77	0.83	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
Other	3	2.33	1.15	1	3
Pre-Calculus	14	2.43	0.64	1	3
AP Calculus AB	13	2.23	0.59	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Other	3	1.67	1.15	1	3
Pre-Calculus	14	1.79	0.97	1	3
AP Calculus AB	13	2.00	1.00	1	3
Total	30	1.87	0.97	1	3

On the Mathematics Beliefs Survey (MBS), the Phase I participants had to select the most advanced Mathematics course they took in high school (pre-Calculus, AP

Calculus, other). Table 18 reported the number of participants that selected their philosophy based on their most advanced level of Mathematics coursework studied in high school. The mean value, standard deviation, maximum and minimum, for the dependent variables (philosophy of Mathematics) was reported for each selected advanced Mathematics level.

Table 19 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the advanced Mathematics level groups. For all three ANOVAs at $p > .05$, there were no statistically significant differences in philosophy of Mathematics by most advanced Mathematics course taken in high school (Table 19).

Means and standard deviations for conception and roles envisioned as a Mathematics teacher according to most advanced Mathematics course taken in high school were reported in Table 20. Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range or roles envisioned as a Mathematics teacher by most advanced Mathematics course taken in high school.

Table 20 reported the number of participants' selected role of a Mathematics teachers based on their most advanced level of Mathematics coursework studied in high school. The mean value, standard deviation, maximum and minimum for the dependent variable (conception of the type and range or roles envisioned as a Mathematics teacher) were reported for each selected advanced course level group.

Table 21 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three

Table 19

ANOVAs Testing Differences between Phase I Participants' Philosophy of Mathematics and the Most Advanced Mathematics Coursework Participants Studied in High School

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.13	2	0.06	0.12	0.88
Within Groups	14.66	27	0.54		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.26	2	0.13	0.28	0.75
Within Groups	12.40	27	0.45		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	0.44	2	0.22	0.22	0.80
Within Groups	27.02	27	1.00		
Total	27.46	29			

Table 20

Descriptive Statistics for the Participant's Conception of Role Envisioned as Mathematics Teacher and the Participants' Most Advanced Level of Mathematics Coursework Studied in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Other	2	1.50	0.70	1	2
Pre-Calculus	14	2.36	0.84	1	3
AP Calculus AB	13	2.62	0.76	1	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Other	3	1.67	1.15	1	3
Pre-Calculus	14	1.79	0.80	1	3
AP Calculus AB	13	1.85	0.68	1	3
Total	30	1.80	0.76	1	3

Table 20 continues

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Facilitator emphasizing confident problem posing and solving.					
Other	3	2.33	0.57	2	3
Pre-Calculus	14	1.86	0.77	1	3
AP Calculus AB	13	1.54	0.66	1	3
Total	30	1.77	0.72	1	3

Table 21

ANOVA Testing the Differences between the Phase I Participants' Conception of Role Envisioned as Mathematics Teacher and the Participants' Most Advanced Level of Mathematics Coursework Studied in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	2.24	2	1.12	1.73	0.19
Within Groups	16.79	26	0.64		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.08	2	0.04	0.06	0.93
Within Groups	16.71	27	0.61		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	1.75	2	0.87	1.74	0.19
Within Groups	13.61	27	0.50		
Total	15.36	29			

ANOVAs that were conducted to identify significant differences between the selected course level groups. For all three ANOVAs, at $p > .05$ there were no statistically significant differences in conception and range or roles envisioned as a Mathematics teacher by most advanced Mathematics course taken in high school (Table 21).

Means and standard deviations for plans to use curricular materials according to most advanced Mathematics course taken in high school were reported in Table 22. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by most advanced Mathematics course taken in high school.

Table 22

Descriptive Statistics for Phase I Participants' Plan to Use Curricular Materials According to the Participants' Most Advanced Level of Mathematics Coursework Studied in High School

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
Other	3	3.00	0.00	3	3
Pre-Calculus	14	2.71	0.61	1	3
AP Calculus AB	13	2.92	0.27	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
Other	3	1.00	0.00	1	1
Pre-Calculus	14	1.43	0.51	1	2
AP Calculus AB	13	1.15	0.37	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
Other	3	2.00	0.00	2	2
Pre-Calculus	14	1.86	0.77	1	3
AP Calculus AB	13	1.92	0.49	1	3
Total	30	1.90	0.60	1	3

Table 22 reported the number of participants' selection of the use of curricular materials based on their most advanced level of Mathematics coursework studied in high school. The mean value, standard deviation, maximum and minimum for the dependent

variable (plan to use curricular materials in the following order) were reported for each advanced level group.

Table 23 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the groups. For all three ANOVAs, at $p > .05$ there were no statistically significant differences in plans to use curricular materials by most advanced Mathematics course taken in high school (Table 23).

Table 23

ANOVAs Testing the Differences between Phase I Participants' Plan to Use Curricular Materials and the Participants' Most Advanced Level of Mathematics Coursework Studied in High School

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.38	2	0.19	0.90	0.41
Within Groups	5.78	27	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.74	2	0.37	1.96	0.16
Within Groups	5.12	27	0.19		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.06	2	0.03	0.07	0.92
Within Groups	10.63	27	0.39		
Total	10.70	29			

Relationship between the dependent variables and number of science courses completed in high school. Means and standard deviations for philosophy of Mathematics according to number of science courses were reported in Table 24. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by number of science courses category.

On the Mathematics Beliefs Survey (MBS) the Phase I participants (N = 30) had to check all of the science courses they had completed in high school (earth science, biology, chemistry, physics, AP physics B, AP physics C, AP biology, AP chemistry, AP environmental science, science research, others). A median splits was used to break the participants into two groups, 2-4 and 5-6 science courses. The explanation of how the participants were grouped by the number of science courses completed in high school was applied in Tables 24-29.

Table 24 reports the number of participants that selected their philosophy based on the number of science courses they completed in high school. The mean value, standard deviation, maximum and minimum for the dependent variable (philosophy of Mathematics) were reported for the two groups 2-4 and 5-6 science courses.

Table 25 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups 2-4 and 5-6 courses. The three ANOVAs were tested at $p > .05$. There were no statistically significant differences in philosophy of Mathematics by number of science courses category (Table 25).

Table 24

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to the Number of Science Courses Completed in High School

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Other	3	3.00	0.00	3	3
2-4 courses	24	1.75	0.67	1	3
5-6 courses	6	2.00	0.89	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
2-4 courses	24	2.33	0.70	1	3
5-6 courses	6	2.33	0.51	2	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
2-4 courses	24	1.92	0.97	1	3
5-6 courses	6	1.67	1.03	1	3
Total	30	1.87	0.97	1	3

Table 25

ANOVAs Testing the Differences between the Phase I Participant's Philosophy of Mathematics and the Number of Science Courses Completed in High School

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.30	1	0.30	0.57	0.45
Within Groups	14.50	28	0.51		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.00	1	0.00	0.00	1.00
Within Groups	12.66	28	0.45		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	0.30	1	0.30	0.30	0.58
Within Groups	27.16	28	0.97		
Total	27.46	29			

Means and standard deviations for conception and range of roles envisioned as a Mathematics teacher according to number of science courses are reported in Table 26. Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range of roles envisioned as a Mathematics teacher by number of science courses category. When participants with 5-6 courses ($M = 3.00$) were compared to those having 2-4 courses ($M = 2.26$) the former were more likely to believe that, Instructor placed the main emphasis on Mathematics skills mastery with correct performance, and was least important ($F(1, 27) = 4.27, p < .05$ (see Table 27). That was statistically significant (Table 27).

Table 26 reported the number of participants' conception of roles envisioned as Mathematics teachers based on the number of science courses they completed in high school. The mean value, standard deviation, maximum and minimum, for the dependent variable (conception of the types and range of roles) were reported for the two groups 2-4 and 5-6 number of science courses.

Table 27 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups 2-4 and 5-6 courses. For two of the three ANOVAs no statistical significance occurred (Explainer...and Facilitator...) at $p > .05$.

Means and standard deviations for plans to use curricular materials according to number of science courses were reported in Table 28. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by number of science courses category. There was one statistically significant

Table 26

Descriptive Statistics for Phase I Participants' Conception of Roles Envisioned as a Mathematics Teacher According to the Number of Science Courses Completed in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
2-4 courses	23	2.26	0.86	1	3
5-6 courses	6	3.00	0.00	3	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
2-4 courses	24	1.83	0.81	1	3
5-6 courses	6	1.67	0.51	1	2
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
2-4 courses	24	1.88	0.74	1	3
5-6 courses	6	1.33	0.51	1	2
Total	30	1.77	0.72	1	3

Table 27

ANOVAs Testing the Differences between Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher and the Number of Science Courses Completed in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	2.60	1	2.60	4.27	0.04
Within Groups	16.43	27	0.60		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.13	1	0.13	0.22	0.64
Within Groups	16.66	28	0.59		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	1.40	1	1.40	2.82	0.10
Within Groups	13.95	28	0.49		
Total	15.36	29			

Table 28

*Descriptive Statistics for Phase I Participants' Plans to Use Curricula Materials**According to the Number of Science Courses Completed in High School*

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
2-4 courses	24	2.88	0.44	1	3
5-6 courses	6	2.67	0.51	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
2-4 courses	24	1.33	0.48	1	2
5-6 courses	6	1.00	0.00	1	1
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
2-4 courses	24	1.79	0.58	1	3
5-6 courses	6	2.33	0.51	2	3
Total	30	1.90	0.60	1	3

difference in plans to use curricular materials by number of science courses category (see Table 29). Participants with 5-6 courses ($M = 2.33$) were more likely than those with 2-4 courses ($M = 1.79$) to rank the statement, "A teacher or school construction of the Mathematics curriculum" closer to second ($F(1, 28) = 4.24, p < .05$ (see Table 29).

Table 28 reported the number of participants' plans to use curricular materials based on the number of science courses they completed in high school. The mean value, standard deviation, maximum and minimum, for the dependent variable (plan to use curricular materials in the following order) were reported for the two groups, 2-4 and 5-6 science courses.

Table 29

ANOVA's Testing Differences between Participants' Plans to Use Curricular Materials and the Number of Science Courses Completed in High School

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.20	1	0.20	0.97	0.33
Within Groups	5.95	28	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.53	1	0.53	2.80	0.10
Within Groups	5.33	28	0.19		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	1.40	1	1.40	4.24	0.04
Within Groups	9.29	28	0.33		
Total	10.70	29			

Table 29 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 2-4 and 5-6 science courses. Two of the three ANOVAs conducted (a strict following of a text . . . and a modification of textbook . . .) were not statistically significant at $p > .05$.

Relationship between the dependent variables and number of applied

Mathematics courses (high school). Means and standard deviations for philosophy of Mathematics according to number of Mathematics classes were reported in Table 30. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by number of Mathematics courses category.

On the Mathematics Beliefs Survey (MBS), the phase I participants (N = 30) were asked to check all of the applied Mathematics courses they had completed in high school (engineering, graphic design, AP computer science, computer programming, AP economics, business, music, AP Psychology). A median split was used to break the participants into two groups, 0-1 and 2-7 applied Mathematics courses.

Table 30 reported the number of participants that selected their philosophy based on the number of applied Mathematics courses they completed in high school. The mean value, standard deviation, maximum and minimum for the dependent variable (philosophy of Mathematics) were reported for the two groups, 0-1 and 2-7 applied Mathematics courses.

Table 30

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to the Number of Mathematics Applied Mathematics Courses Completed in High School

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
0-1 applied Mathematics courses	21	1.86	0.72	1	3
2-7 applied Mathematics courses	9	1.67	0.70	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
0-1 applied Mathematics courses	21	2.38	0.66	1	3
2-7 applied Mathematics courses	9	2.22	0.66	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
0-1 applied Mathematics courses	21	1.76	0.94	1	3
2-7 applied Mathematics courses	9	2.11	1.05	1	3
Total	30	1.87	0.97	1	3

Table 31 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-7 courses. For all three ANOVAs, at the $p > .05$ level there were no statistically significant differences in philosophy of Mathematics.

Table 31

ANOVAs Testing Differences between Phase I Participants' Philosophy of Mathematics According to the Number of Mathematics Applied Mathematics Courses Completed in High School

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.22	1	0.22	0.43	0.45
Within Groups	14.57	28	0.52		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.15	1	0.15	0.35	1.00
Within Groups	12.50	28	0.44		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	0.76	1	0.76	0.80	0.58
Within Groups	26.69	28	0.95		
Total	27.46	29			

Means and standard deviations for conception and range of roles envisioned as a Mathematics teacher according to number of applied Mathematics courses the participants completed in high school were reported in Table 32. The mean value, standard deviation, maximum and minimum for the dependent variable (conceptions of

Table 32

Descriptive Statistics for Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to the Number of Applied Mathematics Courses Completed in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
0-1 applied Mathematics courses	21	2.19	0.87	1	3
2-7 applied Mathematics courses	8	3.00	0.00	3	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
0-1 applied Mathematics courses	21	1.90	0.83	1	3
2-7 applied Mathematics courses	9	1.56	0.52	1	2
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
0-1 applied Mathematics courses	21	1.90	0.76	1	3
2-7 applied Mathematics courses	9	1.44	0.52	1	2
Total	30	1.77	0.72	1	3

roles envisioned as a Mathematics teacher) was reported for groups with 0-1 and 2-7 applied Mathematics courses.

Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range or roles envisioned as a Mathematics teacher by number of applied Mathematics courses category. There was one statistically significant difference in conception and range or roles envisioned as a Mathematics teacher by number of applied Mathematics courses category (see Table 33).

Table 33

ANOVAs Testing the Differences between Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to the Number of Applied Mathematics Courses Completed in High School

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	3.79	1	3.79	6.72	0.01*
Within Groups	15.23	27	0.56		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.76	1	0.76	1.34	0.25
Within Groups	16.03	28	0.573		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	1.33	1	1.33	2.66	0.11
Within Groups	14.03	28	0.50		
Total	15.36	29			

Participants with 0-1 courses ($M = 2.19$) were less likely than those with 2-7 courses ($M = 3.00$) to believe that an instructor placing the main emphasis on Mathematics skills mastery with correct performance was least important ($F(1, 27) = 6.72, p < .05$ (see Table 33).

Table 33 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-7 applied Mathematics courses. Two of the three ANOVAs reached no statistical significance (Explainer . . . Facilitator) at $p > .05$.

Means and standard deviations for plans to use curricular materials according to number of applied Mathematics courses were reported in Table 34. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by number of applied Mathematics category. There was one statistically significant difference in plans to use curricular materials by number of applied Mathematics courses category (see Table 35). Participants with 2-7 courses ($M = 1.00$) were more likely than those with 0-1 courses ($M = 1.38$) to rank the statement, “Modification of the textbook approach, enriched with additional problems and activities,” closer to first ($F(1, 28) = 5.16, p < .05$ (see Table 35).

Table 34 reported the number of participants’ conceptions of proclivity to use curricular materials based on the number of applied Mathematics courses they completed in high school. The mean value, standard deviation, maximum and minimum for the dependent variable (conception of the roles envisioned of Mathematics teachers) was reported for applied Mathematics course as groups 0-1 and 2-7.

Table 35 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-7 applied Mathematics courses. Two of the three ANOVAs were not statistically significant at (A strict following of a text . . . A teacher or school construction. . .) $p > .05$.

Table 34

Descriptive Statistics for Phase I Participants' Plans to Use Curricular Materials According to the Number of Applied Mathematics Courses Completed in High School

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
0-1 applied Mathematics courses	21	2.81	0.51	1	3
2-7 applied Mathematics courses	9	2.89	0.33	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
0-1 applied Mathematics courses	21	1.38	0.49	1	2
2-7 applied Mathematics courses	9	1.00	0.00	1	1
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
0-1 applied Mathematics courses	21	1.81	0.68	1	3
2-7 applied Mathematics courses	9	2.11	0.33	2	3
Total	30	1.90	0.60	1	3

Table 35

ANOVAs Testing Differences between Phase I Participants' Plans to Use Curricular Materials and the Number of Applied Mathematics Courses Completed in High School

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.04	1	0.04	0.18	0.67
Within Groups	6.12	28	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.91	1	0.91	5.16	0.03*
Within Groups	4.95	28	0.17		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.57	1	0.57	1.58	0.21
Within Groups	10.12	28	0.36		
Total	10.70	29			

Relationship between the dependent variables and high school GPA. Means and standard deviations for philosophy of Mathematics according to high school GPA were reported in Table 36. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by number for high school GPA category.

Table 36

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to High School GPA

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Other	1	2.00		2	2
2.6 – 3.0	2	2.00	0.00	2	2
3.1 – 3.5	7	1.57	0.78	1	3
3.6 – 4.0	20	1.85	0.74	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
Other	1	1.00		1	1
2.6 – 3.0	2	3.00	0.00	3	3
3.1 – 3.5	7	2.29	0.48	2	3
3.6 – 4.0	20	2.35	0.67	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Other	1	3.00		3	3
2.6 – 3.0	2	1.00	0.00	1	1
3.1 – 3.5	7	2.14	1.06	1	3
3.6 – 4.0	20	1.80	0.95	1	3
Total	30	1.87	0.97	1	3

On the Mathematics Beliefs Survey, the Phase I participants ($N = 30$) were asked to select the range into which their high school GPA fell. The participants were grouped into the following GPA ranges; 2.6-3.0, 3.1-3.5, 3.6-4.0, and other. Table 36 reported the number of participants that selected the high school GPA range. The mean value, standard deviation, maximum and minimum, for the dependent variable (philosophy of Mathematics) were reported for the high school GPA groups.

Table 37 presented the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the high school GPA groups. For all three ANOVAs there was a $p > .05$. There were no statistically significant differences.

Table 37

ANOVAs Testing Differences between Phase I Participants' Philosophy of Mathematics According to High School GPA

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.536	3	0.179	0.32	0.80
Within Groups	14.26	26	0.54		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	2.68	3	0.89	2.33	0.09
Within Groups	9.97	26	0.38		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	3.41	3	1.13	1.22	0.31
Within Groups	24.05	26	0.92		
Total	27.46	29			

Means and standard deviations for conception and range of roles envisioned as a Mathematics teacher according to high school GPA were reported in Table 38. Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range of roles envisioned as a Mathematics teacher by high school GPA category. Table 38 reported the number (N) of participants in the high school GPA range. The mean value, standard deviation, maximum and minimum for the dependent variable (conception of the type and range of roles envisioned as a Mathematics teacher) were reported for the high school GPA groups.

Table 39 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the high school GPA groups. For two (Explainer . . . Facilitator) of the three ANOVAs $p > .05$. There was one statistically significant difference. Participants with a high school GPA of 3.6-4.0 ($M = 2.74$) were more likely than those with a GPA of 3.1 -3.5 ($M = 1.43$) to believe that “Instructor placing the main emphasis on Mathematics skills mastery with correct performance” was least important ($F(3, 25) = 8.54, p < .05$).

Means and standard deviations for plans to use curricular materials according to high school GPA were reported in Table 40. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by high school GPA category. There were no statistically significant differences in plans to use curricular materials by high school GPA category (see Table 41).

Table 38

Descriptive Statistics for Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to High School GPA

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Other	1	2.00		2	2
2.6 – 3.0	2	3.00	0.00	3	3
3.1 – 3.5	7	1.43	0.53	1	2
3.6 – 4.0	19	2.74	0.65	1	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Other	1	1.00		1	1
2.6 – 3.0	2	1.50	0.70	1	2
3.1 – 3.5	7	2.43	0.78	1	3
3.6 – 4.0	20	1.65	0.67	1	3
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
Other	1	3.00		3	3
2.6 – 3.0	2	1.50	0.70	1	2
3.1 – 3.5	7	2.14	0.90	1	3
3.6 – 4.0	20	1.60	0.59	1	3
Total	30	1.77	0.72	1	3

Table 39

*ANOVAs Testing Differences between Phase I Participants' Conceptions of Roles**Envisioned as Mathematics Teacher and Participants' High School GPA*

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	9.63	3	3.21	8.543	0.00*
Within Groups	9.39	25	0.37		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	4.03	3	1.34	2.74	0.06
Within Groups	12.76	26	0.491		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	3.21	3	1.07	2.28	0.10
Within Groups	12.15	26	0.46		
Total	15.30	29			

Table 40

*Descriptive Statistics for Phase I Participants' Plans to Use Curricular Materials**According to High School GPA*

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
Other	1	3.00		3	3
2.6 – 3.0	2	3.00	0.00	3	3
3.1 – 3.5	7	2.57	0.78	1	3
3.6 – 4.0	20	2.90	0.30	2	3
Total	30	2.83	0.46	1	3

Table 40 continues

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
Modification of the textbook approach, enriched with additional problems and activities.					
Other	1	1.00		1	1
2.6 – 3.0	2	1.50	0.70	1	2
3.1 – 3.5	7	1.57	0.53	1	2
3.6 – 4.0	20	1.15	0.36	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
Other	1	2.00		2	2
2.6 – 3.0	2	1.50	0.70	1	2
3.1 – 3.5	7	1.86	0.90	1	3
3.6 – 4.0	20	1.95	0.51	1	3
Total	30	1.90	0.60	1	3

Table 40 reported the number (N) of participants in the high school GPA range. The mean value, standard deviation, maximum and minimum, for the dependent variable (plan to use curricular materials in a certain order) were reported for the high school GPA groups.

Table 41 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the high school GPA groups. The three ANOVAs were tested at $p > .05$.

Table 41

ANOVAs Testing Differences between Phase I Participants' Plans to Use Curricular Materials and Participants' High School GPA

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.65	3	0.21	1.02	0.39
Within Groups	5.51	26	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	1.10	3	0.36	2.00	0.13
Within Groups	4.76	26	0.18		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.39	3	0.13	0.33	0.80
Within Groups	10.30	26	0.39		
Total	10.70	29			

Relationship between the dependent variables and number of

Mathematicscourses taken in college. Means and standard deviations for philosophy of Mathematics according to the number of Mathematics courses taken in college were reported in Table 42. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by number of Mathematics courses taken in college. There was one statistically significant difference in philosophy of Mathematics by number of Mathematics courses taken in college (see Table 43). More specifically, participants with 6-9 courses ($M = 1.50$) were more likely than those with 10-15 courses ($M = 2.06$) to believe strongest about the statement, "Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end" ($F(1, 28) = 5.31, p < .05$) (see Table 43).

Table 42

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to the Number of Mathematics Courses Studied in College

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
6-9 courses	14	1.50	0.51	1	2
10-15 courses	16	2.06	0.77	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
6-9 courses	14	2.36	0.63	1	3
10-15 courses	16	2.31	0.70	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
6-9 courses	14	2.14	1.02	1	3
10-15 courses	16	1.63	0.88	1	3
Total	30	1.87	0.97	1	3

On the Mathematics Beliefs Survey (MBS), the Phase I participants (N = 30) were asked to select all of the Mathematics courses they had studied in college (calculus I, II, III, IV, advanced calculus, linear algebra, college geometry, statistics, topology, logic, set theory, non-Euclidean geometry, number theory, computer science, others). The number of courses was tallied for each participant, including the specified others listed courses. A median split was used to break the participants into two groups, 6-9 and 10-15 college Mathematics courses. Table 42 reported the number of participants that selected their philosophy based on the number of Mathematics courses they studied in college. The mean value, standard deviation, maximum and minimum, for the dependent

Table 43

ANOVAs Testing Differences between Phase I Participants' Philosophy of Mathematics and the Number of Mathematics Courses Studied in College

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	2.36	1	2.36	5.31	0.02
Within Groups	12.43	28	0.44		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.01	1	0.01	0.03	0.85
Within Groups	12.65	28	0.45		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	2.00	1	2.00	2.20	0.14
Within Groups	25.46	28	0.90		
Total	27.46	29			

variable (philosophy of Mathematics) were reported for the two groups, 6-9 and 10-15 college Mathematics courses.

Table 43 showed the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 6-9 and 10-15 courses. For two (Mathematics is static . . . Mathematics is dynamic) of the three ANOVAs exceeded $p > .05$. There were no other statistically significant differences in philosophy of Mathematics by number of Mathematics courses taken in college.

Means and standard deviations for conception of the type and range or roles envisioned as a Mathematics teacher according to number of Mathematics courses

studied in college were reported in Table 44. The mean value, standard deviation, maximum and minimum regarding the dependent variable (conception of the type and range or roles envisioned as a Mathematics teacher) were reported for groups with 6-9 and 10-15 courses.

Table 44

Descriptive Statistics for Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to the Number of Mathematics Courses Studied in College

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
6-9 courses	14	2.07	0.91	1	3
10-15 courses	15	2.73	0.59	1	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
6-9 courses	14	2.07	0.82	1	3
10-15 courses	16	1.56	0.62	1	3
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
6-9 courses	14	1.86	0.77	1	3
10-15 courses	16	1.69	0.70	1	3
Total	30	1.77	0.72	1	3

Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range or roles envisioned as a Mathematics teacher by number of Mathematics courses taken in college. There was one statistically significant difference in conception and range or roles envisioned as a Mathematics

teacher by number of Mathematics courses taken in college (see Table 45). Participants with 6-9 courses ($M = 2.07$) were more likely than those with 10-15 courses ($M = 2.73$) to believe “Instructor placing the main emphasis on Mathematics skills mastery with correct performance” was moderately important ($F(1, 27) = 5.40, p < .05$) (see Table 45). There were no other statistically significant differences in conception and range or roles envisioned as a Mathematics teacher by number of Mathematics courses taken in college (see Table 45).

Table 45

ANOVAs Testing the Differences between Phase I Participants’ Conceptions of Roles Envisioned as a Mathematics Teacher and the Number of Mathematics Courses Studied in College

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	3.17	1	3.17	5.40	0.02
Within Groups	15.86	27	0.58		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	1.93	1	1.93	3.64	0.06
Within Groups	14.86	28	0.53		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	0.21	1	0.21	0.39	0.53
Within Groups	15.15	28	0.54		
Total	15.36	29			

Table 45 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 6-9 and 10-15 courses.

Means and standard deviations for plans to use curricular materials according to the number of Mathematics courses taken in college were reported in Table 46. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by number of Mathematics courses taken in college. Table 46 reported the number of participants under N based on the number of Mathematics courses they studied in college. The mean value, standard deviation, maximum and minimum, regarding the dependent variable (participants plan to use curricular materials in a following order) were reported for each group, 6-9 and 10-15 courses.

There was one statistically significant difference in philosophy of Mathematics by the number of Mathematics courses taken in college (see Table 47). Participants with 6-9 courses ($M = 1.50$) were less likely than those with 10-15 courses ($M = 1.06$) to rank, “Modification of the textbook approach, enriched with additional problems and activities” as first ($F(1, 28) = 9.01, p < .05$) (see Table 47). There were no other statistically significant differences in philosophy of Mathematics by number of Mathematics courses taken in college.

Table 46

Descriptive Statistics for Phase I Participants' Plans to Use Curricular Materials According to the Number of Mathematics Courses Studied in College

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
6-9 courses	14	2.79	0.57	1	3
10-15 courses	16	2.88	0.34	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
6-9 courses	14	1.50	0.51	1	2
10-15 courses	16	1.06	0.25	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
6-9 courses	14	1.71	0.72	1	3
10-15 courses	16	2.06	0.44	1	3
Total	30	1.90	0.60	1	3

Table 47

ANOVAs Testing the Differences between Phase I Participants' Plans to Use Curricular Materials and the Number of Mathematics Courses Studied in College

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.06	1	0.06	0.27	0.60
Within Groups	6.10	28	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	1.42	1	1.42	9.01	0.00
Within Groups	4.43	28	0.158		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.90	1	0.90	2.58	0.119
Within Groups	9.79	28	0.35		
Total	10.70	29			

Table 47 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 6-9 and 10-15 courses.

Relationship between the dependent variables and number of college science courses. Means and standard deviations for philosophy of Mathematics according to the number of college science courses completed were reported in Table 48. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by number of college science courses category.

Table 48

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to the Number of Science Courses Completed in College

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
0-1 college science courses	15	1.67	0.72	1	3
2-4 college science courses	15	1.93	0.70	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
0-1 college science courses	15	2.27	0.59	1	3
2-4 college science courses	15	2.40	0.73	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
0-1 college science courses	15	2.07	1.03	1	3
2-4 college science courses	15	1.67	0.90	1	3
Total	30	1.87	0.97	1	3

On the Mathematics Beliefs Survey (MBS), the Phase I participants (N = 30) were asked to select all of the science courses they had completed in college (Physics, Biology, Chemistry, Geology, Meteorology, Astronomy, Oceanography, Others). The number of courses was tallied for each participant, including the specified others listed courses. A median split was used to break the participants into two groups, 0-1 and 2-4 college science courses.

Table 48 reported the number of participants that selected their philosophy based on the number of science courses they studied in college. The mean value, standard deviation, maximum and minimum regarding the dependent variable (philosophy of Mathematics) were reported for the two groups, 0-1 and 2-4 science courses.

Table 49 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and percentages calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-4 courses. For the three ANOVAs the testing was at $p > .05$. There were no statistically significant differences in philosophy of Mathematics by number of college science courses category (see Table 49).

Means and standard deviations for conception of the types and range or roles envisioned as a Mathematics teacher according to the number of college science courses studied were reported in Table 50. It showed the number of participants' conception of the roles envisioned as a Mathematics teacher based on the number of science courses they studied in college. The mean value, standard deviation, maximum and minimum regarding the dependent variable (conception of roles envisioned as a Mathematics teacher) were reported for groups with 0-1 and 2-4 college science courses.

Table 49

ANOVAs Testing Differences between Phase I Participants' Philosophy of Mathematics and the Number of Science Courses Completed in College

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.53	1	0.53	1.04	0.31
Within Groups	14.26	28	0.51		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.13	1	0.13	0.29	0.59
Within Groups	12.53	28	0.44		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	1.20	1	1.20	1.29	0.26
Within Groups	26.26	28	0.93		
Total	27.46	29			

Table 50

Descriptive Statistics for Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to the Number of Science Courses Completed in College

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
0-1 college science courses	15	2.13	0.99	1	3
2-4 college science courses	14	2.71	0.46	2	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
0-1 college science courses	15	1.80	0.86	1	3
2-4 college science courses	15	1.80	0.67	1	3
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
0-1 college science courses	15	2.07	0.59	1	3
2-4 college science courses	15	1.47	0.74	1	3
Total	30	1.77	0.72	1	3

Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range of roles envisioned as a Mathematics teacher by number of college science courses category. There was one statistically significant difference in conception and range of roles envisioned as a Mathematics teacher by number of college science courses category (see Table 51). Participants with 0-1 courses ($M = 2.07$) were more likely than those with 2-7 courses ($M = 1.47$) to believe that “Facilitator emphasizing confident problem posing and solving” was moderately important ($F(1, 28) = 5.96, p < .05$) (see Table 51).

Table 51

ANOVAs Testing Differences between Phase I Participants' Conceptions of Roles Envisioned as a Mathematics Teachers and the Number of Science Courses Completed in College

Conception and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	2.44	1	2.444	3.97	0.05
Within Groups	16.59	27	0.614		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.00	1	0.00	0.00	1.00
Within Groups	16.80	28	0.60		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	2.70	1	2.70	5.96	0.02*
Within Groups	12.66	28	0.45		
Total	15.36	29			

Table 51 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and the level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-4 college science courses. The ANOVA as Instructor placing the main emphasis on Mathematics skills mastery was statistically significant at $p = .05$; the ANOVA as Explainer emphasized conceptual understanding.

Means and standard deviations for plans to use curricular materials according to number of college science courses were reported in Table 52. The mean value, standard deviation, maximum and minimum regarding the dependent variable (plan to use curriculum materials) were reported for the two groups, 0-1 and 2-4 college science courses.

Table 52

Descriptive Statistics for Phase I Participants' Plans to Use Curricular Materials According to the Number of College Science Courses Studied

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
0-1 college science courses	15	2.80	0.56	1	3
2-4 college science courses	15	2.87	0.35	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
0-1 college science courses	15	1.40	0.50	1	2
2-4 college science courses	15	1.13	0.35	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
0-1 college science courses	15	1.80	0.67	1	3
2-4 college science courses	15	2.00	0.53	1	3
Total	30	1.90	0.60	1	3

Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by college science courses category.

Table 53 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance calculated for the three ANOVAs that were conducted to identify significant differences between the two groups, 0-1 and 2-4 college science courses. For all three ANOVAs with $p > .05$ there were no statistically significant differences.

Table 53

ANOVAs for Participants' Plans to Use Curricular Materials According to the Number of Science Courses Completed in College

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.03	1	0.03	0.152	0.69
Within Groups	6.13	28	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.53	1	0.53	2.80	0.10
Within Groups	5.33	28	0.19		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.30	1	0.30	0.80	0.37
Within Groups	10.40	28	0.37		
Total	10.70	29			

Relationship between the dependent variables and Mathematics GPA. Means and standard deviations for philosophy of Mathematics according to Mathematics GPA

were reported in Table 54. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by Mathematics GPA category. On the Mathematics Beliefs Survey (MBS), the Phase I participants (N = 30) were asked to select the range into which their GPA for all of the Mathematics courses they had completed in college (3.6-4.0, 3.1-3.5, 2.6-3.0, 2.1-2.5, and below 2.0). It should be noted that the selected GPA range represented the participants' perceptions of their respective GPAs.

Table 54

Descriptive Statistics for Phase I Participants' Philosophy of Mathematics According to Participants' Mathematics GPA (College)

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
2.1 – 2.5	2	2.00	0.00	2	2
2.6 – 3.0	8	1.63	0.74	1	3
3.1 – 3.5	8	2.25	.70	1	3
3.6 – 4.0	12	1.58	0.66	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
2.1 – 2.5	2	2.00	1.41	1	3
2.6 – 3.0	8	2.38	0.51	2	3
3.1 – 3.5	8	2.13	0.83	1	3
3.6 – 4.0	12	2.50	0.52	2	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
2.1 – 2.5	2	2.00	1.41	1	3
2.6 – 3.0	8	2.00	1.06	1	3
3.1 – 3.5	8	1.63	0.91	1	3
3.6 – 4.0	12	1.92	0.99	1	3
Total	30	1.87	0.97	1	3

Table 54 reported the number of participants that selected their philosophy based on the GPA for all the college Mathematics courses they completed. The mean value, standard deviation, maximum and minimum, regarding the dependent variable (philosophy of Mathematics) were reported for the college Mathematics course GPA groups.

Table 55 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the college Mathematics GPA groups. For all three ANOVAs at the $p > .05$ there were no statistically significant differences.

Means and standard deviations for conception and range of roles envisioned as a Mathematics teacher according to Mathematics GPA were reported in Table 56. It showed the number of participants that selected conception of roles envisioned as Mathematics teachers based on their Mathematics course GPA they studied in college. The mean value, standard deviation, maximum and minimum regarding the dependent variable (conception of roles envisioned as Mathematics) were reported for the college Mathematics course GPA groups.

Table 57 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the college Mathematics GPA groups. For all three ANOVAs at $p > .05$ there were no significant differences.

Table 55

ANOVAs Testing Differences between Participants' Philosophy of Mathematics and College Mathematics Course GPA

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	2.50	3	0.83	1.76	0.17
Within Groups	12.29	26	0.47		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.91	3	0.30	0.67	0.57
Within Groups	11.75	26	0.45		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	0.67	3	0.22	0.21	0.88
Within Groups	26.79	26	1.03		
Total	27.46	29			

Table 56

Descriptive Statistics for Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to College Mathematics Course GPA

Conception and Range of Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
2.1 – 2.5	1	3.00		3	3
2.6 – 3.0	8	2.38	0.74	1	3
3.1 – 3.5	8	2.38	0.91	1	3
3.6 – 4.0	12	2.42	0.90	1	3
Total	29	2.41	0.82	1	3

Table 56 continues

Conception and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
2.1 – 2.5	2	1.00	0.00	1	1
2.6 – 3.0	8	1.75	0.88	1	3
3.1 – 3.5	8	1.50	0.75	1	3
3.6 – 4.0	12	2.17	0.57	1	3
Total	30	1.80	0.76	1	3
Facilitator emphasizing confident problem posing and solving.					
2.1 – 2.5	2	2.00	0.00	2	2
2.6 – 3.0	8	1.88	0.83	1	3
3.1 – 3.5	8	2.13	0.64	1	3
3.6 – 4.0	12	1.42	0.66	1	3
Total	30	1.77	0.72	1	3

Table 57

ANOVAs Testing Differences between Participants' Conceptions of Roles Envisioned as a Mathematics Teachers and College Mathematics Course GPA

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	0.368	3	0.12	0.16	0.91
Within Groups	18.667	25	0.74		
Total	19.034	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	3.633	3	1.21	2.39	0.09
Within Groups	13.167	26	0.50		
Total	16.800	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	2.700	3	0.90	1.84	0.16
Within Groups	12.667	26	0.48		
Total	15.367	29			

Means and standard deviations for plans to use curricular materials according to Mathematics GPA were reported in Table 58. Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by Mathematics GPA category.

Table 58

Descriptive Statistics for Participants' Plans to Use Curricular Materials According to College Mathematics Course GPA

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
2.1 – 2.5	2	3.00	0.00	3	3
2.6 – 3.0	8	2.63	0.74	1	3
3.1 – 3.5	8	2.88	0.35	2	3
3.6 – 4.0	12	2.92	0.28	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
2.1 – 2.5	2	1.00	0.00	1	1
2.6 – 3.0	8	1.25	0.46	1	2
3.1 – 3.5	8	1.25	0.46	1	2
3.6 – 4.0	12	1.33	0.49	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
2.1 – 2.5	2	2.00	0.00	2	2
2.6 – 3.0	8	2.13	0.64	1	3
3.1 – 3.5	8	1.88	0.64	1	3
3.6 – 4.0	12	1.75	0.62	1	3
Total	30	1.90	0.60	1	3

Table 59 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs, referenced above, that were conducted to identify significant differences between the college Mathematics GPA groups. For all three ANOVAs at $p > .05$ there were no statistically significant differences.

Table 59

ANOVAs Testing the Differences between for Participants' Plans to Use Curricular Materials According to College Mathematics Course GPA

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.50	3	0.16	0.76	0.52
Within Groups	5.66	26	0.21		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.20	3	0.06	0.30	0.82
Within Groups	5.66	26	0.21		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.70	3	0.23	0.60	0.61
Within Groups	10.00	26	0.38		
Total	10.70	29			

Relationship between the dependent variables and overall GPA. Means and standard deviations for philosophy of Mathematics according to overall GPA were reported in Table 60. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by overall GPA category.

Table 60

Descriptive Statistics for Participant's Philosophy of Mathematics According to Participants' overall College GPA

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
2.1 – 2.5	1	2.00		2	2
2.6 – 3.0	2	2.00	1.41	1	3
3.1 – 3.5	16	1.81	0.65	1	3
3.6 – 4.0	11	1.73	0.78	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
2.1 – 2.5	1	3.00		3	3
2.6 – 3.0	2	2.00	0.00	2	2
3.1 – 3.5	16	2.31	0.79	1	3
3.6 – 4.0	11	2.36	0.50	2	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
2.1 – 2.5	1	1.00		1	1
2.6 – 3.0	2	2.00	1.41	1	3
3.1 – 3.5	16	1.88	0.95	1	3
3.6 – 4.0	11	1.91	1.04	1	3
Total	30	1.87	0.97	1	3

On the Mathematics Beliefs Survey (MBS), the Phase I participants (N = 30) were asked to select the range into which their overall college GPA fell (3.6-4.0, 3.1-3.5, 2.6-3.0, 2.1-2.5, and below 2.0). It should be noted that the selected GPA range represented the participants' perception of their overall college GPA.

Table 60 reported the number of participants that selected their philosophy of Mathematics based on their overall GPA. The mean value, standard deviation, maximum

and minimum regarding the dependent variable (philosophy of Mathematics) were reported for the all of the overall college GPA groups.

Table 61 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the overall college GPA groups. For all three ANOVAs at the $p > .05$ there were no statistically significant differences.

Table 61

ANOVAs Testing Differences between Participant's Philosophy of Mathematics and Participants' Overall College GPA

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.181	3	0.06	0.10	0.95
Within Groups	14.61	26	0.56		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.68	3	0.22	0.49	0.68
Within Groups	11.98	26	0.46		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	0.80	3	0.26	0.26	0.85
Within Groups	26.65	26	1.02		
Total	27.46	29			

Means and standard deviations for conception and range or roles envisioned as a Mathematics teacher according to overall GPA were reported in Table 62. The mean value, standard deviation, maximum and minimum regarding the dependent variable (conceptions of roles) were reported for the all of the overall college GPA groups.

Table 62

Descriptive Statistics for Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to Overall GPA

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
2.1 – 2.5	0				
2.6 – 3.0	2	2.50	0.70	2	3
3.1 – 3.5	16	2.44	0.81	1	3
3.6 – 4.0	11	2.36	0.92	1	3
Total	29	2.41	0.82	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
2.1 – 2.5	1	1.00		1	1
2.6 – 3.0	2	1.00	0.00	1	1
3.1 – 3.5	16	1.69	0.70	1	3
3.6 – 4.0	11	2.18	0.75	1	3
Total	30	1.80	0.76	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
2.1 – 2.5	1	2.00		2	2
2.6 – 3.0	2	2.50	0.70	2	3
3.1 – 3.5	16	1.88	0.80	1	3
3.6 – 4.0	11	1.45	0.52	1	2
Total	30	1.77	0.72	1	3

Three ANOVAs were conducted to determine whether there were significant mean differences in conception and range or roles envisioned as a Mathematics teacher by overall GPA category. There were no statistically significant differences at the $p > .05$ level in conception and range or roles envisioned as a Mathematics teacher by overall GPA category (see Table 63).

Table 63

ANOVAs Testing Differences between Participants' Conceptions of Roles Envisioned as a Mathematics Teacher and Participants' Overall College GPA

Conception and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	0.052	2	0.02	0.03	0.96
Within Groups	18.98	26	0.73		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	3.72	3	1.24	2.47	0.08
Within Groups	13.07	26	0.50		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	2.38	3	0.79	1.59	0.21
Within Groups	12.97	26	0.49		
Total	15.36	29			

The mean value, standard deviation, maximum and minimum regarding the dependent variable (conceptions of roles) were reported for the overall college GPA groups. Three ANOVAs were conducted to determine if significant mean differences existed between the overall college GPA groups on plans to use curricular materials. Table 64 reported the number of participants who planned to use curricular materials according to their overall GPA. That table contained information on the mean value, standard deviation, maximum and minimum regarding the dependent variable of philosophy of Mathematics.

Table 64

Descriptive Statistics for Participants' Plans to Use Curricular Materials According to Overall College GPA

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
2.1 – 2.5	1	3.00		3	3
2.6 – 3.0	2	3.00	0.00	3	3
3.1 – 3.5	16	2.75	0.57	1	3
3.6 – 4.0	11	2.91	0.30	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
2.1 – 2.5	1	1.00		1	1
2.6 – 3.0	2	1.00	0.00	1	1
3.1 – 3.5	16	1.31	0.47	1	2
3.6 – 4.0	11	1.27	0.46	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
2.1 – 2.5	1	2.00		2	2
2.6 – 3.0	2	2.00	0.00	2	2
3.1 – 3.5	16	1.94	0.68	1	3
3.6 – 4.0	11	1.82	0.60	1	3
Total	30	1.90	0.60	1	3

Table 65 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the overall college GPA groups. For all three ANOVAs at $p > .05$ there were no statistically significant differences.

Table 65

*ANOVAs Testing Differences between Participants' Plans to Use Curricular Materials**According to Overall College GPA*

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.25	3	0.080	0.37	0.77
Within Groups	5.90	26	0.220		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.24	3	0.080	0.38	0.76
Within Groups	5.61	26	0.216		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.12	3	0.04	0.10	0.95
Within Groups	10.57	26	0.40		
Total	10.70	29			

Relationship between the dependent variables and gender. Means and standard deviations for philosophy of Mathematics according to gender were reported in Table 66. Three ANOVAs were conducted to determine whether there were significant mean differences in philosophy of Mathematics by gender. There were no statistically significant differences in philosophy of Mathematics by gender (see Table 67).

On the Mathematics Beliefs Survey (MBS), the Phase I participants (N = 30) were asked to select their gender (male versus female). Table 67 reported the number of participants that selected their philosophy based their gender groups. The mean value, standard deviation, maximum and minimum, regarding the dependent variable (philosophy of Mathematics) were reported for the gender groups.

Table 66

Descriptive Statistics for Participants' Philosophy of Mathematics According to Gender

Philosophy of Mathematics	N	M	SD	Min	Max
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Male	16	1.69	0.70	1	3
Female	14	1.93	0.73	1	3
Total	30	1.80	0.71	1	3
Mathematics is a static but unified body of knowledge, discovered, not created.					
Male	16	2.25	0.68	1	3
Female	14	2.43	0.64	1	3
Total	30	2.33	0.66	1	3
Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.					
Male	16	2.06	0.99	1	3
Female	14	1.64	0.92	1	3
Total	30	1.87	0.97	1	3

Table 67

ANOVAs Testing Differences between Participants' Philosophy of Mathematics and Gender

Philosophy of Mathematics	SS	df	MS	F	p
Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.					
Between Groups	0.43	1	0.43	0.84	0.36
Within Groups	14.36	28	0.51		
Total	14.80	29			
Mathematics is a static but unified body of knowledge, discovered, not created.					
Between Groups	0.238	1	0.23	0.53	0.47
Within Groups	12.42	28	0.44		
Total	12.66	29			
Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.					
Between Groups	1.31	1	1.31	1.40	0.24
Within Groups	26.15	28	0.93		
Total	27.46	29			

Table 67 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs conducted to identify significant differences between the gender groups. For all three ANOVAs at $p > .05$ there were no statistically significant differences.

Table 68 reported the participants' conception of roles envisioned as a Mathematics teacher based on their gender. Presented is the mean value, standard deviation, maximum and minimum regarding the dependent variable (conception of roles envisioned as Mathematics teachers).

Table 68

Descriptive Statistics for Participants' Conceptions of Roles Envisioned as a Mathematics Teacher According to Gender

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	N	M	SD	Min	Max
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Male	15	2.40	0.910	1	3
Female	14	2.43	0.756	1	3
Total	29	2.41	0.825	1	3
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Male	16	1.69	0.704	1	3
Female	14	1.93	0.829	1	3
Total	30	1.80	0.761	1	3
Facilitator emphasizing confident problem posing and solving.					
Male	16	1.88	0.719	1	3
Female	14	1.64	0.745	1	3
Total	30	1.77	0.728	1	3

Table 69 reported the sum of the squares (SS), the degrees of freedom (df), the mean square (MS), the F-Ratio, and level of significance (p) calculated for the three ANOVAs that were conducted to identify significant differences between the gender groups. For all three ANOVAs at $p > .05$ there were no statistically significant differences.

Table 69

ANOVAs Testing Differences between Participants' Conceptions of Roles Envisioned as a Mathematics Teacher and Gender

Conception of the Type and Range or Roles Envisioned as a Mathematics Teacher	SS	df	MS	F	p
Instructor placing the main emphasis on Mathematics skills mastery with correct performance.					
Between Groups	0.00	1	0.00	0.00	0.92
Within Groups	19.02	27	0.70		
Total	19.03	28			
Explainer emphasizing conceptual understanding with unified knowledge of Mathematics.					
Between Groups	0.43	1	0.43	0.74	0.39
Within Groups	16.36	28	0.58		
Total	16.80	29			
Facilitator emphasizing confident problem posing and solving.					
Between Groups	0.40	1	0.40	0.75	0.39
Within Groups	14.96	28	0.53		
Total	15.36	29			

Means and standard deviations for plans to use curricular materials according to gender by GPA were reported in Table 70.

Table 70

Descriptive Statistics for Participants' Plans to Use Curricular Materials According to Gender

I plan to use curricular materials in the following order:	N	M	SD	Min	Max
A strict following of a text or scheme.					
Male	16	2.81	0.543	1	3
Female	14	2.86	0.36	2	3
Total	30	2.83	0.46	1	3
Modification of the textbook approach, enriched with additional problems and activities.					
Male	16	1.25	0.44	1	2
Female	14	1.29	0.46	1	2
Total	30	1.27	0.45	1	2
A teacher or school construction of the Mathematics curriculum.					
Male	16	1.94	0.57	1	3
Female	14	1.86	0.66	1	3
Total	30	1.90	0.60	1	3

Three ANOVAs were conducted to determine whether there were significant mean differences in plans to use curricular materials by gender. For all three ANOVAs at $p > .05$ there were no statistically significant differences (Table 71).

Summary of Quantitative Results

In response to research issues question #1: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?* ANOVAs were conducted for ten independent variables (see Tables 12-71) to learn if there were meaningful relationships between pre-service teachers' Mathematics education background and beliefs about Mathematics and Mathematics teaching. The analyses allowed for claiming there were statistically

Table 71

ANOVA s Testing Differences between Participants' Plans to Use Curricular Materials and Gender

I plan to use curricular materials in the following order:	SS	df	MS	F	p
A strict following of a text or scheme.					
Between Groups	0.01	1	0.01	0.06	0.79
Within Groups	6.15	28	0.22		
Total	6.16	29			
Modification of the textbook approach, enriched with additional problems and activities.					
Between Groups	0.01	1	0.01	0.04	0.83
Within Groups	5.85	28	0.20		
Total	5.86	29			
A teacher or school construction of the Mathematics curriculum.					
Between Groups	0.04	1	0.04	0.12	0.72
Within Groups	10.65	28	0.38		
Total	10.70	29			

significant differences in: philosophy of Mathematics, the role of the instructor, and the use of curricular materials by the number of Mathematics courses completed in college. How many Mathematics and science courses the participants took in college influenced their beliefs as follows:

1. Participants that had taken fewer college Mathematics courses (6-9) were more likely to believe strongest about the instrumentalist philosophy (Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end (Ernest,1989) than did persons who had taken more Mathematics courses (10-15). The level of statistical significance was $p < .05$.

2. Participants who completed fewer college Mathematics courses (6-9 versus 10-15) were more likely to believe that an instructor placing the main emphasis on Mathematics skills mastery with correct performance was moderately important.
3. Participants who had completed fewer college Mathematics courses (6-9 versus 10-15) were less likely to rank modification of the textbook approach, enriched with additional problems and activities, as a first choice.
4. Participants who had completed 0-1 instead of 2-7 college science courses were more likely to believe that the facilitator role of teaching was of moderate importance.

There were statistically significant differences in the dependent variables (role of a teacher, and curricular resources choices) that were influenced by the number of high school science courses and applied Mathematics courses the participants completed in high school and the respective high school GPA. The level of statistical significance was $p < .05$. Participants' beliefs were influenced by their high school background as follows:

1. Participants completing 5-6 high school science courses were more likely than those that completed 2-4 high school science courses to rank the "instructor" role as weakest.
2. Participants with 5-6 high school science courses were more likely than did those with 2-4 high school science courses to rank the statement "A teacher or school construction of the Mathematics curriculum" closer to second in importance.

3. Participants with 2-7 applied Mathematics courses were more likely to believe that the instructor placing the main emphasis on Mathematics skills as least important.
4. Participants with 2-7 applied Mathematics courses were more likely to rank the statement “Modification of the textbook approach, enriched with additional problems and activities” closer to first than did those with 0-1 applied Mathematics courses.
5. Participants with a high school GPA of 3.6-4.0 were more likely to believe that the role of “instructor” as a teacher was least important than did those with a high school GPA of 3.1-3.3.

The multivariate data analyses led to the decision that the most potent influence(s) on a person’s Mathematics beliefs, envisioned roles as a Mathematics teacher, and choice of curricular materials were the number of successfully completed experiences in college and high school Mathematics courses. The more college Mathematics courses completed, the less they believed in an instrumentalist style that was translated into considering themselves as instructors. Instead, there was evidence that participants with more Mathematics courses completed were apt to view embarking upon creation of relevant instructional materials as being of greater importance than adhering to a prescribed sequence of materials; and they embraced the role of being a Facilitator/Explainer.

The univariate results were used to confirm the same types of data (belief, social context, reflection), conduct ANOVAs in the multivariate analysis, and to support answers to the following research issue question#2: *To what extent do the same types of*

data (belief, social context, reflection) confirm each other? The results reported in Tables #5-11 were used to characterize the factors of autonomy (beliefs about Mathematics, reflection on the teaching practice, social constraints of school environment) for the Phase I participants (N = 30), and generalize about the autonomy factors (beliefs about Mathematics, how Mathematics is learned and best taught; reflection on the role of teaching; and behavior skills needed to navigate the social constraints of the school environment) of the pre-service secondary Mathematics teachers that were available to enter the profession in the fall, 2010. The results reported for the Mathematics Beliefs Survey (MBS), the Mathematics Learning Style profile (MLS), and Teaching Style Inventory were used to provide the demographic information about the participants, and to quantify their philosophy of Mathematics, conception of roles envisioned as Mathematics teachers, how they planned to use curricular materials, and how they believe Mathematics is learned.

The Phase I participants held moderate (46.7%) to strong (36.7%) beliefs about the Instrumentalist philosophy of Mathematics (Mathematics is an accumulation of facts, rules, and skills used in the pursuance of some external end), reflecting the traditional Mathematics programs in high schools. The participants exhibited all four Mathematics learning styles, with mastery (Mathematics is best learned procedurally; step-by-step) as the most frequent style. It should be noted that the percent of mastery dominant Mathematics learning style of the 30 participants (36.7%) was reflective of the general student population (Silver, Thomas, & Perini, 2008).

Mastery was the dominant teaching style of the 30 participants. It was characterized by having well-organized classroom environments with a highly structured

teacher. Such teachers considered student work as purposeful, and they emphasized the acquisition of skills and information. The Teacher Style Inventory (TSI) served as the primary information source for reaching that decision.

In reference to the role of teaching envisioned by the participants, it should be noted that over 80% of the Phase I participants favored the Explainer and Facilitator teaching roles on the Mathematics Beliefs Survey (MBS), yet over 65% of the participants' dominant teaching style was mastery. A master teaching style emphasized acquisition of skills akin to the role of an instructor. Mastery teaching style was inherent in the role of instructor in that mastery style teachers as instructors serve as the primary information source for their students.

The majority of the participants (60%) TTI TriMetrix talent questionnaire results identified compliant and steady behavior within the social context of the school environment. The Myers-Briggs Type Indicator supported the TTI TriMetrix results, indicating the majority of the participants were loyal, steadfast, attentive, and stable; i.e., they will support the current school social context.

Qualitative data was reported in the next chapter. In Chapter VI (Discussion), the findings from Chapter IV (Quantitative) and Chapter V (Qualitative) were presented; and toward the latter part of that chapter was a model showing how the two sets of data were integrated.

Chapter V

Qualitative Findings

Qualitative analysis was used to describe the process (level) of autonomy experienced by pre-service teachers who were purposely selected according to their Mathematics learning styles at pre- and post-student teaching. All participants in this phase of the study were volunteers, and respective perceptions of their pre- and post-student teaching experiences provided the researcher with the understanding of how the student teaching experiences had impacted their levels of autonomy regarding instructional practice.

The seven participants for Phase II (the qualitative phase) of this study were selected from the Phase I participant ($N = 30$) group. The criteria for selecting them was based on their: (a) respective beliefs about how Mathematics was learned and taught as identified by the dominant style score on the Mathematics Learning Styles Inventory (MLS), (b) gender, and (c) eligibility to be placed in a student teaching assignment for the fall, 2009.

The researcher intended to select eight Phase II participants, four male and four female candidates representing each of the four Mathematics learning styles (mastery, self-expressive, understanding, and interpersonal). However, there was a male to represent each Mathematics learning style, but no Phase I female with a dominant interpersonal learning style eligible to student teach in the fall, 2009. Notably, there were a limited number of female pre-service teachers engaged in this investigation. That topic, commented upon in the preceding chapter was addressed in the next chapter (Discussion).

Two one-hour interviews were conducted by the researcher with each participant; one prior to student teaching and the second interview conducted post-student teaching. The interview questions crafted for the pre-student teaching interview were developed on the basis of each participant's rationale for their decision to teach, their identification of the role of teaching attributes, Mathematics beliefs, perception of the school culture, and postsecondary preparation for student teaching. The post-interview questions were crafted on the basis of perceptions of their student teaching experiences, attributes of cooperating teachers and school culture, student teaching impact on instructional decisions, perceived impact of their student teaching experiences on future teaching practice, and outcomes from the student teaching experiences.

The pre- and post-interview questions are contained in Appendix B. Both sets of questions were sent to the participant two-weeks before each respective interview. Analysis of each interview, completed within two-weeks of an interview (including the transcriptions, intra-rater reliability, and the opportunity for each interviewee to audit the contents of a respective transcription) juxtaposed against the quantitative data from the surveys (Mathematics Beliefs Survey, Mathematics Learning Style Inventory, Teaching Style Inventory, TTI TriMetrix Talent questionnaire, Myers-Briggs Type Indicator), and yielded two sets of themes relating to the participants' level of autonomy (Tables A and B Appendix F).

To aid readers in understanding the qualitative analysis, the following definitions from Chapter I have been reiterated:

Autonomy—"The ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be

flexible in modifying their beliefs when faced with disconfirming evidence” (Cooney & Shealy, 1997, p. 88).

Beliefs—Teachers conceptions of the nature and meaning of Mathematics, and on their mental models of teaching and learning Mathematics (Thompson, 1992).

Mathematics Reform—Refers to two approaches (a) Individual: The individual cognitive practices and the current focus as to how learners actively incorporate information into an existing set of understandings, often referred to as constructivism; and (b) Social: View of Mathematics as a process of enculturation of a learner into the practices of an intellectual community (Stocks & Schofield, 1997).

Philosophy of Mathematics—Three conceptions of Mathematics proposed by Ernest (1989);

1. Problem solving view—Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product; a process of enquiry, and coming to know, not a finished product, for its results to remain open to revision (Mathematics Beliefs Survey item 14c);
2. Platonist view—Mathematics is a static unified body of knowledge, a crystalline realm of interconnecting structures and truths, bound together by filaments of logic and meaning. Mathematics is not discovered but created (Mathematics Beliefs Survey item 14b); and
3. Instrumentalist view—Mathematics is a set of unrelated but utilitarian rules and facts; an accumulation of facts, rules, and skills to be used in the pursuance of some external end (Mathematics Beliefs Survey item 14a).

Three mental models depicting teachers' conceptions of the type and range of teaching roles, actions and classroom activities associated with the teaching of Mathematics (Ernest, 1989):

1. Instructor—Skills mastery with correct performance. (Mathematics Beliefs Survey item 15a);
2. Explainer—Conceptual understanding with unified knowledge. (Mathematics Beliefs Survey item 15b);
3. Facilitator—Confident problem posing and solving. (Mathematics Beliefs Survey item 15c).

Reflection—The teacher's level of thought processes regarding self assessment, descriptions and commentaries about learning activities, and analysis of student work on what the teacher intended and whether the teacher's goals were achieved (Danielson, 2000).

Social Context—The opportunities and constraints of the student teaching setting and environment (Ernest, 1989; Jones, 1997).

In preparation for the later integration of the quantitative with the qualitative results, research issues questions #3 and #4 were addressed in this chapter:

Question # 3: To what extent did the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers' autonomy prior to and after their student teaching experiences?

Question #4: To what extent do the open-ended themes of qualitative analysis support and clarify the quantitative survey results?

- What similarities and differences exist across the levels of analysis?

- How do autonomy factors relate to pre-service teachers' perceptions of the practice of teaching?
- Do teachers restructure belief systems in practice?
- What factor (s) of pre-service teacher autonomy is (are) impacted the most by a student teaching experience?

This chapter was divided into three sections:

I. Presentation of the multiple case studies (seven) qualitative data results

included:

1. Artifacts that were used to support the data gleaned from the pre- and post-student teaching interviews were listed prior to the narrative text for each case study.
2. A narrative for each case that was divided into a : (a) Pre-Student Teaching discussion that addressed a participant's rationale for becoming a Mathematics teacher; perception of Mathematics beliefs, teaching role attributes, school culture, and preparation for student teaching by their post secondary institutions; and (b) Post-Student Teaching discussion that addressed a participant's student teaching assignment; perception of a participant's cooperating teacher's attributes, school culture, impact on their future teaching practice, and the outcomes of their respective student teaching experience.

II. Qualitative comparison of the participants with the same Mathematics

learning style (i.e., male and female mastery, understanding, self-expressive, and interpersonal learning style).

III. Cross case analysis of pre-student teaching and post-student teaching

qualitative data. Pre-student teaching—Rationale for teaching, Mathematics beliefs, role of teacher attributes, perceptions of school culture, and post-secondary preparation for student teaching (Table A, Appendix F) Post-student teaching – Perceptions of respective student teaching experiences, future impact of student teaching experiences on future practices, and outcomes of student teaching experiences (Table B, Appendix F)

A list of artifacts collected from each case study participant preceded the qualitative analysis for each case study. The artifacts included participant responses to the: *Mathematics Beliefs Survey* (MBS); *Mathematics Learning Style Inventory* (MLS) scores for each learning style (Mastery, Understanding, Self-Expressive, Interpersonal); *Teaching Style Inventory* (TSI) for each teaching style (Mastery, Understanding, Self-Expressive, Interpersonal); *TTI TriMetrix Talent questionnaire*(TTI)—Personal Skills Feedback (7 top), Personal Interests, Attitudes, and Values Feedback (3 top), and the Behavioral Feedback (3 top); *DISC* (Dominance, Influencing, Steadiness, Compliance scores; and the *Myers-Briggs Type Indicator* (MBTI)—represented the four domains [Attitude—Extraversion (E)/Introversion (I), Perception Function—Sensing (S)/Intuition (N), Judgment Function—Thinking (T)/Feeling (F), and Lifestyle—Judging (J)/Perceiving (P)].

Multiple Case Studies

Research question #3 (To what extent did the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers' autonomy prior to and after their student teaching experiences?) was addressed

in this section of the chapter. The artifacts data collected from the Phase I participants were used to support the qualitative results and were identified within the narrative of each participant's case study. The researcher noted convergence of the quantitative with the qualitative data and viewed it as "support," and it subsequently was embedded in the narrative relating to each case study.

Case Study 1: Mary

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (67), Understanding (58), Self-expressive (45), and Interpersonal (28). Mary's dominant (highest MLS) score in the Mathematics Learning Style Inventory was in Mastery (67), indicating that she wanted to learn practical information and procedures regarding her study of Mathematics. She liked Mathematics problems she had solved before, and that used a set of procedures to produce a single solution; and she approached problem solving in a step-by-step manner. Learning Mathematics was difficult when the Mathematics became too abstract for her when faced with open-ended problems; and she learned Mathematics best when instruction was focused on modeling new skills, practice, and feedback and coaching sessions (Silver et al., 2008).

Teaching Style Inventory (TSI) scores for: Mastery (58), Understanding (31), Self-expressive (11), and Interpersonal (26). Mary's dominant (highest TSI, Mastery = 58) score indicated that as an instructor she preferred to focus on clear outcomes (skills learned; projects completed), and demonstration of the acquisition of skills and information. In the role of teaching, Mary preferred to serve as the primary

information source and to give detailed directions to students for their learning activities (Silver et al., 2005).

Myers-Briggs Type Indicator (MBTI) dimensions ISTJ (Introvert, Sensing, Thinking, and Judging). Characterized as a “systematizer” by Champagne and Hogan (1979), Mary exhibited “... practical, orderly, matter-of-fact, logical, realistic, and dependable behavioral characteristics.”

Mathematics Beliefs Survey (MBS). Mary’s response to:

Item #2: “I really enjoy children and I think I always wanted to be a teacher.”

Item #9: College Mathematics Courses Completed: Calculus I, II,III, IV; Linear Algebra; Logic, Non-Euclidean Geometry; Applied Algebra.

Item #14:Philosophy of Mathematics—Platonic: Mathematics is a static but unified body of knowledge; discovered, not created.

Item #15:Role of Teacher-Explainer—Emphasizing conceptual understanding with unified knowledge of Mathematics.

Item #16:Use of Resources—Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Mary on the Mathematics Beliefs Survey and represented Mary’s: (a) rationale supporting her decision to teach (item #2); (b) list of the eight Mathematics courses she completed in college (item #9); (c) philosophy regarding Mathematics, Instrumentalist (item #14); (d) preferred role of teaching, Explainer (item #15); and (e) her preferred use of curricular materials (item #16).

TTI TriMetrix Personal Skills Feedback.

1. Accountability for Others—The ability to take responsibility for others’ actions.
2. Continuous Learning—The ability to take personal responsibility and action toward learning and implementing new ideas, methods and technologies.
3. Conflict Management—The ability to resolve different points of view constructively.
4. Problem Solving—The ability to identify key components of a problem to formulate a solution or solutions.
5. Empathetic Outlook—The capacity to perceive and understand the feelings and attitudes of others.
6. Developing Others—The ability to contribute to the growth and development of others.
7. Customer Focus—A commitment to customer satisfaction.

The above were Mary’s seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that “accountability for others” ranked as her top skills area and her major area of strength. The seven skills highlighted Mary’s well-developed capabilities and revealed where she was most effective when focusing her time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV).

1. Theoretical—Mary valued knowledge, continuing education and intellectual growth.

2. Social—Mary valued opportunities to be of service to others and contribute to the progress and well-being of society.
3. Individualistic/Political—Mary valued personal recognition, freedom and control over her own destiny and others.

The above represented Mary's top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix Talent questionnaire. The understanding was that those identified areas were what would motivate her to be successful on the job. Those values were important to Mary and needed to be satisfied through the nature of her work for personal reward (Bonnstetter & Suiter, 2008a).

TTI TriMetrix Behavioral Hierarchy.

1. Organized Workplace—Mary's strength resided in accurate recordkeeping and planning. Her successful performance depended on established systems and procedures, and was tied to careful organization of activities, tasks and projects.
2. Analysis of Data—Mary was able to analyze and challenge a large number of details, data, and facts prior to making decisions. In addition, she was able to accurately maintain those records for repeated examination.
3. Customer Related—Mary had a positive and constructive view of working with others and was able to successfully work with a wide range of people from diverse backgrounds to achieve "win-win" outcomes.

The above represented the top three (out of 8) phenomena necessary for Mary to experience job success and increased levels of personal satisfaction. They were best exemplars of her natural behaviors (Bonnstetter & Suiter, 2008c).

TTI TriMetrix Style Insights DISC (Dominance, Influence, Steadiness, Compliance) scores.

Adapted Behavior DISC scores: Dominance (D = 20), Influence (I = 20),
Steadiness(S = 91), Compliance (C = 85)

Natural Behavior DISC scores: Dominance (D = 13), Influence (I = 18),
Steadiness (S = 93) Compliance (C = 98)

The TTI TtiMetrix Style Insights (SI) measured four dimensions of Mary's behavior, i.e., how she : (a) responded to problems and challenges, Dominance (D); (b) influenced others to her point of view, Influence (I); (c) responded to the pace of the environment, Steadiness (S); and (d) responded to rules and procedures set by others, Compliance (C). This participant's scores in the four dimensions were quantified into two behavioral types: Adaptive behavior was defined as the identification of a person's responses to their environment, i.e., what behavior an individual believed they needed to exhibit in order to survive and succeed at the job; and, Natural was defined as the identification of an individual's basic behavior, i.e., the core, "the real you" (Bonnstetter & Suiter, 2004).

Mary's DISC scores were highest in Steadiness (S) and Compliance (C) behaviors for both her adaptive and natural behavior types. The adaptive behavior Steadiness (S = 91) score was higher than the Compliance (C = 85) score, indicating that she was determined to be "on course" with past procedures; but not at the expense of quality or with no regard for the expectations of others. Her natural behavior Compliance (C = 98) score was higher than the Steadiness (S = 93) score, and that indicated she was ready to adapt to respected systems and procedures, but was cautious and took time to assess

possible consequences. She was especially wary of making changes that could damage long-standing relationships and was contrary to deeply ingrained techniques and procedures (Bonnstetter & Suiter, 2004).

Pre-student teaching.

Rationale for decision to teach. Mary described herself as a “mature student,” deciding to enter teaching after starting a family. Previously, she had worked as an administrative assistant, studied computer science, and planned to become a computer programmer. When her children became of school age, she decided that the teaching practice afforded her more quality time to spend with her family. She claimed that she wanted to do “something important,” and her choice of teaching was based on a belief that teaching was an acceptable alternative to the “huge . . . corporate type commitment.” This participant listed her reason to pursue teaching secondary Mathematics on the Mathematics Beliefs Survey Item #2 as, “I really enjoy children and I think I always wanted to teach.”

The rationale Mary used for her decision to enter the teaching practice was supported by her TTI TriMetrix personal interests, attitudes, and values (PIAV) results; and led to the identification of “social” as one of her highest ranked personal values. This interviewee valued opportunities to be of service to others, and sought opportunities to contribute to the progress and well-being of society. Additional support for Mary’s rationale to become a teacher came from her TTI TriMetrix behavioral hierarchy trait that was customer related; she had a positive and constructive view of working with others. Mary’s narrative coincided with her Mathematics Beliefs Survey and TTI TriMetrix results as she valued teaching as something important to society.

The earlier comment on Mary's professional work in computer science was interpreted as meaning that she had recognized that computer programming had the "logical flow" of Mathematics, her first "love." Connecting her study of computer science to Mathematics was supported by her Mathematics Learning Style (MLS); a mastery style approach to problem solving because it had the same logical step-by-step approach to work activities. The TTI TriMetrix behavioral feedback analysis of data allowed for making the following deduction: Mary was "able to analyze and challenge a large number of details, data, and facts prior to making decisions." That was definitive support for her avowed passion for studying computer programming and Mathematics.

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included a teacher's conception of the nature and meaning of Mathematics, i.e., philosophy, and on their mental models of teaching and learning Mathematics, i.e., how an individual perceived how they best learn Mathematics; an individual's preference for types of problems they like to solve; how Mathematics instruction is presented to the individual; and the individual's perceived difficulties in learning Mathematics. Mary's beliefs were presented as her philosophy, how she believed that she best learns Mathematics, her preference for types of Mathematics problems she likes to solve, the delivery of instruction she perceived to help her better understand Mathematics, and difficulties she encountered learning Mathematics.

When asked to define Mathematics and formulate a philosophy of Mathematics, Mary considered it as the most difficult question in the interview. She said that, "Mathematics was a system of using numbers, logic, and spatial relationships;" and as her philosophy she considered Mathematics as a "tool of life." On the Mathematics

Beliefs Survey Item #14 she indicated her philosophy as being Platonic (Mathematics is a static but unified body of knowledge; discovered, not created), which was deemed as additional evidence supporting the definition and philosophy of Mathematics given during her interview (Mathematics was a system that used numbers, logic, and spatial relationships).

When asked how she best learned Mathematics, Mary explained that she used the index card method to memorize facts and procedures, i.e., placing theorems and proofs on the cards and keeping them separate from definitions. This interviewee said she needed to “work out problems” in order to understand Mathematics. When Mathematics problems were obscure, Mary claimed that she always referred back to the index cards she had created for each college Mathematics course she completed. Mary liked to refer to problems that had been solved before following set procedures. That was revealed when she said that when studying computer science issues she “loved just deciphering them and figuring them out, fixing them and then getting them to run. I thought it was the greatest thing.” Presumably her approach was to utilize protocols/procedures that had been employed previously and had yielded favorable outcomes. Her MLS mastery style supported the index card method for learning Mathematics; liking Mathematics problems that she had solved before and that used a set of procedures to produce a single solution. It was deemed to support her explanation of how she best learned Mathematics.

Mary’s preference for delivery of Mathematics instruction came from when she attended the college Mathematics lab where she would get individual help from doctoral Mathematics student tutors. She commented that lectures were not the best method of instruction for her to learn Mathematics. Her preference for how she needed to be taught

was supported by her mastery learning style, i.e., Mathematics students learned best when instruction was focused on modeling new skills, practice, and feedback and coaching sessions. This participant understood Mathematics best when it was presented as “methodical and well organized . . . [with] notes that made sense.”

Difficulties learning Mathematics occurred for Mary when the content was too abstract, such as theorems and proofs that she encountered during her college geometry course. Mary also reported that she could not connect the relevance of linear algebra to her life, and that non-Euclidean geometry and logic were difficult to understand due to their abstract nature. Mastery dominant style Mathematics learners “like problems that they have solved before and that use set procedures to produce a single solution.” The MLS Mastery profile supported Mary’s description of her difficulty when learning Mathematics became too abstract (Silver et al., 2008).

Role of teaching attributes. This participant stated that a good teacher’s instructional attributes included being methodical and well-organized. For example, Mary said that calculus was her favorite Mathematics course because she determined that it was applicable to real life situations. She adhered to the dominant teaching style (identified by the TSI) as Mastery; teachers maintain highly structured, well-organized classroom environments where “teachers serve as the primary information source and give detailed directions for student learning” (Silver et al., 2005, p. 4).

This participant identified the behavioral attributes of an excellent teacher as one whom: related to students; inspired students to learn; believed that students can learn Mathematics; made learning fun; respected the differences in students; and did not embarrass students. Good teaching, according to Mary, had to do with how a teacher

interacted with students; being warm and reinforcing. Her personal skills, as identified by the TTI TriMetrix (her ability to perceive and understand the feelings and attitudes of others, her ability to contribute to the growth and development of others, and a commitment to customer satisfaction) supported her description of a good teacher's behavioral attributes.

“Poor teaching” was described as teachers having given skill practice worksheets to students without an explanation on how the skills could be applied to real life situations. She claimed having observed a poor teacher who was concerned only with test scores, cracked politically incorrect jokes about disabled students, and did not know students' names. The poor teaching behavior Mary identified was supported by Mary's TTI TriMetrix results, i.e., her empathetic outlook toward others (capacity to perceive and understand the feelings and attitudes of others).

On the Mathematics Beliefs Survey (Item # 15), Mary selected Explainer (emphasizing conceptual understanding with unified knowledge of Mathematics) for her role as a Mathematics teacher. She explained that it was necessary to get students to believe they could learn Mathematics; getting them to the point where they were comfortable “doing the Mathematics” and could understand how it was relevant to life. Interestingly, she held the opinion that learning how to program a computer could enhance a student's reasoning and problem solving. This aspect of her interview was considered as important for supporting her desire to contribute to the growth and development of others, viz., her students.

This participant's comments about having integrated curricular resources into her lessons included alternative (to lectures and worksheets) instructional strategies (use of

algebra tiles, group project work) and the use of technology resources (interactive whiteboard, graphing calculators, Mathematics software) to plan lessons. These were viable approaches for teaching Mathematics, and she talked about the use of visual representation (drawing pictures) and manipulatives (physical objects to represent Mathematics concepts) as additional, useful vehicles for the teaching of Mathematics.

It was notable that this interviewee reported having had minor exposure to “a differentiated instructional strategy in her methods courses, and subsequently determined that it would be prudent to plan lessons based on students’ declared interests, especially on how Mathematics “fits into student lives.” Her expressed desire to craft instruction to meet the individual needs of her students was supported by her TTI TriMetrix personal skills—developing others (the ability to contribute to the growth and development of her students) and customer focus (her commitment to customer satisfaction).

In her college methods courses, Mary said that she was introduced to interactive whiteboard (e.g., SmartBoard) technology and the Geometers’ Sketchpad interactive Mathematics program, but confided she did not have the confidence to use those technologies as resources. She also expressed her curiosity about how the graphing calculator can be integrated with the interactive white board technology. Perhaps as a constructive criticism, she said that it would have been helpful to view the interactive whiteboard as an instructional tool and not shown as just “another version of a chalkboard.” She continued by saying that she was interested in journaling (writing to learn Mathematics), but was apprehensive about using that strategy because she had not seen it modeled. Mary indicated that she had a desire to learn new methods of

instruction, but was reluctant to try those new methods and technologies before she was comfortable with how to integrate them into her lessons.

The interviewee's desire to learn and her reluctance to try new instructional methods was supported by her: DISC natural behavior scores, which indicated she was ready to adapt systems and procedures (although cautiously), and she needed to take time to assess possible consequences, and she was wary of making change; TTI TriMetrix, which indicated the personal skill of continuous learning (her ability to take responsibility and action toward learning and implementing new ideas, methods and technologies); and the TTI TriMetrix theoretical (PIAV), which was interpreted to mean she valued knowledge, continuing education, and intellectual growth as it pertained to crafting her development of lessons (Bonnstetter & Suiter, 2004).

When discussing how she planned to reflect on her instruction, she liked the idea of "exit slips" as a means for assessing the effectiveness of a lesson. "Exit Slips" were used by teachers as a method of formative assessment. At the end of a lesson, teachers often provided students with a task they needed to complete before exiting the classroom and that showed understanding of the day's lesson. Collection of those slips would then serve as evidence of a teacher's instructional effectiveness. Mary failed to clarify how she would pre-assess students' knowledge of Mathematics prior to designing her lesson, however.

Perception of the school culture. When describing the school culture, Mary believed that younger students (elementary and middle school) were more receptive to a teacher's efforts when teaching Mathematics, and commented, "It's nice to get the feeling that people [students] want you there [middle school]." The aforementioned perception of

students as learners may have impacted Mary's preferred level of teaching to be at the middle school level because she believed them to be more receptive to a teacher's presence in the classroom. This was supported by her TTI TriMetrix individualistic/political (PIAV); valued personal recognition.

When asked to comment on the school climate (social constraints of the school environments), the interviewee said the "negative feeling" she experienced when entering a school probably resulted from students appearing uninterested in learning and presumably present because of a state law. Compounding that circumstance was that she suspected many such students considered school time to be a time where they could engage in social interactions and presumably enhance their personal social status. This interviewee claimed that such environments create a climate of "chaotic and rushed learning," and likely were a result of socioeconomic backgrounds—a "rich versus poor" dichotomy. Her TTI profile supported the relationship between personal skill and conflict management (ability to resolve different points of view constructively), and reflected her reservation about administrators needing to be proactive in supporting teachers in an effort to overcome an unsavory school climate.

Post-secondary preparation for student teaching. The interviewee was asked to elaborate on her preparation for the teaching practice by her post-secondary institution. Mary explained that one of the requirements of her college teaching methods class was to design and teach a lesson to high school students. The lesson she developed was on the application of modular arithmetic, and was taught to a high school Mathematics class. "Humiliating" was the term she used to describe her experience teaching that lesson. When viewing the videotape of her lesson it was realized that not one student asked a

question about the topic. Mary's concern about her performance was supported by her TTI TriMetrix personal skill of being accountable for others. The fact that there was no response to her lesson from her students contradicted her top skill and major strength of being accountable for her students' active responses to her lesson.

This participant said that "one of her deficiencies" was teaching geometry, especially theorems and proofs, and that was related to her acknowledged learning difficulties in abstract Mathematics courses. Mary had attended a Mathematics lab at her post-secondary institution in search of help with the abstract geometry concepts. She commented that the tutors (doctoral students) were operating at such a high level of Mathematics that they were not helpful in answering all of her geometry questions. The outcome from those perceived difficulties led her to lose interest in studying higher level Mathematics courses, like topology. Suggestions she offered were that it would be useful if there was a college-level course to help her, and others, learn abstract Mathematics concepts; and a methods course on how to teach the New York State secondary geometry curriculum, ("To see what the students were going to be presented with"). Her view was that high school geometry was "a lot of memorization." Mary's Mastery MLS supported the difficulty she was having with the abstract nature of her college geometry course, i.e., Mary experienced difficulty when the Mathematics becomes too abstract and when faced with open-ended problems, like proving geometric theorems that contain steps that cannot be memorized.

Besides her lack of confidence in teaching abstract Mathematics, Mary was "really anxious" about student teaching; fearing that she would "freeze" in front of the class. Interestingly, she voiced concerns that the curriculum for the high school

Mathematics courses she was going to teach had not been shared ahead of time (during the summer), and that prevented her from giving due diligence to the preparation of lessons. A special concern was that she worried about having an assignment that would require her to teach a high school geometry course.

Mary's DISC natural behavior scores supported her concern about performing as a teacher. Her DISC scores indicated that she is wary of making a change (teaching an unfamiliar geometry course), which is contrary to the deeply ingrained teaching techniques (mastery teaching style) with which she is comfortable and familiar. She had high S (Steadiness), and C (Compliance) in both her adaptive (S = 91, C = 85) and natural behaviors (S = 93, C = 98). Individuals with high S and C scores tended to be "alert and sensitive to: problems, controls, dangers, mistakes, errors, regulations, procedures, and disciplines" (Bonnstetter & Suiter, 2004, p. 123). Mary was alert and ready to adapt to respected systems and procedures (with caution), and needed time to assess possible consequence. Low I (Influence) and D (Dominance) scores were represented in Mary's adaptive (D = 20, I = 20) and natural (D = 13, I = 18) behaviors. Those scores allowed for saying that her emotions likely would be internalized and not displayed to others. The sequel would be that her emotional turmoil would be magnified if her standards were not met (Bonnstetter & Suiter, 2004).

Post student teaching. All pre-service teachers in New York State were required to complete two student teaching placements (one middle level and one high school level). There was no restriction as to where the pre-service teacher was placed first, i.e., either middle or high school level. Each student teaching placement was eight-weeks in length. In her first eight-week student teaching placement (September-October 2009),

Mary was assigned to teach grade 9 in a high school setting. The participant's college field placement supervisor, however, considered Mary's placement as middle school, despite the fact that the class was not in a middle school facility. Her responsibilities included teaching three integrated algebra inclusion classes, with each taught in an 80-minute block period. The 80-minute block schedule was considered challenging by Mary because she did not understand the rationale for block scheduling in a secondary public school. Three teachers were assigned to each inclusion class; the Mathematics cooperating teacher, Mary, and the special education teacher.

Mary reported that the student population of her first placement to consisted primarily of White middle class students. She believed that White middle class student populations exuded a positive school culture, where the educational needs of students were being addressed. The interviewee indicated that the tone of the school climate was "positive." The students that Mary taught were being prepared to take the New York State Integrated Algebra Regents exam in June, 2010. June, 2009 was the first time that the newly-revised New York State Education Department's (NYSED) Integrated Algebra Regents exam was administered.

In November, 2009, Mary began her second student teaching placement. It was in a different high school building, with a student population described by Mary to be of a lower socio-economic status, and mainly Hispanic. She was assigned to teach five geometry classes to 10th and 11th graders expected to take the New York State Geometry Regents exam in June, 2010. Mary taught two-and-a-half weeks of an abbreviated placement, and then left due to what was explained as irreconcilable differences with her cooperating teacher. This participant decided to leave her second placement because the

experience was riddled with many negative issues. Not only was Mary assigned to teach a geometry class (an uncomfortable teaching assignment for her), she found the students were more difficult to handle and “less active” compared to her first placement. Mary perceived that she was not welcomed by the high school faculty, and she commented that the high school staff was “usually complaining about the students.”

Perception of student teaching experience. “Disappointing” and “really wrecking” her confidence was how she described her overall student teaching experiences. She said it was disappointing that her first placement was not in a middle school setting, despite having expressed a desire to work in such an environment. The college field supervisor claimed that her placement in that 9th grade was a valid middle school placement, regardless of its physical location.

Due to the instructional structure of the inclusion class (initial student teaching assignment), this participant claimed that she never had the opportunity to take control and teach an entire lesson to the class. In the middle school she used her cooperating teacher’s lesson notes to prepare her lessons, did not say whether a formal lesson plan was required by the cooperating teacher, and that she was not required to align the lessons with the NYSED Mathematics Learning Standards.

Attributes of cooperating teachers and school culture. During the first student teaching placement, Mary reported the school social climate was friendly, supportive, and conducive to student learning. She believed that she had a good relationship working with the students, and that was what she enjoyed the most from the experience. Importantly, Mary was a first-time experience for her cooperating teacher, and that led to some apparent uncertainty related to the responsibilities of mentoring a student teacher.

Yet, the experience was reported as having been professional by both, and there were opportunities for Mary to watch and learn from her cooperating teacher.

“Mean” and “sadistic” were the descriptors used to describe the second placement cooperating teacher. Reportedly, that person was not forthcoming with support and guidance for planning instruction, and did not provide adequate professional interactions. Illustrative of Mary’s concerns was the cooperating teacher pointing her in the direction of the computer lab with the edict to “make this test for the unit.” Reportedly, the student teacher did not know how to use the test software, and thus was at a loss on how to proceed.

That cooperating teacher’s approach to how students learned geometry probably was constructivist; wanting students to come to their own conclusions about properties of geometric shapes. Perhaps that constructivist attitude was extended to Mary, since the cooperating teacher did not explain a rationale for how she should design the lesson that would provide students with an opportunity to discover the properties of quadrilaterals.

Classroom management at the second placement seemed controversial. Mary said there was much related to classroom discipline that was unfamiliar; the cooperating teacher offered her no assistance for working with what appeared to be an at-risk student population.

Student teaching impact on instructional decisions. The interviewee reported that the first placement for the NYSED Integrated Algebra Mathematics curriculum traditionally was taught by the lecture method; traditionally sequenced (number systems, order of operations, scientific notation, rates and proportion, percentages, monomials, polynomials). The manner for presenting that lesson, done by the three teachers in the

room was “a real back and forth thing . . . as you were teaching it was completely natural for someone else to chime in and say, ‘Oh, another way of thinking of this is.’” Mary said that if she faltered in delivering part of a lesson someone was there to help her. She claimed that her lessons were embellishments of her cooperating teachers’ lesson notes, but with detailed explanations. Mary was able to craft one “sort of cooperative” lesson she described as “playing games;” after which, as a group, students had to decide on the answer and present their answer on a whiteboard. However, Mary reported that the majority of the lessons she designed were based on what the cooperating teacher had developed. For example, Mary suggested to her cooperating teacher that she would like to use algebra tiles (manipulatives) as an activity to “fill up” the 80-minutes, but her cooperating teacher dissuaded Mary from using them. Mary described her cooperating teacher as “not too eager to try” to use manipulatives, i.e., the algebra tiles.

Mary was not able to identify the textbook used the integrated algebra inclusion class during her first placement, and said the accompanying teacher’s manual had been loaned to her by the cooperating teacher without clarification on how to use it as a resource. She was required to align her lessons with the New York State Mathematics Learning Standards as part of the college field requirement, but never had guidance from her cooperating teacher. Reportedly, the teacher’s manual was a good resource.

The cooperating teachers from the student teaching placements neither shared data about students (IEPs included), nor gave any information/modeling on how to pre-assess student knowledge. Of note was that she said she did not observe lessons designed to differentiate instruction, despite apparent differentiated learning abilities among the students.

During Mary's brief time in her second student teaching experience, the cooperating teacher asked her to develop two geometry lessons for learning the attributes of quadrilaterals. Mary designed the lessons; and subsequently reported that she introduced her first quadrilateral lesson with the properties of parallelograms, where she required students to use a graphic organizer. Her cooperating teacher instructed Mary to prevent the students' use of any of the algebraic formulas to find perimeter and area of quadrilaterals until the students were familiar with properties of each specific quadrilateral (i.e., square, parallelogram, and trapezoid). Mary explained her concern that leaving the algebraic formula discussion to the end may confuse students as to the proper formula to solve perimeter and area problems for the appropriate quadrilaterals. Mary did not understand her cooperating teacher's rationale for leaving instruction about the algebraic formulas last. She commented that presenting the properties of the quadrilaterals first without the algebra formulas germane to each type of quadrilateral was "boring" to her, and that she didn't agree with it [the instructional decision].

This participant deferred to her cooperating teacher's edict and agreed to present the first lesson on quadrilaterals as addressing properties. On the day that Mary was to present her first lesson, her cooperating teacher was absent. The participant presented the lesson to the students as written. Mary noted that that particular lesson ended earlier than expected and she was left with extra instructional time. The participant made the instructional decision to use that time to introduce to the students the algebraic formulas, against the advice of her cooperating teacher. As a result of her decision, Mary's cooperating teacher berated her for having introduced the algebraic formulas instead of having had the students only explore the properties. What this participant believed to be a

great practice to “think on your feet” while in front of the class, her cooperating teacher considered to be insubordinate.

The cooperating teacher reportedly did not support the participant’s second attempt to develop a lesson using a creative strategy planned to integrate and address the properties of triangles with trapezoids. The cooperating teacher panned the participant’s second lesson, and chastised Mary for again straying from the original plan. She returned Mary’s lesson plans, filled with negative comments in the margins.

Regarding the use of curricular materials, the participant reported that her second placement cooperating teacher gave a copy of the geometry curriculum and a “grey” textbook as a resource, expecting her to plan a unit without any guidance on how to design a unit. The cooperating teacher, Mary reported, did not use the “grey” textbook because it proved “too difficult” for the students to understand, leaving worksheets as the only instructional resource.

Perceived impact on future teaching practice. Mary said that her student teaching experiences did not provide sufficient and adequate opportunities to accrue the confidence needed to hone her instructional skills needed to become a professional. She acknowledged that she did herself a disservice in her first placement by using the cooperating teacher’s lesson plans and not asking to go solo in front of the class. The participant expressed her enjoyment of being in front of a class, but commented that she never acquired the confidence to teach an entire lesson by herself prior to her second placement assignment.

Mary perceived the traditional routine of the Mathematics instruction in her first placement as a valid and effective way to teach Mathematics, and she would incorporate

the “traditional routine” in her future teaching practice. The traditional, status quo, Mathematical instruction supported Mary’s mastery style of teaching. The only critique that the participant’s first placement cooperating teacher offered was that Mary should work on her vocal inflections when speaking to the class. The cooperating teacher, who Mary described as having been in a continuous excited and animated state, suggested that Mary’s monotone low voice was not engaging her middle school students in the lesson. The participant accepted the critique about her voice as an acceptable recommendation.

In summary, Mary’s student teaching experience in both placements did not provide opportunities for her to observe and practice the alternative instructional methods she was introduced to in her college methods classes. Not observing a variety of instructional practices left Mary with only experiencing the traditional Mathematics teaching practices.

Outcomes of student teaching. Mary expressed concern about how her college had prepared her for the practice of teaching. Her view was that there needed to be more emphasis in several areas: on pedagogy and alternative instructional methods (and that these needed to be modeled for a pre-service teacher); on instructional methods for special needs and at-risk students; on the secondary Mathematics curriculum; and on instructional resources.

Mary was not clear in what she believed “Mathematics” to be. Mary was not afforded the opportunity to teach in a middle school setting. She taught grade nine in a high school setting and was disappointed that she could not experience a middle school environment.

Case Study 2 –Ursula

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (52);

Understanding (81); Self-expressive (42); Interpersonal (23). Ursula’s dominant (highest MLS) score in the Mathematics Learning Style Inventory (MLS) was in Understanding (81), indicating that she wanted to understand the “why” of the Mathematics she learned; she liked Mathematics problems that asked her to explain, prove, or take positions; and she approached problem solving by looking for patterns and identifying hidden questions. Learning Mathematics became difficult for her when there was a focus on the social environment of the classroom (e.g., on collaboration and cooperative problem solving; and, she learned Mathematics best when she was challenged to think about a problem and explain her thinking) (Silver et al., 2008).

Teaching Style Inventory (TLI) scores for: Mastery (64); Understanding (34);

Self-expressive (12); Interpersonal (16). Ursula’s dominant (highest TSI, Mastery = 64) score indicated that as an instructor she preferred to focus on clear outcomes (skills learned, projects completed) and demonstration of the acquisition of skills and information. In the role of teaching, Ursula preferred to serve as the primary information source and to give detailed directions for student learning (Silver et al., 2005).

Myers-Briggs Type Indicator (MBTI) dimensions ISTJ (Interpersonal, Sensing, Thinking, and Judging). Characterized as a “systematizer” by Champagne and Hogan (1979). Ursula exhibited “practical, orderly, matter-of-fact, logical, realistic, and dependable” behavioral characteristics.

Mathematics Beliefs Survey (MBS). Ursula's response to:

Item #2—"I always loved Mathematics and I believe that I am a natural teacher."

Item #9—College Mathematics: Calculus I, II, III, Linear Algebra, College Geometry, Statistics, Set Theory, Computer Science.

Item #14—Philosophy of Mathematics: Instrumentalist—Mathematics is an accumulation of facts, rules, and skills to be used in the pursuance of some external end.

Item #15—Role of Teacher: Explainer—Emphasizing conceptual understanding with a unified knowledge of Mathematics.

Item # 16—Use of Resources: Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Ursula on the Mathematics Beliefs Survey and represented Ursula's: (a) rationale supporting her decision to teach (item #2); (b) list of the nine Mathematics courses she completed in college (item #9); (c) philosophy regarding Mathematics, Instrumentalist (item #14); (d) preferred role of teaching, Explainer (item #15); and (e) her preferred use of curricular materials (item #16).

TTI TriMetrix Personal Skills Feedback.

1. Leading Others—The ability to organize and motivate people to accomplish goals while creating a sense of order.
2. Objective Listening—The ability to make many points of view without bias.
3. Empathetic Outlook—The capacity to perceive and understand the feelings and attitudes of others.

4. Developing Others—The ability to contribute to the growth and development of others.
5. Teamwork—The ability to compromise with others to meet objectives.
6. Conflict Management—The ability to resolve different points of view constructively.
7. Customer Focus—A commitment to customer satisfaction.

The above were Ursula's seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that "leading others" ranked as her top skill area and her major strength. The seven skills highlighted Ursula's well-developed capabilities and revealed where she was most effective when focusing her time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV) Feedback.

1. Theoretical—Ursula values knowledge, continuing education, and intellectual growth.
2. Utilitarian/Economic—Ursula values practical accomplishment, results, and rewards for her investments, time, resources, and energy.
3. Individualistic/Political—Ursula values personal recognition, freedom, and control over her own destiny and others.

The above represented Ursula's top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix talent questionnaire. The understanding was that those identified areas were what would motivate her to be successful on the job. Those values were important to Ursula and needed to be satisfied through the nature of her work for personal reward (Bonnstetter & Suiter, 2008a).

behavioral types: Adaptive behavior was defined as the identification of a person's responses to their environment, i.e., what behavior an individual believed they needed to exhibit in order to survive and succeed at the job; and Natural was defined as the identification of an individual's basic behavior, i.e., the core, "the real you" (Bonnstetter & Suiter, 2004).

Ursula's DISC scores were highest in influence (I) behavior for both her adaptive and natural behavior types. The natural behavior (I = 86) score and her adaptive behavior (S = 85) score indicated that she tended to wear her "heart on her sleeve," and she harbored positive enthusiasm that can influence others to jump on her bandwagon. Having a high I profile indicated that she has a greater tendency to trust other people.

Further examination of Ursula's DISC scores revealed that the point spread between her natural I (86) and D (58) scores indicated a strong tendency for Ursula to enjoy communicating with people, with an awareness for the supportive strength they provided to succeed. The point spread indicated that Ursula convinced others and promoted her ideas in a friendly, talkative manner to achieve her goals.

Pre-student teaching.

Rationale for decision to teach. Ursula's decision to become a secondary Mathematics teacher was delayed due to her previous endeavors that included work in the insurance field and market research. Her first choice of those work situations ostensibly came about because she was a Mathematics major in college. Ursula did not find job satisfaction in the insurance field and left because she, "did statistics, but found it boring." Ursula's next professional endeavor was in the field of market research, for six-years. She found it interesting, but it seemed that she became the "go to" person on the

site to solve problems. The interviewee intimated that her job description did not provide for the aegis of solving colleagues' problems. Ursula regretted that she had not gone into a teacher preparation program directly after high school; "I should have just done it." The participant's lack of motivation to remain in the insurance field was supported by her TTI TriMetrix PIAV personal interests, attitudes, and values, i.e., Utilitarian/Economic. The insurance position did not support Ursula's values (practical accomplishment, results and rewards for her investments, time, resources, and energy). She needed to be satisfied by her job.

Ursula's response to the Mathematics Beliefs Survey (item #2) on why she decided to become a teacher was: "I always loved Mathematics and I believe that I am a natural teacher." She saw a connection between her avocation and an aerobics instructor; she was able to "teach" by connecting Mathematics to music. This participant said, during her pre-student teaching interview, that she saw herself as "good at explaining things to people." That observation of herself as an explainer was supported by the TTI TriMetrix, Personal Skills Feedback that identified "Developing Others" (the ability to contribute to the growth and development of others; developing appropriate time to training, coaching, and developing others) as one of her seven highest personal skills. Her success at teaching aerobics, her love for Mathematics, and her belief that she was a natural teacher was supported by the TTI TriMetrix Behavioral Hierarchy results, which indicated that frequent interactions with others and being customer oriented were the phenomena she needed to experience job success and personal satisfaction.

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included a teachers' conception of the nature and meaning of Mathematics, i.e.,

philosophy; of their mental models of teaching and learning Mathematics, i.e., how an individual perceives they best learn Mathematics; of individuals' preferences for types of problems they like to solve; of how Mathematics instruction is presented to the individual; and of the individual's perceived difficulties in learning Mathematics.

Ursula's beliefs were presented as her philosophy, how she believed that she best learned Mathematics, her preference for types of Mathematics problems she liked to solve, the delivery of instruction she perceived to help her better understand Mathematics, and difficulties she encountered learning Mathematics.

It was difficult for Ursula to answer the interview questions, "How do you define Mathematics?" and "What is your philosophy of Mathematics?" She defined Mathematics as the "study of numbers, like counting, measurements, logic, shapes," and explained that upper level Mathematics was connected to science and engineering, and basic Mathematics (below calculus) was connected to life and was vital for living. As her strongest philosophical view of Mathematics, Ursula selected on the Mathematics Beliefs Survey the instrumentalist philosophy, "Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end." The participant's instrumentalist view was representative of her second dominant MLS style, Mastery, evidenced by her wanting to learn Mathematics that is practical and procedural, i.e., Ursula's philosophy of Mathematics was supported by her Mastery (second dominant trait) MLS profile results.

Ursula's dominant MLS was Understanding, and that corroborated her explanation of how she best learned Mathematics. This participant commented that she learned best by first hearing an explanation, going home and reading the textbook, using

the author prompts to visualize what was going on with the problem, and then seeking the solution to the problem herself. The interviewee believed her passion for learning Mathematics superseded how she was taught Mathematics (mostly by lecture, K-16). She believed it took talent to “do” higher Mathematics; that classroom situations are a difficult place for learning Mathematics; and that Mathematics is better learned one-to-one. Her approach to how she best learned Mathematics (by herself and one-to-one) was supported by the MLS Understanding learning style, i.e., Mathematics learners want to understand why the Mathematics they learn worked and tend to experience difficulty when there was a focus on the social environment of the classroom, e.g., on collaboration and cooperative problem solving (Silver et al., 2008).

Role of teaching attributes. Ursula stated that students needed to like a teacher as a person before they liked the teacher as a teacher. “Gaining the respect of students” was identified by the interviewee as the most important attribute of a teacher’s role. That belief was corroborated by her highest ranked TTI TriMetrix Personal Skills, i.e., Leading Others, Empathetic Outlook, Objective Listening, and Customer Focus; and her TTI TriMetrix Behavioral Hierarchy phenomena, i.e., Frequent Interaction with Others; and being Customer Oriented (Bonnstetter & Suiter, 2008c). The participant believed that in order to gain student respect teachers needed to speak to students “with authority.” Her comment on the aforementioned attribute (speaking with authority) is supported by Ursula’s TSI dominant style, Mastery. Mastery style teachers serve as the primary information source, with discipline that is firm but fair (Silver et al., 2005).

To reach students that did not like Mathematics, Ursula believed an effective teacher needed to provide opportunities of how the use of concepts from the discipline

related to real-life situations. Her claim was that effective teachers made the learning “fun.” The interviewee perceived that Mathematics teachers needed to use interactive whiteboard technology and graphing calculators as effective tools for delivering instruction on how to graph equations, but she would first teach for the understanding of the Mathematics graphing concepts before having the students use any form of instructional technology. Ursula said that she did not support the idea of procedural teaching (step-by-step lecturing) as an attribute of an effective teacher, and did not envision herself as a lecturer. Instead she believed that her approach was to be an explainer and facilitator.

Ursula’s identification of the instructional attributes of effective teachers, i.e., providing real-life applications of Mathematics to support conceptual understanding, using technology to enhance student understanding of Mathematics concepts, and the primary role of a Mathematics teacher being an explainer was supported by her Mathematics Learning Style (MLS) dominant Understanding Style. Her choice of the role of “explainer” as the most important role was supported on the Mathematics Beliefs Survey (MBS item # 15). The interviewee’s dominant Understanding MLS was reflected by her identification of effective instructional attributes, i.e., perception of Mathematics problems she preferred (asking for explanation and proof) and how she learned best when she was challenged to think and explain her thinking (Silver et al., 2008).

Perception of the school culture. Ursula believed that the culture (e.g., faculty, staff, administrators, students, parents) of a school “should capture students’ interests.” She identified ongoing faculty collaboration as an important component of the school environment that increased the continuity of the school program and curriculum. The

participant considered the socio-economic make-up of the school community to be a determining factor of school culture. The interviewee perceived the students as not being aware of what was going on in the schools, and generalized that students were not connected to the school. The participant intimated that cloistering of courses, and students being told what they “have to learn” were responsible for student disconnection. The interviewee was not able to articulate how she believed school administrators impacted the school culture. Ursula’s idealized conception of a school culture being collaborative in nature was supported by her TTI TriMetrix Personal Skills results, i.e., Teamwork, Customer Focus; and her TTI TriMetrix Behavioral Hierarchy phenomena necessary for her to experience job satisfaction, i.e., Frequent Interaction with Others, Versatility, and being Customer Oriented (Bonnstetter & Suiter, 2008b, 2008c).

Post secondary preparation for student teaching. Graduate school was credited by Ursula as having helped her reconnect to her passion about learning Mathematics. In graduate school she was introduced to discovery learning strategies through a hands-on geometry experience, where she could “make shapes and figure out things herself.” The geometry course provided Ursula with a “fun,” hands-on foundation that contained “lots of proofs and analyses.” Ursula perceived that role playing classroom management issues in her methods classes prepared her for her practice. Ursula commented that her methods teacher was an “actual high school Mathematics teacher,” and attributed to her learning about the teaching practice to the methods classes. The interviewee’s perception of her Mathematics teaching methods preparation was supported by her MLS dominant learning style, Understanding, i.e., she learned best when she was challenged to think and explain her thinking; and her TTI TriMetrix PIAV feedback theoretical personal interest, i.e., she

valued knowledge, continuing education, and intellectual growth (Bonnstetter & Suiter, 2008a).

In her post-secondary preparation to student teach, Ursula had the opportunity to observe teachers in both low and high socio-economic districts. Based on her observations, she found, to her surprise, that the teachers in the lower economic bracket schools seemed to enjoy their jobs more. Ursula had the opportunity to observe at-risk students, and concluded that special needs students were not able to internalize Mathematics concepts of the curriculum taught in an integrated algebra class. The interviewee deduced her opinion as a result of the opportunity to teach algebra concepts in a one-on-one format with the special education students. Ursula intimated via her general education classroom observations that she did not see lecturing as good instructional practice for teaching algebra, but she was unable to articulate why she thought the special needs students were unable to grasp integrated algebra Mathematics concepts. The interviewee's discovery that teachers who taught in lower socio-economic school cultures had greater job satisfaction; and her concern for special needs students learning algebra was supported by her TTI TriMetrix Personal Skill feedback, i.e., Empathetic Outlook (her capacity to perceive and understand the feelings and attitudes of others) and Developing Others (her ability to contribute to the growth and development of others) (Bonnstetter & Suiter, 2008b).

Ursula hoped that her student teaching experience would give her more background on how to integrate different instructional methods into her teaching practice. The interviewee divulged her desire to craft discovery learning and hands-on lessons, but was "scared" because she never had any experience designing the aforementioned

instructional strategies. The participant was concerned that she did not know “how to be a teacher,” and was worried about “pulling off a lesson.” Ursula viewed the teaching practice as a huge responsibility and noted that she lacked confidence “to do this.” For example, she was not sure how the school day worked. The interviewee expressed high expectations that her student teaching experience would boost her confidence. To alleviate her perceived anxiety produced by her student teaching placement, Ursula had contacted her first placement cooperating teacher. The response of her cooperating teacher was that Ursula should start teaching the first day of the school year. Ursula was concerned about starting to teach the first day of classes without prior preparation help from her cooperating teacher. The result of the interviewee being proactive was increased anxiety.

Ursula’s DISC scores supported her concerns about student teaching. Ursula had a high I (Influence), and low S (Steadiness) in both her adaptive (I = 80, S = 41) and natural behaviors (I = 86, S = 11). As a high I, the results indicated that Ursula was optimistic and trusting, socially and verbally aggressive, and people oriented. As a low S, the results indicated that Ursula was expressive, eager, and pressure-oriented (Bonnstetter & Suiter, 2005). In summary, Ursula’s concern for how the student teaching practice was to proceed prompted her to contact her first placement cooperating teacher. The combined effect of a high I score and a low S score is a behavior that Ursula exhibited when she actively sought to communicate with her cooperating teacher.

Post-student teaching.

Assignment. A middle school with a diverse population (lower socio-economic white, black, Hispanic) was Ursula’s first student teaching placement. The interviewee

was responsible to teach an 8th grade program that ranged from inclusion (classes that contained mainstreamed special needs students) to honors classes. Ursula reported that she taught the entire program from day one of the school year. The classes at the middle school were taught in an 80 minute alternate day block schedule, i.e., the participant would meet her classes every other day for 80 minutes. The interviewee reported that in her middle school placement no technology resources were made available to her, i.e., she did not have access to an interactive whiteboard or access to the school Internet/Local Area Network (LAN).

Ursula described her second placement to be in an “affluent” high school. The interviewee’s second placement program assignment included teaching one 10th grade integrated algebra course, two 10th grade post integrated algebra classes (students who passed integrated algebra), and two 12th grade pre-calculus classes. There was only one class, the 10th grade integrated algebra, where students needed to be prepared to re-take the NYS Integrated Algebra Regents exam in June, 2010. Even though the class was small (10 students) Ursula experienced difficulty teaching the at-risk students that had failed the June, 2009 exam.

The participant explained that she was eased into teaching her program in the high school, i.e., she was able to observe her cooperating teacher before taking over the classes. However, Ursula reported that she had limited use of the school interactive whiteboards. In the second placement the students were “tracked,” giving the at-risk student only the opportunity to learn integrated algebra I, algebra II, and trigonometry. Ursula disagreed with her second placement Mathematics program that had the students taking NYSED Algebra II over two-years and not being able to study geometry.

Perception of student teaching experience. “Unnatural . . . disappointing . . . let down by the whole situation” were the words Ursula used to describe her overall student teaching experience. Ursula believed that the role of a cooperating teacher would be to mentor her, “somebody that she could bounce ideas off,” and teach her the ropes. She depicted her experience as being “pushed into the deep end and having to sink or swim.” Even though she was not able to develop and practice the varied instructional strategies she learned in her college methods classes, one positive outcome that Ursula believed she developed as a result of her experience was a sense of confidence that she could manage a classroom. She commented that the first placement impacted her confidence as an instructional practitioner, and she was reluctant to move onto the second placement. She wanted to quit after her first placement, but her college field supervisor was supportive in moving Ursula to a more collaborative second placement.

Cooperating teachers and school environment. Ursula noted that she felt isolated from the school culture in her first placement. She perceived that she was not considered a colleague by her cooperating teacher, and attributed this opinion to her cooperating teacher liking “newbies,” and not older student teachers, like her. The interviewee reported that the relationship with her first cooperating teacher was estranged from day one of her placement, and posited that the unwelcoming reaction of the faculty towards her came from comments made to the faculty by her cooperating teacher. Ursula described the middle school culture as having a “sense of community,” but she was not considered a member of that community. The participant reported that she ate lunch by herself in her room and the only contact she had with students, outside of class time, was when she invited students to come in for extra help during that lunchtime period. The

interviewee's isolation from the school culture was intensified when the cooperating teacher asked Ursula to discontinue the practice of inviting students for help during lunch. The participant reported the rationale given by the cooperating teacher to discontinue the review sessions was that this practice would not be supported after Ursula left.

The interviewee explained that having been able to observe daily teaching practice in a school setting was an important component of the student teaching experience. Ursula reported that she was not able to observe one middle school Mathematics class taught by her first cooperating teacher. To compound matters, Ursula reported that the cooperating teacher never stated what was expected from the interviewee for the eight-week student teaching assignment. At times, Ursula believed, she would have been better off if she was left alone to teach in the classroom without the presence of her cooperating teacher.

The second student teaching assignment provided a more comprehensive experience for Ursula. She considered her second placement to be a more supportive environment. The faculty was friendly, and her cooperating teacher was very receptive and supportive about Ursula's ideas about Mathematics instruction. Ursula was able to interact with the school faculty, and depicted the climate of the Mathematics department to be collaborative, where lessons and ideas about instruction (manipulatives, using textbooks as resources) were shared.

Ursula explained that she was very forthcoming about her bad first student teaching experience. The interviewee shared with her second placement how the first experience negatively impacted her confidence to teach, and reported that the high school

cooperating teacher was very supportive and understanding of the issues Ursula had to address in her first student teaching experience. The participant's cooperating teacher asked what goals Ursula needed to achieve as a result of student Mathematics in a high school setting.

The interviewee described the attributes of her second placement cooperating teacher as compassionate toward her students, "New Age" (begins each lesson with a poem), integrating hands-on instruction into her lessons, and a facilitator. Ursula noted that her high school student teaching experience provided her with opportunities where she observed the cooperating teacher teaching, eased into teaching the classes, experienced students doing hands-on activities, and gave her the ability to plan instruction. In contrast with the first cooperating teacher, who supplied the NYSED standards to be taught, the interviewee was concerned that her second placement cooperating teacher was not at all familiar with the NYSED Mathematics learning standards. Ursula was surprised that with such an affluent culture present in the second placement school that supported learning, her students did not do the homework assigned and the second placement cooperating teacher did not have a homework policy.

Impact on making instructional decisions. Ursula perceived the first placement to have a negative impact on her instructional decisions because the participant was never given any guidance by her first placement cooperating teacher on how to plan and develop lessons for the 80-minute block period. She also never had the opportunity to observe her cooperating teacher teach an 80-minute lesson. Due to the lack of instructional guidance from her cooperating teacher, Ursula decided to design two

procedural lessons that would be taught during one 80 minute period which required two different sets of worksheets for each 80-minute lesson.

When Ursula attempted to share her instructional ideas with the first placement cooperating teacher, the teacher would comment, “Nah, you can’t do that.” There was no rationale given by as to why or why not an instructional strategy would work. As a result of the lack of guidance, Ursula decided not to attempt to integrate any alternate methods of instruction she learned in her methods courses into her lessons. She believed that her cooperating teacher would “squash” her plans. For example, the participant wanted to do some project work with the students, but because she could not engage her cooperating teacher in a discussion about her ideas, Ursula decided not to execute project work plans. The interviewee attributed her cooperating teacher’s reluctance to use cooperative instructional methods to avoiding instruction that afforded students the opportunity to get out of their seats, do hands-on work, or discuss Mathematics. There was one instance that the cooperating teacher had no choice but to let Ursula teach a lesson (required by her college) that used the cooperative learning (structured lessons designed for students to work on Mathematics problems in groups) strategy. Ursula reported that she even had a difficult time convincing her first placement cooperating teacher that as part of the college requirement for student teachers the field supervisor had to observe and critique a cooperative lesson.

Ursula summed up the first placement cooperating teacher’s teaching style as, “Here’s my teaching, here’s my dittoes, and be quiet.” Curriculum for the Mathematics courses that Ursula taught was not provided by the cooperating teacher. Ursula wanted to spend more time in the lesson to get the students to understand the concepts, but her first

placement cooperating teacher repeatedly told her to “pick up the pace.” The participant reported that the cooperating teacher shared the NYSED Mathematics standards, on which Ursula was to base her daily lessons, the night before the lesson.

There were similarities experienced by Ursula in both placements. New York State assessment data and/or IEPs for her students were not shared with her. Differentiated instructional strategies were not implemented by the first placement cooperating teacher and the not correctly identified by the second placement cooperating teacher. And Mathematics course curriculums and rationales for the Mathematics program were not explained by either cooperating teacher.

Perceived impact on future teaching practice. Ursula described the one thing she learned from her student teaching experience: she was able to “define what kind of teacher she wanted to be.” The interviewee placed herself as somewhat between the styles of both cooperating teachers, i.e., the rigid and inflexible Mastery teaching style of the middle school cooperating teacher (first placement) and the laid back, Interpersonal teaching style of the high school cooperating teacher. Despite the two opposite styles of her teachers, Ursula reported that in both placements she enjoyed the opportunities of working one-to-one and doing group activities with the students.

Ursula embraced her second placement cooperating teacher’s philosophy about teaching Mathematics: “I used to be in love with Mathematics, trying to force it down their throats; but I realized that it is more important to get to know these kids and just give them what they need.” Ursula saw her second placement cooperating teacher as being able to engage students in bizarre ways, but decided that in her own practice she

would use more student engagement “hooks” (methods) that are related to the Mathematics curriculum.

The interviewee evaluated her overall teaching practice as being capable of articulating Mathematics skills and concepts at the student’s level and she considered herself a good explainer. However, she did not want a teaching position that had all low achieving, at-risk students that were not interested in learning, and had poor Mathematics skills. Ursula believed that she was not prepared at all by her student teaching experience to motivate the at-risk students.

Outcomes of student teaching. Pre-service preparation by Ursula’s post-secondary institution was considered adequate by Ursula for the Mathematics content area, but she believed that she was not taught “how to be a teacher.” The interviewee expressed confidence that she was competent answering students’ Mathematics content questions, but would have liked to learn more pedagogy. The participant would like to take a course that would familiarize her with curriculum development.

In her second placement, Ursula had to follow in the footsteps of another student teacher who was well-liked by the students; and believed that it was difficult for the students to transition to a second student teacher. She suggested that the college not place student teachers in a second placement back-to-back with another student teacher because it impacted her relationship with the students in the second placement.

Ursula reflected on her college professor’s statement, “As soon as a student teacher enters the cooperating school they are interviewing for a position.” She believed that if this was the professor’s philosophy about how she was learning how to learn, how would she get her questions about teaching answered? The participant believed that the

student teaching experience should not be “an interview setting,” but a place where pre-service teachers could have instructional methods modeled and afforded the opportunity for the student teacher to implement instructional methods and learn from their mistakes and successes. Utmost was the interviewee’s expectations of the cooperating teachers as mentors, and she regretted that she never saw her first placement cooperating teacher teach. Lack of performance expectations by the cooperating teachers and not having instruction modeled was the biggest surprise and disappointment for Ursula regarding her student teaching experience.

Case Study 3- Selma.

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (24), Understanding (52), Self-expressive (72), and Interpersonal (50). Selma’s dominant (highest MLS) score in the Mathematics Learning Style Inventory was in Self-Expressive (72), indicating that she wanted to use her imagination to explore Mathematical ideas. She liked Mathematics problems that were non-routine, project-like in nature, and allowed her to think outside the box; and she approached problem solving by visualizing the problem, generating possible solutions, and exploring the alternatives. Learning Mathematics was difficult when Mathematics instruction was focused on drill and practice and rote problem solving; and she learned Mathematics best when she was invited to use her imagination and engage in creative problem solving (Silver et al., 2008).

Teaching Style Inventory (TSI) scores for: Mastery (23), Understanding (39), Self-expressive (46), and Interpersonal (18). Selma’s dominant (highest TSI,

Mastery = 46) score indicated that as an instructor she: preferred to focus on encouraging students to explore their creative abilities; highly valued insights and imagination; would design lessons that revolved around discussions that generated possible outcomes; welcomed student curiosity, unique and interesting approaches to problem solving (Silver et al., 2005).

Myers-Briggs Type Indicator (MBTI) dimensions ISTJ/ESTJ (Introvert/Extrovert, Sensing, Thinking, and Judging). Selma's scores for the Introvert and Extrovert dimension were equal, indicating that she could exhibit two personality types. Her ISTJ dimensions characterized her as a "systematizer" and "doer" respectively by Champagne and Hogan (1979). Selma's personality type exhibited the behavioral characteristics of "practical, orderly, matter-of-fact, logical, realistic, and dependable" (systemizer); she "liked to organize and run activities and be involved in community activities" (doer).

Mathematics Beliefs Survey (MBS) Information.

Item #2—"I love Mathematics and enjoy being in the classroom."

Item #9—College Mathematics: calculus I, II, III, linear algebra, college geometry, statistics, non- Euclidean geometry, computer science, differential equations, real analysis, proof.

Item #14—Philosophy of Mathematics: Problem Solving—Mathematics is a continually expanding field of human creation and invention; a cultural product.

Item #15—Role of Teacher/Facilitator: Emphasizing confident problem posing and solving.

Item # 16—Use of Resources: Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Selma on the Mathematics Beliefs Survey and represented Selma's: (a) rationale supporting her decision to teach (item #2); (b) list of the 11 Mathematics courses she completed in college (item #9); (c) philosophy regarding Mathematics, Problem (item #14); (d) preferred role of teaching, Facilitator (item #15); and (e) her preferred use of curricular materials (item #16).

TTI TriMetrix Personal Skills Feedback.

1. Results Orientation—Selma's ability to initiate and sustain momentum without external stimulations.
2. Conceptual Thinking—Selma's ability to analyze hypothetical situations or abstract concepts to compile insight.
3. Interpersonal Skills—Selma's ability to interact with others in a positive manner.
4. Empathetic Outlook—Selma's capacity to perceive and understand the feelings and attitudes of others.
5. Goal Achievement—Selma's overall ability to set, pursue and attain achievable goals, regardless of obstacles or circumstances.
6. Decision Making—Selma's ability to analyze all aspects of a situation in order to gain thorough insight for making decisions.
7. Customer focus—Selma's commitment to customer satisfaction.

The above were Selma's seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that "results orientation" ranked as

her top skill area and her major strength. The seven skills highlighted Selma's well-developed capabilities, and revealed where she was most effective when focusing her time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV) Feedback.

1. Theoretical—Selma valued knowledge, continuing education, and intellectual growth.
2. Utilitarian/Economic—Selma valued practical accomplishment, results and rewards for her investments, time, resources, and energy.
3. Social—Selma had a passion to eliminate hate and conflict in the world, and to assist others.

The above represented Selma's top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix Talent questionnaire. The understanding was that those identified areas were what would motivate her to be successful on the job. Those values were important to Selma and needed to be satisfied through the nature of her work for personal reward (Bonnstetter & Suiter, 2008a).

TTI TriMetrix Behavioral Feedback.

1. Customer Oriented—Selma had a positive and constructive view of working with others, and she was able to successfully work with a wide range of people from diverse backgrounds to achieve “win-win” outcomes.
2. Frequent Interaction with Others—Selma had a strong people orientation, and she was able to deal with multiple interruptions on a continual basis; always maintaining a friendly interface with others.

3. Versatility—Selma was multi-talented, and easily adapted to change with a high level of optimism and “can do” orientation.

The above represented the top three (out of 8) phenomena necessary for Selma to experience job success and increased levels of personal satisfaction. They were the best exemplars of her natural behaviors (Bonnstetter & Suiter, 2008c).

TTI TriMetrix Style Insights DISC (Dominance, Influence, Steadiness, Compliance) scores.

Adapted Behavior DISC scores: Dominance (D = 29), Influence (I = 91),
Steadiness (S = 32), Compliance (C = 62).

Natural Behavior DISC scores: Dominance (D = 13), Influence (I = 86),
Steadiness (S = 82), Compliance (C = 51)

The TTI TriMetrix Style Insights (SI) measured four dimensions of Selma’s behavior: how she (a) responded to problems and challenges, Dominance (D); (b) influenced others to her point of view, Influence (I); (c) responded to the pace of the environment, Steadiness (S); and (d) responded to rules and procedures set by others, Compliance (C). This participant’s scores in the four dimensions are quantified into two behavioral types: Adaptive behavior was defined as the identification of a person’s responses to their environment, i.e., what behavior an individual believed they needed to exhibit in order to survive and succeed at the job; and Natural was defined as the identification of an individual’s basic behavior, i.e., the core, “the real you” (Bonnstetter & Suiter, 2004).

Selma’s DISC scores were highest in Influence (I) for both her adaptive (I = 91) and natural (I = 86) behavior types. Selma’s DISC [Adaptive D (29), I (91), S (32),

C (62) and Natural D (13), I (86), S (82), and C (51)] in both the adaptive and natural behaviors showed a high I and low D, supporting her optimism for implementing alternate methods of instruction (high I); and yet unsure and hesitant (low D) about the mechanics of timing a lesson (Bonnstetter & Suiter, 2004).

Lesson plan: Properties of exponents. Selma submitted a lesson plan, Properties of Exponents that she developed to teach her advanced 8th grade integrated algebra class in her second placement.

Pre-student teaching.

Rationale for decision to teach. Selma's recollection of "playing school" as a child was seminal in her decision to become a teacher. By high school, Selma's experiences in tutoring and teaching dance coupled with her love for Mathematics led to her decision to become a Mathematics teacher. Selma's response to why she wanted to become a secondary Mathematics teacher on the Mathematics Beliefs Survey (item #2) corroborated her explanation of why she decided to become a secondary Mathematics teacher, i.e., "I love Mathematics and enjoy being in a classroom."

While in high school, Selma volunteered to teach dance on Saturdays, and it was through that experience that Selma first considered herself as a role model for the students. Another realization that Selma gleaned from her volunteer dance teacher experience was that she preferred teaching high school age students. Her dance classes consisted of students ranging in age from 3-12 years old; and Selma realized the aforementioned K-8 grade age range was not her favorite age group.

Selma's TTI TriMetrix PIAV identified her interest in the Social (having a passion to eliminate hate and conflict in the world, and to assist others) as one of her

highest ranked personal interests that would be a motivation for her to become a successful teacher; and her TTI Behavioral Hierarchy results identified Customer Oriented (having a positive view of working with others) and Frequent Interaction with Others (a strong people orientation) as two of her highly ranked behavioral traits necessary for Selma to meet with personal satisfaction and job success.

After taking AP calculus in high school, Selma knew that she would like to teach higher level Mathematics courses to high school students. The interviewee attributed her decision to pursue teaching upper level Mathematics courses to her high school AP calculus teacher, whom she considered an excellent teacher. The TTI TriMetrix Personal Skill Goal Achievement (ability to set, pursue and obtain achievable goals) was ranked as one of Selma's well-developed capabilities; and supported her decision to teach upper level Mathematics. The participant's value of accruing knowledge and intellectual growth was evidenced by her TTI TriMetrix PIAV feedback Theoretical interest.

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included a teacher's conception of the nature and meaning of Mathematics, i.e., philosophy; their mental models of teaching and learning Mathematics, i.e., how an individual perceived they best learned Mathematics; an individuals' preference for types of problems they liked to solve; how Mathematics instruction was presented to the individual; and the individual's perceived difficulties in learning Mathematics. Selma's beliefs were presented as her philosophy, how she believed that she best learned Mathematics, her preference for types of Mathematics problems she like to solve, the delivery of instruction she perceived to help her better understand Mathematics, and difficulties she encountered learning Mathematics.

Selma expressed her difficulty in defining Mathematics. Her definition expressed what Mathematics “does,” as opposed to what she believed Mathematics “meant to her.” The interviewee perceived Mathematics as a subject that got a person to think abstractly about the world. Selma was able to articulate her philosophy of Mathematics as being “many different realms and logical steps that were an integral part of the daily life of society.” The participant’s narrative of her philosophy was supported by her selection of the Problem Solving view (a dynamic, continually expanding field of human creation and invention; a cultural product) on the Mathematics Beliefs Survey (item #14) as her strongest philosophy. The interviewee’s description of her philosophy was also supported by TTI TriMetrix Personal Skills Conceptual Thinking, i.e., her ability to analyze hypothetical situations or abstract concepts to compile insight (Bonnstetter & Suiter, 2008b).

Selma described that she best learned Mathematics by: drawing pictures to illustrate problems, collaboration and teaching someone Mathematics, and by solving problems. She believed that students learned Mathematics best when engaged in unique instructional methods, e.g., by creating portfolios, giving presentations, crafting posters, through project-based learning. Her description of how she learned Mathematics best was supported by scoring the highest in the Self-Expressive Mathematics Learning Style Inventory (MLS) and Teaching Style Inventory (TSI), i.e., she showed dominance in the Self-Expressive areas in both her preference for learning and teaching Mathematics. Selma exhibited the attributes of a self-expressive Mathematics learning style: liked Mathematics problems that are non-routine and project-like in nature; and her approach to problem-solving was by visualizing the problem, generating possible solutions, and

exploring among the alternatives (Silver et al., 2008). The interviewee's TSI Self-Expressive teacher supported her narrative proposing unique teaching methods, such as discussions around generating possibilities; and finding interesting connections; and by encouraging students to explore their creative abilities (Silver et al., 2005).

Role of teaching attributes. Selma identified the attributes of an excellent teacher as one whom: challenges students; is excited about teaching; enthusiastic; exhibits a sense of humor; has new ideas about instruction; provides a positive climate for learning; and engages students in learning. The interviewee characterized the role of an excellent classroom teacher as providing a variety of classroom instruction that puts the onus on the students constructing their own learning, i.e., holding a student-centered approach to instruction. The most important attribute of a teacher, deemed necessary by Selma, was to maintain a positive atmosphere where students want to come in and feel that they are encouraged and challenged, and, hopefully, want to excel and come back. The participant's narrative on the attributes of good teachers was supported by her selection of Facilitator (emphasizing confident problem posing and solving) on the Mathematics Beliefs Survey (MBS) as the most important role of teacher. The TTI TriMetrix Behavioral Hierarchy exemplars of the participant's natural behaviors, i.e., Customer Oriented (a positive and constructive view of working with others), Frequent Interaction with Others (a strong people orientation), and Versatility (easily adapting to change with a high level of "can do" orientation) necessary to job satisfaction were identified by Selma's prescribed attributes of a good teacher. Selma projected herself in the role of a secondary Mathematics teacher as getting excited about things that were Mathematics related, i.e., "bringing things into the classroom that are around us." She envisioned

herself doing a little bit of lecture style, doing group work, assigning project work, and providing skill drill and practice. The participant's vision encompassed all four Mathematics Learning Styles and Teaching Styles.

Selma identified the attributes of a poor teacher as: not giving students learning options, not being available to help students, not respected by the students, not part of the culture, and speaking "badly" about the students. The interviewee commented on the poor teaching in college as the "lecture and test" method. The participant expressed discontent for a "lecture," and not giving students options is supported by her: Self-Expressive MLS dominant style profile, i.e., Self-Expressive style Mathematics students experience difficulty when instruction is focused on drill and practice, and rote problem solving; and on her Self-Expressive TSI dominant teaching style, i.e., Self-Expressive teachers provide opportunities for discussion of Mathematics concepts that revolve around generating possibilities and finding new and interesting connections.

To engage unresponsive students, Selma believed that, as a teacher, she needed to create instruction that was open-ended, independent or group project work. The interviewee believed that a lot of students do not like Mathematics, and intuited the challenge of teaching as "getting students to sit there for forty minutes and not feel as if they are going to die." To hook students' interests the participant suggested connecting the learning to something that the students were good at, such as their interests. To access student interests, Selma suggested giving students options, like making a game board, creating a comic strip, writing a research paper, making a photo book, or creating a story about Mathematics. "Hooking student interest" supported Selma's choice of Facilitator as the most important role of a teacher.

Perception of the school culture. Selma believed that the school culture needed to be inviting to students. It had to give students the ability to be creative in learning Mathematics. She perceived the current school culture as “fragmented” and isolating at times; not always inviting students to explore ideas and be creative. The urban/suburban status of the school district factored into the interviewee’s perception of the school culture. Selma portrayed the city school environment with locked doors to be unsafe, as compared to suburban school environments. Her comments were based on her pre-student teaching school observations of the teaching practices that were required by her college teacher preparation program. “All students can learn Mathematics, but at different levels,” commented Selma; and a school “Should be able to provide a learning environment where students feel they have the ability to use their creativity and showcase their strengths as well as getting help in subjects that they struggle in.”

The interviewee posited that the school culture harbors students that get the lesson immediately and those that need one-to-one support, and believed that as long as students think they can learn and the teacher keeps on working with them, every student can do well. She believed that all school faculties need to be collaborative, and the school administration needed to be supportive of the school community and open to new ideas and resources.

In summary, the interviewee’s vision of a school culture was an environment where knowledge was valued, continuing education and intellectual growth was fostered, and conflicts were resolved. This vision was supported by her TTI TriMetrix PIAV Feedback Theoretical and Social interests. The environment described by Selma was supported by the TTI TriMetrix Behavioral Hierarchy as phenomena necessary to

experience job success and personal satisfaction, i.e., Customer Oriented, Frequent Interaction with Others, Versatility (Bonnstetter & Suiter, 2008c).

Postsecondary preparation for student teaching. Prior to student teaching, Selma had the opportunity to visit five different schools to observe teachers. She was required to spend 30-hours at an alternative middle school (40 at-risk students who were expelled from their home school) where she observed some days and taught a lesson other days. The interviewee spoke about a science teacher she observed in the alternative middle school who she perceived as able to engage the students, care about the students, gain the students' respect, and was interested in the content being taught. Selma posited, "If you could teach the at-risk students, then you could teach in a normal high school."

Selma praised her college methods classes as creative, and wished her high school Mathematics classes were taught that way. In her upcoming student teaching experience, the interviewee was concerned that she would have difficulty with time management in planning her lessons. The participant was "nervous" about how NYS Mathematics Regents requirements that required time to prepare students would impact the time needed to effectively deliver Mathematics instruction. Being a high school student as recently as four-years ago, Selma did not know how the intentions and ideas she learned in methods courses would be put to good use in traditional classrooms. She was hopeful, however, as she reflected on her favorite high school course, pre-calculus. She remembered that new ideas about Mathematics were introduced, and the course was not test-driven. The participant's DISC scores supported her concerns about her performance as a student teacher. In both the adaptive and natural behaviors, Selma had a high adaptive I (91) and natural I (86) and a low adaptive D (29) and natural D (13). This

supported her optimism for implementing alternate methods of instruction (high I), but yet unsure and hesitant (low D) about the mechanics of timing a lesson.

Post-student teaching.

Assignment. An urban high school was the first student teaching placement Selma described as having a lower socio-economic diverse population (50% Black and 50% Hispanic) with a predominantly White faculty. The interviewee described her first placement assignment as integrated algebra and intermediate algebra courses with students ranging from freshman to seniors. Three of the participant's classes followed the inclusion model (mainstreaming special needs students with the general education), and two classes were bilingual (taught in English and a second language). Selma noted that each class was supported by three teachers: a cooperating teacher, an inclusion/bilingual teacher, and Selma as the student teacher.

An urban/suburban, predominantly white middle school served as Selma's second placement. The interviewee reported that a portion of the student population was bused in from the city. In that setting Selma taught 8th grade advanced Mathematics (NYSED Integrated Algebra) and a general NYSED 8th grade Mathematics course. Two of the participant's classes were based on the inclusion model. Resources, such as texts books and technology, were made available for Selma at the middle school. The participant identified the texts that were used for 8th grade students and her advanced Mathematics classes in her second placement. The advanced class used the tradition Holt Algebra text.

Perception of student teaching experience. Selma perceived that her student teaching experience had exceeded her expectations. Not only did the interviewee perceive she had a professional relationship with both of her cooperating teachers, she reported

that she was observed by the principal and Mathematics coaches at both placements. Selma believed that the pre-planning sessions with her cooperating teachers and the Mathematics coaches were valuable, as well as the written feedback she received from the afore-mentioned evaluators regarding her instruction. The interviewee commented that teaching in school placements that were so diverse in culture (low socio-economic and affluent communities) created a rich learning environment; and that she learned a great deal about the teaching practice from both venues.

Attributes of cooperating teachers and school culture. Selma believed that both cooperating teachers were good about giving her the freedom to teach her classes; and reported that they were confident in her teaching ability. The interviewee perceived that her cooperating teachers: gave her useful information about her students' ability and readiness to learn; were forthcoming with their expectations of what they wanted from her regarding her student teaching; and provided constructive feedback about her teaching practice (i.e., she needed to wait for the students to get quiet before she began her lesson). Selma considered herself as having exhibited some similarities to both cooperating teachers (young, enthusiastic, student-oriented), but viewed their philosophies on learning as different; having attributed the difference to the type of students they were dealing with. Citing a low socioeconomic culture in the high school, Selma claimed that the discipline was a hard battle. How to make her expectations known to her students was a classroom management strategy that Selma attributed to learning from her cooperating teacher. Selma perceived that the students considered the second placement cooperating teacher as their favorite teacher. He was highly respected by his students, and they loved to come to class.

Selma compared the cultures in both placements and generalized that the faculties were collaborative. The interviewee reported that the faculties, as well as the Mathematics departments in both placements, worked well together; and the Mathematics coach was visible in both settings. The faculties in both placements were characterized by the participant as “young, White and all got along, were friendly and helped each other.” In her first placement, Selma reported that she and her cooperating teacher were only White persons in the classroom.

There were conflict issues among the student population that the interviewee identified. In her first placement, Selma expressed her frustration in getting to know her students; attributing it to her lack of understanding of student cultural differences, i.e., low socio-economic urban Hispanic and Black student populations. The interviewee’s first placement cooperating teacher shared the frustration, and stated that she could not help Selma learn about the cultures.

In contrast to the first placement, Selma perceived the primarily White middle class school culture of the second placement reflected the K-12 school district she attended; and that this was more conducive to education. The interviewee observed that the middle school students enjoyed school and were involved in sports and music. This supported her opinion. There were student conflict issues in the second placement. The interviewee reported that students were able to get along to a large degree outside of class with only minor incidences of bullying, and these were addressed by the guidance counselors. However, there were student conflict issues within her classes. The general education students in her inclusion class did not want to work with the special needs

students, which the interviewee found as difficult to motivate the two factions to work together.

Student teaching impact on making instructional decisions. Selma reported that the impact of her student teaching experience on her practice was evidenced in two areas—classroom management and developing instruction. In her first placement she reported that she was so focused on implementing classroom management strategies that she did not have the opportunity to implement the alternate instructional strategies that she studied in her college methods classes, i.e., she did not have the opportunity to plan differentiated lessons in her first placement.

Designing instruction for the inclusion classes was difficult for Selma. The interviewee attributed her difficulty to not being able to plan instruction for the “wide range” of student abilities in the inclusion classes, and she was not sure that she was “getting” to all her students. Even with the background (standard test data and IEPs) she could obtain about her students from the Mathematics supervisor, she was not able to use the data to develop effective instruction, especially with the at-risk students.

Selma saw the relationship between the students as different for each placement and perceived that with a diverse culture it was difficult to implement cooperative learning strategies and discovery learning. For example, Selma reported rifts between the Black and Hispanic students that extended into the classroom. She experienced a difficult time getting the two cultures to sit together and work on classroom Mathematics instructional tasks. Selma persevered and remarked that she was able to collaborate with the special education teacher assigned to the inclusion class (first placement) to create a BLUFF game, an interactive team game designed for students to present a solution to a

problem to the class and try to “bluff” the answers to the problem. It was up to the other team, described Selma, to decide if the solution to the problem was correct. Selma believed the game to be successful in that it engaged the students. However, when Selma attempted a constructivist lesson with the same class, she deemed the instructional attempt unsuccessful and considered the experience her “worst day ever.”

The interviewee reported that she was able to attempt more of a variety of teaching methods in her second placement, the middle school. The participant attributed the opportunity to implement alternative instructional strategies to the high motivation of her middle school students, especially the middle school students in the advanced Mathematics class.

Selma reported that she was able to use student readiness and ability to create differentiated instruction in the middle school for all student levels. For example, she created station work assignments, and designed constructivist (students constructing their own meaning of a Mathematics concept or skill) lessons. The participant submitted a constructivist lesson (see artifacts) that she developed for her 8th grade advanced students taking the NYSED Integrated Algebra Regents exam in June, 2010, which she identified as one of her most successful lessons. The students were able to construct their own understanding of the multiplication properties for exponents.

Only the advanced middle school Mathematics class experienced the interviewee’s constructivist lesson. Selma’s decision not to teach the constructivist lesson to her general 8th grade Mathematics classes was based on her belief that the students were not able to handle the constructivist approach, and they responded best to direct instruction. When asked by the researcher if Selma had considered using a constructivist

lesson with the high school at-risk students, the interviewee shared her belief that the high school students could not handle the constructivist lesson approach because they needed too much “hand holding;” and they did not care about their education. Another example of the participant’s reluctance to use alternative instructional methods for all levels of students (advanced, general education, at-risk) was evidenced in her beliefs about integrating algebra tiles (alternate method of instruction using manipulatives) into her lessons. Selma reported that she was able to successfully use algebra tiles with her students to teach them the distributive property. When she attempted the same lesson with her advanced students they did not like using the algebra tiles. Selma posited the rationale for the advanced students balking was attributed to the fact they were able to conceptualize without the use of manipulatives.

To summarize, the participant enjoyed teaching the advanced students in her second placement because she perceived them to be more motivated than regular level and at-risk students (the 8th grade Mathematics students and the at-risk high school students who needed hand holding and could not work independently). The students in the advanced class could work independently, and she believed that alternate instructional methods were not valid—based on student reaction, not instructional needs.

Perceived impact on future teaching practice. Selma perceived that in her first placement she did not get to practice content and teaching strategies, but learned more about classroom management. She concluded that she would have liked to have been prepared by her college on how to develop lessons for diverse cultural classrooms, and would have liked to have had a set of strategies that addressed how to teach bilingual classes. Selma believed that she was prepared for teaching the Mathematics content

needed to student teach, but would have liked her second placement cooperating teacher to explain how the Mathematics content was aligned with the Connected Mathematics Program (CMP), a standards based program.

The student teaching experience did not provide the opportunity for the participant to fully integrate and practice alternative instructional methods (e.g., cooperative group work, differentiate instruction, technology) in the instruction for all student levels. Selma believed that if she was ever to be assigned a classroom with low ability, unmotivated students she would provide more challenging problems and develop creative lessons designed to engage at-risk students. Selma posited that the at-risk students might be more engaged in learning Mathematics if she implemented alternate instruction strategies such as project-based instruction because the students would have had a better sense of achievement working on a project based on student interest. Regarding independent work (work done by students outside the lesson), Selma believed that she would be more strict in enforcing a homework policy.

Selma concluded that the urban school at-risk student population was not where she wanted to teacher. She liked the high school content, but perceived the students in urban schools to have poor skills and no motivation. If she were immersed in the aforementioned culture she did not believe at this point in her practice she could be an effective teacher. If she had her own class in the afore-mentioned culture Selma would make sure that the students became proficient in their basic Mathematics skills; and that she would create active lessons based on student interests.

Outcomes of student teaching. Selma lauded her college for preparing her to teach Mathematics content, but she wanted to learn more about instructional methods for

teaching students at-risk and standard based resources (i.e. Selma was not familiar with the CMP Mathematics resource). The interviewee suggested that there be training for future teachers in how to deliver the NYSED secondary Mathematics curriculum and use the new Mathematics resources (standard based textbooks) and technology (interactive whiteboards). The participant regretted that she was not trained in the interactive whiteboard technology; and that neither placement provided her with the opportunity to be introduced to the 21st Century instructional technologies or explained how to use standard based Mathematics textbook programs.

Case Study 4—Mark

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (79), Understanding (44), Self-expressive (34), Interpersonal (4). Mark's dominant (highest MLS) score in the Mathematics Learning Style Inventory (MLS) was in Mastery (79), indicating that he wanted to learn practical information and procedures regarding his study of Mathematics. He liked Mathematics problems he had solved before and that used a set of procedures to produce a single solution, and he approached problem solving in a step-by-step manner. Learning Mathematics was difficult when the Mathematics became too abstract for him when faced with open-ended problems. He learned Mathematics best when instruction was focused on modeling new skills, practice, feedback, and coaching sessions (Silver et al., 2008).

Teaching Style Inventory (TLI) scores for: Mastery (57), Understanding (23), Self-expressive (20), Interpersonal (26). Mark's dominant (highest TSI, Mastery = 57) score indicated that as an instructor he preferred to focus on clear outcomes (skills

learned; projects completed), and demonstration of the acquisition of skills and information. In the role of teaching, Mark preferred to serve as the primary information source and to give detailed directions for student learning (Silver et al., 2005).

Myers-Briggs Type Indicator (MBTI) dimensions INTP/INFP, (Introvert, Intuitive, Thinking/Feeling, and Perceiving). Mark's Myers-Briggs Type Indicator (MBTI) score was the same for the Thinking and Feeling dimensions that led the researcher to identify two MBTI personality types, "theorizer" (INTP) and "idealizer" (INFP). A "theorizer" tended to be quiet, logical, persevering, reserved, and interested in ideas. An "idealizer" tended to care about learning, ideas, was idealistic, committed, and adaptable, i.e., responding to the needs of others (Champagne & Hogan, 1979).

Mathematics Beliefs Survey (MBS). Mark's responses to:

Item #2—"I want to make a difference in the lives of people; I enjoy working with numbers."

Item #9—College Mathematics: calculus I, II, III, linear algebra, abstract algebra, college geometry, statistics, number theory.

Item #14—Philosophy of Mathematics: Instrumentalist—Mathematics is an accumulation of facts, rules, and skills to be used in the pursuance of some external end.

Item #15—Role of Teacher: Facilitator—Emphasizing confident problem solving.

Item # 16—Use of Resources: Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Mark on the Mathematics Beliefs Survey and represented Mark's: (a) rationale supporting his decision to teach (item #2); (b) list of the

eight Mathematics courses he completed in college (item #9); (c) philosophy regarding Mathematics, Instrumentalist (item #14); (d) preferred role of teaching, Facilitator (item #15); and (e) his preferred use of curricular materials (item#16).

TTI TriMetrix Personal Skills Feedback.

1. Empathetic Outlook—The capacity to perceive and understand the feelings and attitudes of others.
2. Customer Focus—A commitment to customer satisfaction.
3. Objective Listening—The ability to listen to many points of view without bias.
4. Conflict Management—The ability to resolve different points of view constructively.
5. Diplomacy and Tact—The ability to treat others fairly.
6. Developing Others—The ability to contribute to the growth and development of others.
7. Interpersonal Skills—The ability to interact with others in a positive manner.

The above were Mark’s seven top personal skills (out of 23) identified by the TTI TriMetrix Talent questionnaire (TTI). Of note was that “empathetic outlook” ranked as his top skill area and major strength. The seven skills highlighted Mark’s well-developed capabilities and revealed where he was most effective when focusing his time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV).

1. Traditional/Regulatory—Mark valued traditions inherent in social structure, regulations and principles.

2. Social—Mark valued opportunities to be of service to others and contribute to the progress and well-being of society.
3. Individualistic/Political—Mark valued personal recognition, freedom, and control over his own destiny and others.

The above represented Mark's top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix talent questionnaire. The understanding was those identified areas were what would motivate him to be successful on the job. Those values were important to Mark and needed to be satisfied through the nature of his work for personal reward (Bonnstetter & Suiter, 2008a).

TTI TriMetrix Behavioral Hierarchy.

1. Organized Workplace—Mark's strength resided in accurate recordkeeping and planning. His successful performance depended on established systems and procedures and was tied to careful organization of activities, tasks, and projects.
2. Analysis—Mark was able to analyze and challenge a large number of details, data, and facts prior to making decisions. In addition, Mark was able to accurately maintain those records for repeated examination.
3. Customer Related—Mark had a positive and constructive view of working with others and he was able to successfully work with a wide range of people from diverse backgrounds to achieve "win-win" outcomes.

The above represented the top three (out of 8) phenomena necessary for Mark to experience job success and increased levels of personal satisfaction. They were best exemplars of his natural behaviors (Bonnstetter & Suiter, 2008c).

Unit plan. Mark submitted a unit plan packet that he crafted for his high school geometry course.

Pre-student teaching.

Rationale for the decision to teach. Mark's decision to enter the teaching practice was based on his love of Mathematics and the process he used to vet his indecision to teach. The interviewee stated, "I always thought about possibly teaching, but I wasn't sure." After high school, the participant attended community college with the expectation that the post-secondary experience would help him decide whether to enter the sports management field or teach. Mark went to work for three-years after he received his Associate Degree in Liberal Arts, and then entered a four-year college to study Sports Management. He spoke of how he "really loved sports" as his motivation to return to college to study sports management. After his first semester, Mark decided that Sports Management was not what he wanted to do and he then entered the college teaching program. He commented on his decision, "I switched majors and went into Mathematics education because I thought that that was best for me." The participant believed that he chose Mathematics because he realized there was a connection between statistics and his love of sports. Besides teaching, Mark wanted the opportunity afforded by secondary teaching positions to coach a middle or high school baseball team. In response to the item #2 on the Mathematics Beliefs Survey (MBS), Mark wrote about his decision to become a secondary Mathematics teacher: "I want to make a difference in the lives of people, I enjoy working with numbers." The interviewee's TTI TriMetrix PIAV "Social" indicated that he was motivated to work in professions that valued opportunities to be of service to others and contribute to the progress and well-being of society.

Middle school was the level that Mark selected as his preference to teach. This decision was based on his belief that he could possibly serve as a role model for the younger (7th, 8th, and 9th grade) secondary students. The participant believed that middle school students were at a very impressionable age, and he wanted to “Help them out, and just help them succeed in life. That’s the reason I want secondary Mathematics.” The interviewee’s TTI TriMetrix PIAV Traditional/Regulatory and Individualistic/Political personal interest indicated that he was motivated to work in a profession that valued traditions inherent in social structure, regulations and principals; and personal recognitions, freedom, and control over his own destiny and others.

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included: A teacher’s conception of the nature and meaning of Mathematics, i.e., philosophy, and on their mental models of teaching and learning Mathematics, i.e., how an individual perceives they best learn Mathematics; an individual’s preference for types of problems they like to solve; how Mathematics instruction is presented to the individual; and the individual’s perceived difficulties in learning Mathematics. Mark’s beliefs were presented as his philosophy, how he believed that he best learned Mathematics, his preference for types of Mathematics problems he liked to solve, the delivery of instruction he perceived to help him better understand Mathematics, and difficulties he encountered learning Mathematics.

The interview question asking Mark for his definition of Mathematics was deemed by Mark as being the most difficult to answer. The interviewee defined Mathematics as “Working with numbers and applying numbers to everyday life.” The participant was asked several times during his interview to iterate his philosophy of

Mathematics, but was not able to articulate an answer. However, when given a choice of philosophies on the Mathematics Beliefs Survey (MBS) item #14, Mark was able to select Instrumentalist (an accumulation of facts, rules, and skills to be used in the pursuance of some external end) as his strongest view of his philosophy of Mathematics. Selecting Instrumentalist philosophy was supported by Mark's dominant Mastery Mathematics Learning Style (MLS). Mastery dominant Mathematics style students want to learn practical information and procedures and like problems that use set procedures to produce a single solution (external end).

Regarding how the interviewee learned Mathematics, he related the question to specific Mathematics courses he had completed in high school and college. Mark identified his favorite high school Mathematics course as algebra because it "made sense." He preferred to solve step-by-step strategically-focused problems, rather than abstract problems. The interviewee expressed his enjoyment in solving factual and practical Mathematics problems, and that the procedural process problem-solving would motivate him if he were to continue the study of Mathematics; and take more statistics courses. The participant explained that the abstract nature of his college calculus course caused him difficulty with understanding the calculus concepts. Besides liking problems that are solved using step-by-step procedures, the participant believed he learned Mathematics by talking to another person, trial and error, and problems that are modeled in a textbook. Mark's experience in learning calculus and problem preference was supported by his mastery Mathematics learning style, i.e., he had difficulty learning Mathematics when Mathematics became too abstract. He learned best when instruction

was focused on modeling new skills, practice, feedback, and coaching sessions (Silver et al., 2008).

Role of teaching attributes. Excellent teachers, as described by Mark, had the following attributes: they knew their content; made Mathematics interesting; and were able to get the material across to the students. When asked if Mark could identify an excellent Mathematics teacher he had in grades K-8 or college, he could not think of an example. The interviewee was able to give an example of a teacher who did not teach Mathematics, his high school history teacher, as having the afore-mentioned excellent teaching attributes. Mark believed that an effective teacher provided ways to practice Mathematics, which was the way he believed Mathematics was best learned. The participant agreed that there was not just one way to teach Mathematics, and that he would need to utilize different methods of instruction because “all students learn differently.” So, Mark said, “I am not going to preach what is the right way to learn to kids.” The participant’s focus on practicing skills as the best way to learn and teach Mathematics was supported by his dominant mastery learning (MLS) and teaching (TSI) styles, i.e., Mathematics is learned by practicing skills in a step-by-step manner and taught in highly structured, well-organized classrooms, where instruction emphasized the acquisition of skills (Silver et al., 2005; Silver et al., 2008).

In his the narrative, the interviewee identified Facilitator as the most important teaching role he strived to emulate. The rationale for selecting Facilitator was based on his pre-student teaching observations of classes where the facilitator role was modeled by middle school teachers. He selected Facilitator as the most important teacher’s role on the Mathematics Beliefs Survey (item #15). However, Mark was adamant that his students

would know that he was in charge of his classroom, and he would “set down rules and boundaries at the beginning of the school year.” Classroom control was evidenced in the attributes of a teacher with a dominant mastery teaching style (Mark) in the role as lecturer, whereas the Facilitator role lends itself to the Understanding teaching style, i.e., where time is provided by the teacher for students to do more independent study and the focus was on critical thinking intellectual challenges.

The interviewee was asked to elaborate on how he would design his daily lesson format. If he were to conduct a class, Mark described his role as a secondary Mathematics teacher where a typical day’s lesson in the classroom would have the following format: (a) go over homework, or topic material; (b) introduce new material and explain to the students “what” and “why it is;” (c) do some examples for the class; and (d) give students some time to work on problems that are like the example problem. Mark would walk around the classroom to see if students could answer the questions. The participant expected the students to use the independent time to do “a lot of exploration and experimenting on their own.” The interviewee described a procedural lesson that was indicative of his Mastery teaching style, i.e., a well-planned, clear and concise lesson format that was directed by the teacher.

To summarize, the participant agreed that all students were able to learn Mathematics, but with his added caveat, “depending on the ability level of student.” The interviewee believed that there existed basic Mathematics concepts and skills that all students needed to succeed in life. However, there was a dichotomy that existed in the participant’s seeing himself in the role of facilitator and his description of how he would manage his classroom and structure his daily lesson. To bring students to their full

potential for learning Mathematics, Mark believed that good teaching involved implementing a variety of instructional methods in a lesson—group work, students teaching each other, designing lessons based on student interests, and using intrinsic and extrinsic motivation. The interviewee posited that the facilitator was the most important role, but his narrative supported the lecture role as he described how he would manage his students and design instruction.

The dichotomy was evidenced by the participant's TTI TriMetrix Behavioral Hierarchy natural behaviors (exemplars necessary for Mark to experience job success and increased levels of personal satisfaction), i.e., Organized Workplace, where successful performance depended on established systems and procedures and was tied to careful organization of activities, tasks, and projects; and Customer Related, where having a constructive view of working with others and being able to work with a wide range of people from diverse background to achieve “win-win” outcomes (Bonnstetter & Suiter, 2008c).

Perception of the school culture. Mark described the school culture as providing a learning environment that was a “safe place [for students] to make mistakes;” a culture that would foster good teacher-student interactions. The participant perceived that teachers needed to be collaborative in order to improve instruction. Mark commented,

I definitely think that teachers should get together and talk about different experiences that they have in the classroom . . . different situations . . . and how to improve their teaching methods . . . or improve their students' time on task in the classroom and talk about different ways to improve the school environment and the students' learning environment.

The interviewee explained that not all schools had that same cultural environment, and attributed the different cultural environments as being determined by the geographic

location of the district. When asked about the role of the administration in a school environment, the participant could not answer the question because he did not have much contact with the administration when he observed public school teachers for his methods courses.

Mark viewed today's students as being different (ruder, not caring about education) from when he was in school, and believed the role of today's parents to be less supportive to education. Motivating students, Mark believed, was the greatest educational challenge to teachers of the 21st Century. Mark commented,

I definitely think the kids are more . . . I would say rude, ruder than . . . they come from a tougher family life, and they had tougher home life backgrounds . . . there is less parental support and . . . it seems like a lot of students don't seem to care anymore . . . I think that that's going to be one of the tough challenges [for teaching].

The interviewee's TTI TriMetrix PIAV Traditional/ Regulatory (valued traditions inherent to social structures) supported his concern for the shift in traditional values away from supporting education.

Preparation for student teaching. One-hundred hours of classroom observations were required by Mark's college as a pre-service Mathematics teacher. The interviewee commented that he saw mostly traditional lessons ("Do Nows," review of homework, introduction of a new topic, demonstrate problems, have students practice, and give homework), that he described as a procedural process. The participant remarked that he did not have the opportunity to observe a variety of instructional strategies modeled, other than seeing "some group work." The interviewee noted that he did observe classes of what he believed to be "poor teaching," where the teacher was teaching to the test, and "cramming" content into lessons. In some of the lessons he observed teachers integrating

technology (interactive whiteboards) into the classroom instruction. However, Mark did not have the opportunity to observe Mathematics lessons using the graphing calculators (germane to high school courses) because most of the lessons he observed took place in a middle school setting. The participant had no opportunity to review Mathematics resources (textbooks, manipulatives, and standards based Mathematics programs) in either his college methods classes or his field observations.

Mark's DISC scores supported his comfort with the school system's status quo traditional style and the traditional methods that he studied and observed. The interviewee did not express any concerns about his upcoming student teaching experience supporting his comfort in the traditional style of teaching that exists today. Mark scored a high S (Steadiness) and a low D (Dominance) for both his adaptive (S = 91, C = 62) and natural (S = 82, C = 75) behaviors respectively. High S scores indicated that Mark was loyal to those that he identified with, viz., the traditional school environment. Mark's low D supported his cooperative, low key nature and not being disgruntled with today's education profession; he feels comfortable. The combination of high S and low D supports Mark's stability when under pressure. As a result, it was not evident if the participant was flustered about the pressures of student teaching. When evaluated tighter, Mark's high S score and low I (SI) scores were indicative of his ability to focus and not be distracted for long periods of time. He has the ability to logically and systematically center all attention on current needs, with little concern for being liked by others (Bonnstetter & Suiter, 2004).

Post -student teaching.

Assignment. Mark's first student teaching placement was in an upper socio-economic middle school. The interviewee was assigned to teach a 7th grade Mathematics program. The Mathematics program was delivered in an alternate day 80-minute block schedule. Mark described the faculty as a little "stuck up;" some were personable and some were snobbish. He believed the Mathematics department generally was supportive. The participant perceived the overall climate of the middle school as "pretty supportive" to student learning, and attributed the collegiality to the positive relationship he developed with the school administration. The administration was favorable, open and praised this years' "crop" of student teachers.

The interviewee's second placement was in a low socio-economic, rural high school. Mark was assigned two geometry/trigonometry I courses (non-Regents) and two geometry/trigonometry II (non-Regents) courses. Mark's first impression of the students in his second placement was that they were "not happy to be in there," but he perceived the second placement school as very friendly.

Perception of student teaching experience. Mark perceived his student teaching to be a good experience, overall. He loved working with the students in both placements. The interviewee explained that the biggest challenge of his student teaching experience was designing instruction for 80-minute periods, something he said that he was not prepared to do. Mark described the structure of the 80-minute period as (a) starting off with a bell ringer (Do Now); (b) reviewing the problems from last night's homework; (c) delivering the lesson for the day; (d) practicing how to solve problems related to the day's lesson as a class together; (e) practicing similar problems relating to the day's

lesson individually, paired with another student, or in a group; and (f) then assigning homework. Mark perceived that students in the 80-minute block do 25-30 minutes of project work a day. . It should be noted that the participant's low tolerance to the block scheduling was supported by his TTI TriMetrix PIAV feedback that indicated that Mark valued traditions inherent in social structure, such as a school culture. The interviewee was more comfortable teaching in his second placement, which afforded him the opportunity to teach in 40-minute periods. The participant concluded that there was a big difference between the 40-minute and 80-minute blocks in developing lessons that kept students engaged for 80 minutes.

Mark was eased into teaching (did not teach right away, picking up classes one at time until he taught the entire program) and had the opportunity to observe his cooperating teachers in both of his assigned placements (middle and high school). The participant reported that the favorite aspect of both his student teaching experiences was his interaction with the students, but found that the paperwork needed to track students impacted his instructional preparation time.

Attributes of cooperating teachers and school culture. The interviewee commented that he was the first student teacher to be mentored by his first placement cooperating teacher. Mark reported that his first cooperating teacher was vague in defining her expectations of him as her student teacher. He would have liked to have had a little more feedback from her about his middle school teaching practice. However, the interviewee claimed he overlooked her vagueness and adjusted to her inexperience. "Overall, she did not do a bad job," commented Mark. By comparison with his first cooperating teacher, the participant rated his second cooperating teacher as "awesome,"

and considered her a seasoned mentor because she hosted other student teachers in the past. Overall, the participant reported that he had a good professional relationship with both of his cooperating teachers.

Mark believed that the students at both placements were friendly, and welcomed him. Mark felt that he was personable and had a good rapport with the students. He viewed the students as feeling safe and happy with him as their teacher.

Student teaching impact on instructional decisions. In both of Mark's placements it was school policy that instructional resources were to be in the form of packets created by the staff. It was a district decision not to use textbooks, but rather teacher created resources. As part of the participant's high school assignment he was responsible for creating resources for the courses he taught. Mark described how the packets were published as follows: the staff packets, once created, were shipped to BOCES to be duplicated, returned to the school, and distributed. The same packets were used for one course to ensure resource continuity. Consequently, Mark spent most of his time in his second placement creating packets for his lessons. Mark did not have to create packets for his middle school assignment, however; he was handed the packets for his first placement in the middle school. Therefore, Mark did not have the opportunity to develop instructional packets for his middle school lessons.

Creating packets as a lesson resource was a totally new experience for Mark. As an artifact, the participant submitted one of the "unit" packets that he created during his high school placement. The interviewee commented that he was told what unit he was to create and was given an outline of what to include as he crafted the "unit" packet. In creating the packet the participant did not have to experience the decision of what content

needed to be included. It was based on the curriculum content or on the structure of the resource learning tasks. Upon review of the researcher, the unit packet submitted by the participant was a collection of similar geometry problems regarding quadrilaterals, presented in a procedural style, i.e., all the problems were similar, with no “challenging” problems, and no reference as to how the content had real life application. To augment the unit packet, the interviewee claimed he used a Mathematics textbook he believed had clear concise definitions, and good problems and diagrams to develop his lessons. It should be noted that The NYSED Mathematics learning standards were not identified on the packets and not shared with the students. [ARTIFACT]

In the middle school placement Mark had more input into designing instruction and was able to use the interactive whiteboard as a technology tool (he played a “Jeopardy” game that he developed for students to play in groups) and to integrate video clips into his lessons. The interviewee commented that besides finding video clips useful in engaging students in a Mathematics lesson he also used websites to access other resources that he used to introduce topics. The participant described his best middle school lesson as a hands-on activity, where students used materials (colored paper, and string) to craft factor trees.

The interviewee was asked if he integrated any alternative instructional methods or strategies, and how he assessed his lessons. Mark commented that he did not have the opportunity to develop lessons using differentiated instruction strategies, and the only method he used to informally assessed students was by observing them working on activities. Data (state assessments) about the students was not shared with Mark at either placement.

Perceived impact on future teaching practice. Mark compared the 80-minute block schedule to 40-minute tradition period schedule and believed that the 80-minute periods were not suited for 7th graders. He based his opinion about the efficacy of the 80-minute period on his college field placement supervisor's statistic that 12- year-olds have the attention span of 13-minutes. The researcher inquired about the rationale of the district in using a block schedule for the 7th grade; and Mark commented that he could "kick" himself for not asking what the rationale was for the 7th grade in the middle school to be singled out as the only grade to have implemented a block schedule.

The interviewee decided that he would integrate teacher-created resource packets into his practice, and preferred the use of a textbook with the packets. Mark believed that he spent the majority of his time, "a lot of late nights and early mornings developing packets." Mark used three or four textbooks and online materials to create the packets, and felt it was rewarding to see his work in print. In retrospect, however, Mark would have liked to have spent less time on this in order to create other varied instruction, and explore other resources and technology.

The participant commented that he did experience some apprehension about going to the high school because he was nervous about the level of the content he would be required to teach. When he started to teach at the high school, however, his apprehension proved to be unfounded. What he did find, to his surprise, was that he met with success teaching Mathematics content to the at-risk high school students; and that lead him to believe that he could "make a difference" teaching the lower level students. The participant attributed his success to the guided note instructional strategy he

implemented, i.e., providing the high school students a set of guided notes where they could fill in the answers as he taught.

The interviewee was assigned inclusion classes in both placements, and remarked on the different roles of the teaching aides assigned to those classes. In the middle school the aide took an active role in the delivery of instruction to the class. The participant claimed that the level of activity of the aide's role prevented him from having a lot of experience working in the middle school inclusion setting. Mark claimed the aide assigned to the class had "control" of the special education students in the class, as compared to his high school placement where the aide in the inclusion class just took notes.

Outcomes of student teaching. Mark viewed his student teaching experience as "pretty much what he expected." He wished that he could have had more time to do other activities and integrate more technology. Mark said that his second cooperating teacher commented in her evaluation of Mark, that it was a "smooth transition" for her getting back to teaching her class. Mark stated, "The kids could notice that we were both on the same page."

Case Study 5—Upton.

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (22), Understanding (87), Self-expressive (70), Interpersonal (19). Upton's dominant (highest MLS) score in the Mathematics Learning Style Inventory (MLS) was in Understanding (87), indicating that he wanted to understand the "why" of the Mathematics he learned. He liked Mathematics problems that asked him to explain, prove, or take a position; and

he approached problem-solving by looking for patterns and identifying hidden questions. Learning Mathematics became difficult for him when there was a focus on the social environment of the classroom (e.g., on collaboration and cooperative problem solving); and he learned Mathematics best when he was challenged to think about a problem and explain his thinking (Silver et al., 2008).

Teaching Style Inventory (TSI) scores for: Mastery (29), Understanding (58), Self-expressive (28), Interpersonal (11). Upton's dominant (highest TSI, Understanding = 58) score indicated that as an instructor he preferred to: place primary importance on students' intellectual development; provide time and intellectual challenges to encourage students to develop skills in critical thinking, problem solving, logic, research techniques, and independent study; and plan instruction that emphasized concepts and frequently centered around a series of questions and themes (Silver et al., 2005).

Myers-Briggs Type Indicator (MBTI) dimensions INTP (Introvert, Intuitive, Thinking, and Perceiving). Upton's personality type is characterized as a "theorizer" by Champagne and Hogan (1979), i.e., quiet, reserved . . . brilliant in exams, especially in theoretical or scientific subjects . . . needs to choose careers focused around strong interests . . . logical, precise, persevering and thorough, somewhat impersonal, not impressed with authority, and theoretical.

Mathematics Beliefs Survey (MBS). Upton's response to:

Item #2—"Teaching is one occupation where I could see myself."

Item #9—College Mathematics: calculus I, II, III, linear algebra, abstract algebra, college geometry, statistics, logic, set theory, non-Euclidean geometry, and many others.

Item #14—Philosophy of Mathematics: Problem Solving—Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product.

Item #15—Role of Teacher: Facilitator—Emphasizing confident problem posing and solving.

Item # 16—Use of Resources: Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Upton on the Mathematics Belief's Survey (MBS) and represented Upton's: (a) rationale supporting his decision to teach (item #2); (b) list of the eleven plus Mathematics courses he completed in college (item #9); (c) philosophy regarding Mathematics problem solving (item #14); (d) preferred role of teaching, Facilitator (item #15); and (e) his preferred use of curricular materials (item #16).

TTI TriMetrix Personal Skills Feedback.

1. Personal Accountability—A measure of the capacity to be answerable for personal actions.
2. Self Starting—The ability to initiate and sustain momentum without external stimulation.
3. Planning and Organization—The ability to establish a process for activities that lead to the implementation of systems, procedures, or outcomes.
4. Developing Others—The ability to contribute to the growth and development of others.

5. Results Orientation—The ability to identify actions necessary to complete tasks and obtain results.
6. Flexibility—The ability to readily modify, respond to, and integrate change with minimal personal resistance.
7. Objective Listening—The ability to make many points of view without bias.

The above were Upton’s seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that “personal accountability” ranked as his top skill area and major strength. The seven skills highlighted Upton’s well-developed capabilities and revealed where he was most effective when focusing his time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV) Feedback.

1. Theoretical—Upton values knowledge, continuing education, and intellectual growth.
2. Social—Upton values opportunities to be of service to others and contribute to the progress and well-being of society.
3. Individualistic/Political—Upton values personal recognition, freedom and control over his own destiny and others.

The above represented Upton’s top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix talent questionnaire. The understanding was those identified areas were what would motivate him to be successful on the job. Those values were important to Upton and needed to be satisfied through the nature of his work for personal reward (Bonnstetter & Suiter, 2008a).

TTI TriMetrix Behavioral Feedback.

1. Urgency—Upton is decisive and quick to respond. Upton is able to make on-the-spot decisions with good judgment, and meets deadlines on time.
2. Competitiveness—Consistent winning is critical for Upton. Upton is tenacious, bold, assertive, and has a “will to win” in highly competitive situations.
3. Versatility—Upton is multi-talented and easily adapts to changes with a high level of optimism and “can do” orientation.

The above represented the top three (out of 8) phenomena necessary for Upton to experience job success and increased levels of personal satisfaction. They were best exemplars of his natural behaviors (Bonnstetter & Suiter, 2008c).

TTI TriMetrix –Style Insights DISC (Dominance, Influence, Steadiness, and Compliance) scores.

Adapted Behavior DISC scores: Dominance (D = 89), Influence (I = 41),
Steadiness (S = 16), Compliance (C = 72).

Natural Behavior DISC scores: Dominance (D = 92), Influence (I = 62),
Steadiness (S = 2), Compliance (C = 61).

The TTI TriMetrix Style Insights (SI) measured four dimensions of Upton’s behavior, i.e., how he : (a) responded to problems and challenges, Dominance (D); (b) influenced others to his point of view, Influence (I); (c) responded to the pace of the environment, Steadiness (S); and (d) responded to rules and procedures set by others, Compliance (C). This participant’s scores in the four dimensions are quantified into two behavioral types: Adaptive behavior was defined as the identification of a person’s responses to their environment, i.e., what behavior an individual believed they needed to

exhibit in order to survive and succeed at the job; and Natural was defined as the identification of an individual's basic behavior, i.e., the core, "the real you" (Bonnstetter & Suiter, 2004).

Upton's DISC scores were high D (Dominance) and Low S (Steadiness) in both of Upton's adaptive (D = 89, S = 16) and natural (D = 92, S = 2), behavior respectively. High D can be described as an egocentric problem-solver with a "short fuse," and is motivated by direct answers and dislikes routine work. His low S score supports his expressive style. In combination, high D and low S individuals are results-oriented and are self-starting; they are driven to succeed.

Pre-student teaching.

Rationale for decision to teach. Upton's decision to teach secondary Mathematics was born out of necessity when he realized that with his BA in philosophy there was very little opportunity for employment as a philosopher or college professor. Upton considered teaching at the college level until reality set in when he saw that the closest college posting a position was 2000-miles away. With further investigation of job opportunities, Upton discovered that there were positions posted recruiting secondary Mathematics teachers. Upton remembered how he always enjoyed learning Mathematics and he thought that teaching Mathematics in a secondary setting would give him better access to employment. Being a high school Mathematics teacher was Upton's preferred teaching level.

Upton posited that his study of philosophy gave insight into Mathematics and inquiry in general. "I always considered Mathematics thinking and philosophical thinking to be pretty congruent in that they both involved logically-structured type

thoughts. Upton's response to the Mathematics Beliefs Survey (item #2) question on why he decided to become a secondary Mathematics teacher was, "Teaching was the one occupation where I could see myself." According to Upton, students have a natural aversion to Mathematics, and he believed that he was able to remedy student resistance to Mathematics by making his Mathematics instruction as interesting as possible.

Developing Others (TTI TriMetrix Personal Skills) was listed as one of the participant's top personal skills that supported his rationale for becoming a teacher, i.e., the interviewee connected his professed love of Mathematics and philosophy with his desire to contribute to the growth and development of others.

Mathematics beliefs. Upton defined Mathematics as "The study of axiomatic systems involving abstracts; the rules created by man are taken out of the real world to a point, but can also be in people's minds." The interviewee identified his philosophy of Mathematics as a "formalist" philosophy, where Mathematics is considered more of a formal game. He believed that the rules of the game were axioms of the number system that were applied to a problem, and explained that the "formalist" philosophy, the rules, did not necessarily lend itself too much to applied Mathematics, i.e., the participant believed that man chooses to apply the Mathematics to real world problems. The interviewee provided examples of how he perceived Mathematics applications: Learning how to play a game, improving critical thinking, problem-solving, and pondering a decision rather than jumping in right away. Upton commented,

I think it [Mathematics] was good because I had a really different insight into Mathematics, especially having taken philosophy and the other courses. I was looking at it [Mathematics] more critically than other students were. So I was always asking questions why certain functions act the way they did. . . . Why we had certain rules and laws in Mathematics.

The interviewee's "Understanding" Mathematics learning style (MLS) supported his explanation, i.e., he wanted to know why the Mathematics he learned worked. The TTI TriMetrix PIAV "Theoretical" personal interest supported Upton's insight into Mathematics, i.e., he valued knowledge, continuing education and intellectual growth.

Upton believed that he learned Mathematics best by memorizing theorems and formulas, but when he was having problems implementing theorems he would go back and do sample problems to understand how the theorems were applied. The interviewee's persistence in understanding how to implement theorems was supported by his MLS "Understanding," i.e., Upton approached problem solving by looking for patterns and identifying hidden rationale for how the theorem worked.

Symbolic logic (Mathematics without the symbols) and the history of Mathematics were Upton's favorite Mathematics courses in college. The participant believed that symbolic logic created a "world of abstracts." He was fascinated with how the Mathematics, so abstract in its nature, evolved through society, e.g., how civilizations devised number systems to be a functional part of their culture. The participant's narrative was supported by his response to item #14 on the Mathematics Beliefs Survey (MBS), selecting his strongest philosophy of Mathematics to be Problem Solving: Mathematics is a dynamic, continually expanding field of human creation and invention; a cultural product. Upton indicated that as a Mathematics teacher he would try to get the students to understand the Mathematics concept so that it does not become an abstract rule. The interviewee believed that students would benefit from learning symbolic logic so they can make logical arguments. The participant's desire to create understanding of Mathematics concepts was supported by his Mathematics Learning Style Inventory

(MLS) “Understanding” dominant style, i.e., Upton’s belief that the logic behind the Mathematics leads to better understanding of concepts; and he wanted to instill that logic in students to help them understand why the Mathematics they were learning works.

Role of teaching attributes. Upton believed an attribute common to excellent teaching was the teacher’s ability to adapt to the learning styles of the students, and be receptive to student questions. Upton based his belief on his observations of teachers. He commented:

You know, it’s funny . . . the Mathematics teachers that I kind of remember kind of left me wondering about things . . . about what they were teaching . . . I would go home and think. . . . A lot of the best Mathematics teachers I had just kind of lectured. I know that sounds strange, but I would say that the excellent Mathematics teachers that I’ve had were receptive to my questioning either in class or after hours . . . I have seen very professional lectured type classes in high school where the kids were like pre-calculus students and it was more like a lecturing type atmosphere, but it seemed to go very smoothly . . . and the teacher was able to explain things very clearly and very concisely. . . . On the other hand, I’ve seen the kids whose Mathematics comprehension wasn’t as high as some others, and the teacher was more laid back and tried to communicate on their level. I thought that that worked well for them. So it’s strange how different characteristics [teacher] fit well with different teachers.

Upton posited how excellent teachers were judged, i.e., being able to get students to score well on state exams and being able to instill in students an understanding of Mathematics concepts. The interviewee described the role of an excellent Mathematics teacher as first, to get the students to understand the Mathematics concepts, to be receptive to student inquiry, and then to leave their students wondering about Mathematics. The participant’s description of the role of an effective Mathematics teacher is supported by both his MLS “Understanding” Mathematics learning style and TSI “Understanding” teaching style, i.e., it is important to Upton that he understands how Mathematics works. As a teacher, he would place the primary importance on students’

intellectual development. He would provide instruction that allowed time for intellectual challenges to encourage students to develop skills in critical thinking, problem solving, and logic. The participant would prefer a Mathematics curriculum that emphasized concepts and that was frequently centered on a series of questions or themes (Silver et al., 2005; Silver et al., 2008).

Upton believed that he always took Mathematics understanding as paramount in learning Mathematics, but that in his role as a Mathematics teacher he realized that he could not to turn all students into Mathematicians. The interviewee believed that he would be OK with the students just wanting to know how they used correct formulas, and realized that the students had a right NOT to know the reasons. The participant was open to all the learning styles of the students, and stated that the biggest instructional challenge for a teacher was to adapt to student differences. The participant's TTI TriMetrix Personal Skill "Flexibility" and TTI TriMetrix Behavioral Hierarchy "Versatility" behavior supported Upton's realization that he was able to integrate change in his teaching practice, and that as a teacher he would need to adapt to student differences in a positive manner.

Perception of the school culture. Upton characterized student behavior in the school culture as fickle, possessing short attention spans, and not motivated to learn. He attributed the student demeanor to the school culture as "not conducive to learning," i.e., that it was the social life of the students that "trumped all attempts to teach effectively." The participant commented that his perception was based on how he remembered his high school culture: "Too big and difficult to navigate the social terrain." However, Upton believed that if all students were able to study symbolic logic in high school it may

help them become better critical thinkers and be more adept at making logical arguments in real life situations. Upton's view on the "social nature" of students not being conducive to learning is supported by his Mathematics Learning Style (MLS) "Understanding" profile, i.e., MLS students with a dominant "Understanding" Mathematics style experience difficulty learning Mathematics when there is a focus on the social environment in the classroom.

The participant provided a narrative about the other components of the school culture, viz., the faculty, parents, and administration. These all interfaced within a school culture. Upton perceived that collaboration on the part of the faculty added to the school culture, but in his experience he had encountered some great teachers that do well without collaboration. Although the interviewee was comfortable with discussing faculty and students in relation to a school culture, he believed that he did not have the experience to comment on how district cultures may differ. He could only posit that it may be possible that different districts exhibited different cultures. Upton considered parents as part of the school culture, but did not elaborate on this; and was looking forward to seeing what role the administration played in the school culture. The administration was perceived by the participant to be test driven and on test results, rather than on student understanding.

Post-secondary preparation for student teaching. After observing teachers, Upton reported that he had a hard time visualizing himself as one of the teachers he had witnessed. Upton believed that he was very prepared for the content aspect of teaching Mathematics because he always considered Mathematical understanding as paramount. Upton was concerned about his teaching practice. Would he be able to prepare the

students for the state exam and still address his goal of getting the students to understand the Mathematics?

Upton's DISC scores corroborated his difficulty in visualizing himself as a teacher. With high D (Dominance) and Low S (Steadiness) scores in both of Upton's adaptive (D = 89, S = 16) and natural (D = 92, S = 2) behaviors respectively: High D can be described as an egocentric problem solver with a "short fuse;" and is motivated by direct answers; and dislikes routine work (not the characteristics of a traditional school teacher in a traditional school setting). His low S score supported his expressive style. In combination, high D and low S individuals were results-oriented, self-starting, and they were driven to succeed (Bonnstetter & Suiter, 2004).

Post-student teaching.

Assignment. The first student teaching placement assignment for Upton was at the high school level, where the he was assigned to teach two geometry classes (one NYSED Regents level and one honors level); and three Regents level algebra II- trigonometry classes. Upton's second placement was at the middle school level, in grade 7. In the second placement, the participant was assigned two 7th grade inclusion classes, two accelerated classes, and one general level Mathematics class. The interviewee did not use socio-economic or ethnic descriptors to describe the school community, and did not identify the size of the school population.

Perception of student teaching experience. Upton perceived that the overall teaching experience negatively affected his development as a teacher. The participant described his first placement as "not going well" due to personality issues with his cooperating teacher. In addition to the poor relationship with his cooperating teacher,

Upton did not have the opportunity to interact with the Mathematics department in the first placement. He was only told to attend one district-wide Mathematics curriculum meeting, where he did meet the Mathematics department chairperson.

In the second placement, Upton reported that he experienced a better relationship with his cooperating teacher. However, the participant deemed it unfortunate that the middle school placement did not afford him the opportunity to work with a Mathematics staff. The interviewee attributed the isolation to the team structure (one teacher from all four content areas). In this middle school environment there was a lost opportunity to meet with Mathematics teachers on other teams. Therefore, the interviewee was only able to interact with his second placement cooperating teacher, one other Mathematics teacher, and the special education teacher assigned to the inclusion classes.

Attributes of cooperating teachers and school culture. It was difficult for the interviewee to identify positive attributes of his cooperating teachers due to strained relationships with them and a difference in teaching styles. Upton identified the reason he did not get along with his first placement cooperating teacher was that they did not seem to “click” on a personal level. The interviewee perceived the first placement cooperating teacher did not like him. The participant’s remark was founded, he claimed, when he overheard his cooperating teacher in a discussion with another member of the Mathematics department saying that he (Upton) “did not have the personality to be a teacher.” The remark created what Upton called an “awkward situation with the department,” as he believed they viewed him as someone who “could not teach.” Upton believed that his relationship with the Mathematics staff in his first placement was negatively impacted by his first placement cooperating teacher’s comments about his

personality. In addition to personality conflicts, Upton felt that his first placement cooperating teacher did not treat him as a colleague, and never modeled how to pre-assess students' understandings and skills, or showed him how to design a coherent curriculum Mathematics unit. His mentor only provided a pacing chart (showing the sequence of Mathematics topics to be taught) that identified the number of days that the participant was to spend on each topic.

Upton described both cooperating teachers as unapproachable, preventing him from discussing his instructional concerns with them. He reported that his second placement cooperating teacher gave a good critique of his relationship with the students, but was not able to critique him on creating instruction because Upton used the teacher's lesson plans. Upton perceived his relationship with his second placement cooperating teacher as more congenial, but not helpful in helping him create instruction. Upton could not see any similarities between his teaching style and the styles of his cooperating teachers.

The interviewee was not able to provide an in-depth description of both the high school and middle school cultures. Isolation from the faculty and staff in both placements was considered a problem for Upton. The participant stated that he did have the opportunity to witness in both placements collaboration to some degree among Mathematics department staff, but did not experience any interaction with the administration or the parents.

Student teaching impact on instructional decisions. Upton began teaching the full program from day one of his first placement, the high school. It was not clear to Upton what prompted his cooperating teacher to decide not to let him continue teaching the full

program. She offered no rationale as to why he was demoted to teaching fewer classes. The interviewee reported that he did not get any positive feedback from the high school cooperating teacher. For example, it was not made clear by his cooperating teacher if a lesson went well; and Upton used the non-comments by his mentor to gauge the success of his lesson. The participant considered his mentor's criticisms of his lessons to be more destructive than constructive, with no suggestions on how Upton could improve his instruction. In addition, Upton reported that his mentor did not support his goal of teaching Mathematics for understanding and using alternative instructional methods. The participant also claimed that he had a difficult time convincing his high school cooperating teacher that he needed to demonstrate a cooperative lesson as a field placement requirement by his college.

To illustrate the level of frustration Upton experienced, he gave as an example the interaction he had with his high school cooperating teacher regarding a lesson he had crafted and taught. The participant deemed the symbolic logic lesson he developed and taught to the honors geometry class to be successful because there were no comments made about his performance from his cooperating teacher. However, when he taught the same symbolic logic lesson to the general level geometry students, Upton's cooperating teacher told him that none of the students were able to understand the lesson. Upon reflection of the lesson, the participant identified the problem to be that students were not able to understand how symbols were used in logic problems. His cooperating teacher asked him to redo the symbolic lesson and re-teach the concepts the next day. Upton modified the lesson and delivered the instruction at a slower pace. In hindsight, the participant commented that he would have created a pre-assessment for the symbolic

logic lesson, thus saving time re-teaching the whole lesson. When asked by the researcher if the participant's mentor showed him how to formatively assess students prior to creating a lesson, Upton responded that the cooperating teacher never modeled how to pre-assess student knowledge prior to introducing a new Mathematics concept or skill.

The interviewee's high school placement experience had a negative impact on how he designed instruction, mainly due to the lack of mentoring. There was no opportunity for Upton to discuss alternative instructional methods with his high school cooperating teacher. Towards the end of his first placement, the participant decided that he would go ahead and try some group work and peer presentations without the sanction his cooperating teacher (because he felt that she would not approve). However, Upton received no feedback on the afore-mentioned lessons.

The middle school placement provided a more conducive environment for Upton to practice teaching. The participant portrayed a more professional relationship with his second placement cooperating teacher, and viewed her teaching style as procedural, using a packet approach where students did a full period of work. Upton was given a lot of tools to work with in his second placement, but felt he did not pick up any teaching strategies because his second placement cooperating teacher was procedural. Ironically, the interviewee reported, he was given more lead time to "plan" his lesson and that his cooperating teacher provided the Mathematics topic that was to be taught a week before the lessons were to be implemented. The participant admitted that he did little "planning" of lessons because he did not have to create any lessons or resources; and for the lesson's material he just used the power point slides developed by his mentor teacher.

Regarding the NYSED Mathematics learning standards, Upton commented that he was required to incorporate the standards in planning instruction by his college, but was not required in both placements. The high school did place the standards on the curriculum packet that he was given, but did not share the standards with the students.

To summarize, Upton considered both cooperating teachers as procedural with an instructional style of straight lecturing, and believed that his high school experience negatively impacted how he made instructional decisions. His middle school experience did not afford him the opportunity to make instructional decisions. Neither experience provided the opportunity for Upton to practice and reflect on his teaching, nor did he see different teaching strategies, such as differentiated instruction, modeled. Finally, there was no opportunity for Upton to reflect on how to create a formal lesson plan or integrate textbooks or other resources into his instruction. The only positive outcome of the experiences was Upton's perception of his relationship with his students as being much better than both of his cooperating teachers. But, except for the honor students, he still viewed his students as not caring about Mathematics.

Perceived impact on future teaching practice. The overall impact of Upton's student teaching was his perception that what he learned from the experience was self-taught. For example, the participant believed that he learned on his own how to assess students by walking around and viewing their work. He admitted that he learned from the negative experience in the high school that he needs to pre-assess students prior to crafting an introductory lesson.

Relating to the curriculum put forth in the high school, Upton was at a loss for understanding the logic for the scope and sequence of the geometry course, i.e., the

reasons for what the course was taught in a specific order was never shared with Upton by his high school cooperating teacher. The participant viewed the scope and sequence of the geometry curriculum as disjointed topics, and reflected on the issue that the symbolic logic unit taught as the first topic in the geometry course was too short and did not segue into geometric proofs. He wanted to know why the coordinate plane topic followed symbolic logic. The interviewee was not sure why geometric proofs were placed at the end of the geometry course and not connected to the symbolic logic unit.

The participant had curricular issues with the middle school Mathematics program. Upton described the 7th grade honors curriculum as a compacted 7th and 8th grade curriculum. Again, Upton believed the middle school curriculum to be disjointed, not connecting Mathematics concepts logically. The interviewee projected that if he were a Mathematics teacher in the middle school he would need to revise the 7th grade Mathematics curriculum to foster student understanding of Mathematics concepts. The lack of the use of textbooks was another curriculum issue that Upton was concerned about. He believed that textbooks would be beneficial in both placements, and he would have students use the textbook to aid their understanding of Mathematics concept, i.e., his students would “learn” to use a textbook a reference.

Upton believed that if he had the freedom to teach and a more professional relationship with the high school cooperating teacher, he would have incorporated more cooperative learning experiences, more opportunities for discussion based on the Socratic method, and provide more informal assessments prior to introducing new Mathematics concepts and skills. The participant expressed his desire to integrate reflective writing as a daily component of the Mathematics content area to be used as literacy strategy. With

the exception of teaching one required cooperative learning lesson, no practice or modeling by his cooperative teachers was provided for Upton on how to integrate alternative teaching methods and strategies (that he was open to implementing in his practice).

Outcomes of student teaching. Upton believed that his preparation by his college had provided him with pedagogical idea and theories, “things to strive for.” However, the participant’s student teaching experience did not provide the venue for him to employ the pedagogy, and he could not practice those pedagogical ideas or theories in either of his placements, middle or high school. After observing procedural teaching in both placements, Upton was convinced that his role as a Mathematics teacher would be more of a facilitator of different types of instruction. He was not fond of straight lecturing. Even though his high school placement was arduous, Upton still contended that the level of Mathematics taught in a high school setting would be a better teaching environment for him.

Upton expected that student teaching would be more of a learning experience, rather than maneuvering through a “mentor minefield.” As he said, “How can I please my cooperating teacher?” In both places, Upton wanted to try some alternate teaching strategies by a trial and error approach. When he made mistakes he wanted the chance to vet his rationale for his instructional decisions, but was never given the opportunity to explain why he chose that strategy. If a cooperating teacher can criticize the delivery of instruction, that cooperating teacher should be able to model the correct strategy.

Case Study 6–Seth.

Phase I artifacts.

Mathematics Learning Style Inventory (MLS) scores for: Mastery (24), Understanding (62), Self-expressive (67), Interpersonal (45). Seth's dominant (highest MLS) score in the Mathematics Learning Style Inventory was in the Self-Expressive (67) style, indicating that he wanted to use his imagination to explore Mathematical ideas. He liked Mathematics problems that were non-routine, project-like in nature, and allowed him to think outside the box. He approached problem solving by visualizing the problem, generating possible solutions, and then exploring the alternatives. Learning Mathematics was difficult when Mathematics instruction was focused on drill and practice and rote problem solving; and, he learned Mathematics best when he was invited to use his imagination and engage in creative problem solving (Silver et al., 2008).

Teaching Style Inventory (TSI) scores for: Mastery (8), Understanding (37), Self-expressive (43), Interpersonal.(38). Seth's dominant (highest TSI, Self Expressive = 43) score indicated that as an instructor he: preferred to focus on encouraging students to explore their creative abilities; highly valued insights and imagination; would design lessons that revolved around discussions that generated possible outcomes; welcomed student curiosity; and sought unique and interesting approaches to problem solving (Silver et al., 2005)

Myers-Briggs Type Indicator (MBTI) dimensions ISTJ (Introvert, Sensing, Thinking, and Judging). Characterized as a “systematizer” by Champagne and Hogan (2010), Seth exhibited “practical, orderly, matter-of-fact, logical, realistic, and dependable” behavioral characteristics.

Mathematics Beliefs Survey (MBS). Seth's response to:

Item #2—"I like working with kids, and Mathematics provides a good opportunity to do that."

Item #9—College Mathematics: calculus I, II, III, linear algebra, abstract algebra, college geometry, statistics, computer science.

Item #14—Philosophy of Problem Solving: Mathematics is a dynamic, continually expanding field of human creation; a cultural product.

Item #15—Role of Teacher: Facilitator—Emphasizing confident problem posing and solving.

Item #16—Use of Resources: A teacher or school construction of the Mathematics curriculum.

The above items were selected by Seth on the Mathematics Beliefs Survey and represented Seth's: (a) rationale supporting his decision to teach (item #2); (b) list of the eight Mathematics courses he completed in college (item #9); (c) philosophy regarding Mathematics, Problem Solving (item #14); (d) preferred role of teaching, Facilitator (item #15); and (e) his preferred use of curricular materials (item #16).

TTI TriMetrix Personal Skills Feedback.

1. Planning and Organization—The ability to establish a process for activities that lead to the implementation of systems, procedures, or outcomes.
2. Results Orientation – The ability to identify actions necessary to complete tasks and obtain results.
3. Empathetic Outlook—The capacity to perceive and understand the feelings and attitudes of others.

4. Interpersonal Skills—The ability to interact with others in a positive manner.
5. Flexibility—The ability to readily modify, respond to, and integrate change with minimal personal resistance.
6. Problem Solving—The ability to identify key components of a problem to formulate a solution or solutions.
7. Continuous Learning—The ability to take personal responsibility and action toward learning, and implementing new ideas, methods, and technologies.

The above were Seth's seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that "planning and organization" ranked as his top skill area and major strength. The seven skills highlighted Seth's well-developed capabilities, and revealed where he was most effective when focusing his time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV) Feedback.

1. Social—Seth valued opportunities to be of service to others and to contribute to the well-being of society.
2. Individualistic/Political—Seth valued personal recognition, freedom, and control over his own destiny and others.
3. Theoretical—Seth valued knowledge, continuing education, and intellectual growth.

The above represented Seth's top three (out of 6) personal interests, attitudes, and values as identified by the TTI TriMetrix talent questionnaire. The understanding was those identified areas were what would motivate him to be successful on the job. Those

behavioral types: Adaptive behavior was defined as the identification of a person's responses to their environment, i.e., what behavior an individual believed they needed to exhibit in order to survive and succeed at the job; and Natural was defined as the identification of an individual's basic behavior, i.e., the core, "the real you" (Bonnstetter & Suiter, 2004).

Seth had High D (Dominance) and low S (Steadiness) scores for both his adaptive (D = 89, S = 23) and natural (D = 92, S = 25) behaviors. Individuals with high D scores have a drive for results; and are pioneering, disliking routine work. Low S scores suggest individuals are variety oriented and active. When the D and S scores were combined, the descriptors indicated that Seth was a self-starter, and preferred a wide scope of activities; was anxiously impatient to overcome obstacles and competition in the most expedient way; and used many choices of action available.

Pre-student teaching.

Rationale for decision to teach. Seth admitted that his decision to become a secondary Mathematics teacher was based his being drawn into teaching more by the students than his love of Mathematics. He selected Mathematics as the conduit to teaching students based on there being a more abundance of job opportunities for Mathematics teachers, and his personal satisfaction from "doing" Mathematics in high school. The participant decided to attend college after he served in the armed forces as an electronics maintenance specialist. The electronics maintenance school, according to Seth, provided a "lot of applied Mathematics," which lead Seth to also consider teaching physics. The interviewee chose biology over Mathematics and physics as his first college

major because he intended to become a dentist. However, Seth decided after his first semester that becoming a dentist was not what he wanted to do.

Seth's interest in teaching students became evident as a result of working as a mentor for troubled youth. Part of the mentoring position required Seth to tutor his clients in academic subjects. Seth believed that his mentoring experience influenced his teaching choice of age range to be the middle school age students. His rationale for teaching middle school age was supported by his belief that he might have a "better shot" of having an impact on the younger students. Seth's Mathematics Beliefs Survey (MBS) answer to item #2, "I like working with kids, and Mathematics provides a good opportunity to do that," supported his narrative explanation why he wanted to become a secondary Mathematics teacher. He spoke about the trials and tribulations of his own youth as preparing him as a mentor and teacher, which added further rationale for his decision; i.e., Seth claimed that he did a lot of "stupid things as a kid," and he thought he could "help kids with similar experiences." "Empathic Outlook" and "Interpersonal Skills" were identified as two of Seth's top TTI TriMetrix Personal Skills. These supported his desire to work with students, i.e., he had the capacity to perceive and understand the feelings and attitudes of students and the ability to interact with the students in a positive manner. "Social" was rated as one of the participant's top TTI TriMetrix PIAV, supporting his desire to help students academically develop. Seth valued opportunities to be of service to others and to contribute to the well-being of society.

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included a teacher's conception of the nature and meaning of Mathematics (philosophy),

and on their mental models of teaching and learning Mathematics, i.e., how an individual perceives they best learn Mathematics; an individual's preference for types of problems they like to solve; how Mathematics instruction is presented to the individual; and the individual's perceived difficulties in learning Mathematics. Seth's beliefs were presented as his philosophy, how he believed that he best learns Mathematics, his preference for types of Mathematics problems he likes to solve, the delivery of instruction he perceived to help her better understand Mathematics, and difficulties she encountered learning Mathematics.

Seth had difficulty both in defining Mathematics and articulating his philosophy of Mathematics. The participant believed that Mathematics was "not arithmetic," but real life applications. The interviewee circumvented the philosophy questions and focused more on how he thought Mathematics was best taught. The participant commented that "Mathematics was not mimicking a problem that a teacher did, or learning how to do Mathematics with algorithms." The best attempt that Seth made to define Mathematics was that it was a tool that improves a person's ability to think. When given a choice of philosophies of Mathematics on the Mathematics Beliefs Survey (MBS), the interviewee chose the Problem Solving view (Mathematics is a dynamic, continually expanding field of human creations and invention; a cultural product) as his strongest belief. The Problem Solving choice supported the interviewee's description of Mathematics as having real life applications that improved students' abilities to think.

Seth believed that he learned Mathematics best through visualization. Drawing a lot of pictures to get a general idea about a problem before getting to the specifics, Seth stated, was most helpful in how he learned Mathematics. Seth's favorite Mathematics

course was high school trigonometry because he could “see it all on paper.” The participant’s Mathematics Learning Style Inventory (MLS) dominant style was “Self-Expressive,” and this supported his narrative description on how he learned Mathematics best—he approached problem solving by visualizing the problem, generating possible solutions, and exploring the alternatives (Silver et al., 2008).

The traditional procedural teaching of Mathematics was not embraced by Seth, since he believed that “rote memorization and just plugging in numbers [into equations] was not learning.” This was not a useful endeavor for students to do because these processes did not foster critical thinking. College Mathematics courses, Seth said made him think more independently because he had to figure out problems without examples. In fact, the interviewee believed that physics was more interesting than some Mathematics courses he had taken. Seth’s dominant “Self-Expressive” (MLS) supported his statement regarding problem solving, i.e., the interviewee liked problems that were non-routine, project-like in nature, and that allowed students to think “outside the box.” Self-Expressive Mathematics students, like Seth, experience difficulty leaning when Mathematics instruction is focused on drill and practice and rote problem solving (Silver et al., 2008). It should be noted that Seth made it a point the he obtained a BA degree in Mathematics because he wanted to take more Mathematics courses than were required by the BS program. He failed to list the extra Mathematics courses on the MBS item #9 that were required of him to complete his BA.

Role of teaching attributes. Seth believed that excellent teachers made students believe that they (the teachers) were interested in their students’ success; made Mathematics relevant to their students’ lives; and made connections between learning

Mathematics and their students' interests. The interviewee reflected on his high school experience, and commented that none of his Mathematics teachers exhibited the aforementioned attributes. The participant characterized his high school teachers as "traditional." They handed out materials and had students "learn it" because they were supposed to. Teachers, Seth intuited, needed to know their students' interests, abilities, and readiness to learn levels in order to differentiate instruction. Seth believed that all students could learn Mathematics by teachers who used more diverse instructional strategies. Finally, being a role model to students was the overarching attribute that Seth deemed important in the role of the teacher, i.e., giving the teacher the aegis to help students beyond the classroom, in addition to making students feel comfortable in the classroom. "Continuous Learning" and "Problem Solving" were two of Seth's top TTI TriMetrix Personal Skills that supported his narrative on effective teacher attributes, i.e., the teacher would take personal responsibility and action toward learning and implementing new ideas and methods, and would identify key components of a problem in order to formulate a solution or solutions (Bonnstetter & Suiter, 2008b).

To summarize, the interviewee believed that there was a "lot of teaching going on out there that was not creative, but just 'lecture'" indicating teachers in general lacked the teacher attributes Seth believed made for effectively instructing in Mathematics. Even college professors, Seth perceived, were not good examples of teachers because lecturing was the same format used for every college class. The participant cited one exceptional college course instruction experience—when he was learning to use Geometers' Sketchpad, an interactive computer program. It was the only time Seth observed anything different from the standard lecture. Seth considered technology a useful instructional tool

that, when integrated properly into instruction, engaged student interest and expedited problem-solving. The interviewee's "Self- Expressive" MLS supported his dislike for Mathematics instruction that was rote and not creative. Seth claimed he learned Mathematics best when his teachers invited him to use his imaginations, explore Mathematics ideas, and engage him in creative problem solving (Silver et al., 2008).

Perception of the school culture. The school environment needed to be a "safe haven" for students, according to Seth. He believed that the school culture should exude a sense of community and pride for its constituents, and project a climate of fair treatment for all. The interviewee commented that he perceived inner city schools to have different cultures than suburban and rural schools, but still needed to provide an environment conducive to learning. In all types of school cultures, the administration, the interviewee believed, needed to be supportive of the faculty and students, and that the faculty needed to act as a team. Seth based his afore-mentioned descriptions of the school culture on his pre-student observation of what he described as a "chaotic school environment that was not a conducive place for learning." "Planning and Organization" was one of the top TTI TriMetrix Personal Skills of Seth. And this supported Seth's concern about the impact that a chaotic school environment had on learning, i.e., the participant should be skilled in establishing a process for activities (e.g., classroom management) that lead to the implementation of systems, procedures, or outcomes (e.g., a conducive learning environment) (Bonnstetter & Suiter, 2008b).

Seth had the opportunity to observe a teacher manage a class in a chaotic high school environment. The interviewee deemed the teacher to be a good listener, but posited that not a lot of learning was going on in that environment. The participant said

that the lack of administrative support of student discipline (and backing the teachers) contributed to that chaotic environment. There was a different scenario, however, when he observed a middle school environment. He reported that he saw teamwork, a supportive environment, and collaboration among the faculty in planning the curriculum. “Results Orientation” was one of Seth’s top TTI TriMetrix Personal Skills, and supported his narrative comparing the high school and middle school environments, i.e., he identified the actions (support of the teachers by the school administration and teamwork) necessary to complete tasks and obtain results (student learning) (Bonnstetter & Suiter, 2008b).

To summarize, the interviewee identified aspects of the school culture that were of concern to him in becoming a teacher. Seth generalized that the classroom and how Mathematics was taught had changed from when he was in school. In his field observations, the interviewee experienced chaotic school cultures and generally poor instruction. However, there were some classes the participant observed where more emphasis was placed on hands-on learning. In these situations, he saw students take a more active role in the classroom; a change from what Seth had experienced as a high school student.

When asked how he would handle an unmotivated student, Seth replied that he would speak to the student one-to-one (not in front of the class) to find out what was affecting the student’s performance; then seek to modify the lesson to address the student’s interests. Seth’s TSI “Self- Expressive” dominant style supported his belief that teachers should encourage students to explore their creative abilities. The classrooms of these types of teachers are often full of creative clutter, with the curriculum focused on

creative thinking, moral development, values, and flexible, imaginative approaches to learning.

Preparation for student teaching. Seth reported that his college education program did not totally prepare him for student teaching. The interviewee posited that there was a lot of wasted time in the education program, and that his early methods courses were taught by professors who were “clueless” on Mathematics education. In his last sequence of methods courses, which came later in the education program, Seth said he had the opportunity to converse with “real” Mathematics teachers. Seth believed that the best Mathematics methods professors were the Mathematics teachers that had retired from the secondary school systems—because they provided the best insights into instruction.

Seth suggested that college Mathematics methods courses be more hands-on and be totally focused on how to teach Mathematics, i.e., affording the opportunities to practice instructional strategies that were alternatives to lecture. For example, Seth opined that the use of manipulatives, such as algebra tiles, provided a very effective visual representation of positive and negative numbers, and would enhance Mathematics instruction when integrated into lessons. In addition to using manipulatives as an instructional strategy, the participant claimed that he would have liked to have learned more about how to implement group learning and interactive technology in the structured traditional teaching environment, including alternate ways of engaging students in learning Mathematics. Seth’s “Self-Expressive” TSI dominant teaching style profile supported his request for college methods courses to offer a more in-depth study of alternative strategies to teach Mathematics. He wanted to learn how to create a

classroom environment with a curriculum focused on creative thinking and imaginative approaches to learning that fostered discussions that revolved around generating possible solutions to unique and challenging Mathematics problems.

To summarize, Seth's DISC scores supported his negative attitude towards the traditional way Mathematics was taught. Seth had High D (Dominance) and low S (Steadiness) scores for both his adaptive (D = 89, S = 23) and natural (D = 92, S = 25) behaviors. Individuals with high D scores have a drive for results, and are pioneering; disliking routine work. Likewise, individuals with low S scores are variety-oriented and active. The interviewee painted the picture of the traditional teaching program as having little variation, and being routine. When Seth's D and S scores were combined, the descriptors indicated that he was a self-starter with a wide scope of activities, and is prone to become impatient when having to overcome obstacles in the most expedient way, from many choices of actions available. Seth valued the non-traditional instructional strategies that led toward students becoming engaged in Mathematics; and was prone to wanting to change the way Mathematics was taught.

Post -student teaching.

Assignment. Seth was assigned to a small town high school as his first placement. His course program included three sections of 9th grade integrated algebra, one section of fundamental algebra, and one section of community college Mathematics. Students in the integrated algebra course were scheduled to take the NYSED Integrated Algebra Regents in June, 2010. The courses were taught in an 80- minute block schedule. Seth's second placement was in a low socio-economic, White rural middle school. Seth's course

program was five 8th grade Mathematics classes. One of the classes he was assigned to teach was an inclusion Mathematics class.

Perception of student teaching experience. Overall, Seth claimed that both placements of his student teaching went well, as he was given free range to make instructional decisions. The participant expressed more enjoyment in teaching the older students in the high school college Mathematics course in contrast to the middle level students, which indicated the he had a change of heart from his pre-service preference for teaching middle school. Seth attributed his change of teaching level preference to high school because those students were more focused. (It might have been due to the fact that they had to pay for the course).

In his second placement, the middle school, Seth worked with a team of teachers from other content areas. The team experience led the participant to believe that the middle school philosophy of having all content areas represented in teams provided a more structured environment that kept on top of the students. In comparison, the participant believed that the cloistering of the content areas in the high school made it difficult to stay on top of the students.

Attributes of cooperating teachers and school culture. Both cooperating teachers, Seth claimed, provided positive feedback about his instructional practice. The suggestions that the cooperating teachers made were considered by the participant to be of great help in assessing his teaching performance, even when it “stunk.” Besides having his instruction performance reviewed, Seth reported that both cooperating teachers helped him identify and discuss the instructional needs of the students. It should be noted that the participant decided after his first student teaching placement that he was not cut out to be

a teacher. He explained that he shared his decision with his second placement (middle school) cooperating teacher and indicated that he was going to finish out the student teaching experience. Therefore, his decision to leave and his preference to teach high school students limited his narrative about his second placement cooperating teacher.

Seth believed that his high school cooperating teacher was there to help him but described her as “hands off,” and let him teach and make mistakes, reflect on his practice, and then revise his instruction, based on his self-evaluation and remedy. In the high school, the participant began teaching some of his assigned program the first day of the school year. The interviewee stated that he had regretted that he started teaching right away and would have, in hindsight, preferred to have begun a few days into the semester. The participant believed that starting later would have afforded him the time to develop classroom rules and reflect on classroom management strategies. Not teaching his entire program the first day afforded Seth to observe his high school cooperating teacher teach the first block of the day. In addition to observing his cooperating teacher, Seth had the opportunity to observe other teachers in the high school, and was asked to focus his observation on their style of teaching. The participant reported that he observed an English teacher and was impressed how creative she was in engaging her students.

Regarding the school cultures he experienced at his student teaching placements, Seth reported that the faculty in his first placement (high school) was very close, especially the Mathematics department. They “stuck” together. The interviewee perceived the climate of the high school to be very welcoming, and claimed that the faculty considered him a colleague and not a student teacher. Seth felt “at home” and part of the school culture.

Overall, Seth perceived that he had a good relationship with the students. The participant claimed that students would seek him out and come for help after school. The interviewee reported that he did not see any difference in relating to male or female students in either placement. All his students respected the cooperating teachers and had to follow their classroom rules. The participant mentioned that handling unmotivated students was one of the difficulties that he encountered, and attributed the lack student motivation to their parents. The interviewee considered parents as pivotal in supporting their children's academic success. Seth believed that unmotivated students were the result of unmotivated parents, and that it was difficult for the school culture, especially teachers, to break the failure cycle.

Student teaching impact on instructional decisions. Seth had high expectations prior to his student teaching experience about his instructional prowess. The participant had met with success tutoring one-to-one as a mentor to at-risk students, and believed that he was a good explainer of Mathematics concepts and skills. He did not anticipate students not understanding his explanations right away, and found that as a student teacher faced with a class of students he had to learn to revise his explanations. Seth reported that he thought he explained the Mathematics in a logical way so that every student would “get it,” and was perplexed when students failed to understand his explanations. Seth expressed his disillusionment, “I had a hard time coming to grips with the fact that no matter what I did, there was going to be a certain percentage of students that I couldn't reach.” His frustrations led him to believe that he could not academically reach all of his students.

The participant reported that he learned various teaching strategies relating to assessment and differentiating instruction. Seth claimed that he learned how to use whiteboards (students write answers to questions on individual whiteboards and share them with the class) as a formative assessment tool. He listed other formative assessment methods he used, such as observing student work while walking around the classroom; and viewing facial expressions for confused looks. The interviewee reported that he was able to create differentiated instructional lessons based on student ability, motivation and readiness, and that he was differentiating instruction as a daily practice in his classroom instruction. When the researcher asked the interviewee how differentiation was done on a daily basis, Seth explained that differentiation was done verbally, i.e., asking questions to students based on his perceived differences among the students. For example, he explained that some students liked to answer questions in front of the class and some did not. The participant would question only those students who preferred to share their answers in a group setting.

Regarding curriculum, the participant did not have a choice as to how to present the Mathematics topics for each course. In both placements, Seth was required to follow countywide (district) approved scope and sequences for each Mathematics course he taught in both the middle and high schools. The participant was not allowed, by school policy, to veer from the approved scope and sequence, even though he perceived that he had free range to design instruction. To some degree, Seth agreed with the utility of a district-wide curriculum because many students would move to other district schools; and a district-wide agreed Mathematics curriculum assured that students would not miss any curriculum content if they moved to another district school. Therefore, Seth did not have

the opportunity to interpret the NYSED Mathematics standards and to decide how he wanted to deliver the curriculum topics.

Overall, Seth did not believe that the NYSED Mathematics curriculum met the students' academic needs. The participant noted his frustration with the district curriculum, and found it confining in developing his instruction, i.e., Seth spoke of the blandness of the curriculum that he felt was hard to spice up. Seth did attempt to "spice up" the curriculum in several ways. He developed games like "Mathematics Bingo" that he used to review concepts; activities where students discovered pi; and used drag race videos to illustrate the usefulness of scientific notation; as well as visuals. In general, the participant viewed the NYSED Mathematics course curriculum as boring to him, as well as boring to the students; i.e., the participant did not anticipate the same topics being taught over and over again. Seth stated that,

Overall, I was surprised at how inept they [students] were in not knowing the rules for combining like terms, and what happens when you multiply monomials and binomials. . . what the rules were . . . because even more so when I went to the 8th grade they were doing the same thing, and I think that I heard that they did it in 7th and maybe 6th, and I was surprised that by 9th grade it wasn't second nature to them.

The block schedule of the high school provided a challenge for Seth. In planning his lessons for the block, the participant realized that he could not lecture for the entire 80 minutes. When asked to describe a procedural lesson sequence he developed for the block scheduled lessons, he described his lesson format as: (a) first going over the homework; (b) then covering new material for 30-40 minutes; and (c) concluding by having some kind of student activity germane to the lesson topic. The participant preferred the 80-minute block period every other day because it opened up more learning

opportunities for students. It kept the lesson introduced at the beginning of the period fresh in their minds to apply to the activity at the end of the period.

To summarize how student teaching impacted the participant's instructional decisions, Seth's ability to develop lessons was stunted by the district-wide policy for uniform Mathematics scope and sequence of topics and a lack of instruction from his cooperating teachers as to how to develop lessons for block period. The participant's view of the curriculum as not meeting the needs of the students was attributed to the lack of engagement of students in the lessons.

Perceived impact on future teaching practice. Seth viewed his professional relationships with his cooperating teachers not as a student teacher, but as a colleague. However, he considered his style as different from their styles, which he intimated to be procedural. Seth reported that he witnessed some instructional creativity in his cooperating teachers, but held the view that they had lost the big picture of students being able to learn something valuable. Instead, he believed that the cooperating teachers were looking to ensure that their students would pass the NYSED Mathematics assessments. The participant considered his mentor teachers as only valuing whether or not the students understood what questions were going to be on the NYS assessments. Seth posited that the afore-mentioned focus on test scores was something that happened to teachers the longer they were in practice.

Classroom management was a concern for Seth. He thought that he would have had better control of the class in his first placement if he would not have started teaching right away, and spent more time crafting classroom rules and management strategies. The difficulty in managing younger students led Seth to the conclusion that he liked the older

students. Seth perceived that he related to the older students without having to “babysit,” and that he could relate more and relax with the older students. The participant admitted that if he became a teacher the one thing he would improve on was his classroom management. Seth was concerned about keeping order. As a teacher, he claimed he would run a tighter ship; and believed that he learned the teaching practice without the critique of the cooperating teacher.

Outcomes of student teaching. Seth decided not to pursue a teaching career. He believed, based on his observations of teachers in his student teaching placement schools, that veteran teachers had developed patience and tolerance toward student behavior. The interviewee admitted that the behavior of the students and the archaic Mathematics curriculum led him to decide that teaching was not for him, i.e., he was not sure that he had the patience to teach. The student teaching experience had taken an emotional toll and drained his energies. The participant was remorseful that he did not have the strength to continue, that teaching was not the career for him.

The participant admitted that Mathematics was a tough content area to teach, due to the “abstractness” of its nature. His experience in teaching his algebra classes in the high school, where he used the same basic rules and followed the same scope and sequence for everyone, to be too routine and uninteresting to him. In teaching Mathematics, he did not have the freedom and control of his destiny. The participant viewed the students as unmotivated and the curriculum to be stifling; thus providing little, if any, hope of helping students learn Mathematics or prepare students for life. Content aside, the participant commented that if all he did at the end of the day was to teach his students how to combine like terms, he was not successful in teaching his students

something more meaningful – like consumer Mathematics. Seth’s final statement about the education system today was that it was “stuck” in its archaic idea of what kids need to know.

Seth said that his student teaching experience did not prepare him for teaching, commenting, “It’s like a flash – you get some skills, but you don’t come out an excellent teacher; and it may take years to develop your practice.” The participant expected to go into teaching and have students understand the Mathematics if he explained it in a logical way, so that every student would get it. Seth believed that student teaching was not a good barometer to predict how he would be as a teacher next year. Seth sees a real impact on improving teaching practice to lie with colleagues and mentors being assigned to you when you start your own practice.

Case Study 7—Ingmar.

Phase I artifacts.

Mathematics Learning Style Inventory MLS scores for: Mastery

(47), Understanding (46), Self-expressive (45), Interpersonal (60). Ingmar’s dominant (highest MLS) score in the Mathematics Learning Style Inventory (MLS) was in Interpersonal (60), indicating that he wanted to learn Mathematics through dialogue. He liked Mathematics problems that focused on real-world applications and how Mathematics helps people; and he approached problem solving as an open discussion among a community of problem-solvers. Learning Mathematics was difficult for Ingmar when the instruction focused on independent seat work, or when what he was learning lacked real-world application. He learned Mathematics best when the teacher pays attention to his success and struggles in Mathematics (Silver et al., 2008).

Teaching Style Inventory (TSI) scores for: Mastery (46), Understanding (32), Self-expressive (8), Interpersonal (16). Ingmar's dominant (highest TSI, Mastery = 46) score indicated that, as an instructor, he preferred to focus on clear outcomes (skills learned; projects completed) and demonstration of the acquisition of skills and information. In the role of teaching, Ingmar preferred to serve as the primary information source and to give detailed directions for student learning (Silver et al., 2005).

Myers-Briggs Type Inventory (MBTI) dimensions ESTJ (Extrovert, Sensing, Thinking, and Judging). Characterized as a “stabilizer” by Champagne and Hogan (1979), Ingmar was a “practical, realistic, matter-of-fact, responsible, orderly, loyal, and steadfast” personality type, who liked to organize and run activities; and, be involved in community activities.

Mathematics Beliefs Survey (MBS). Ingmar's responses for:

Item #2—“I always wanted to teach; and Mathematics was my best subject.”

Item #9—College Mathematics: calculus I, II, III, linear algebra, college geometry, statistics, logic, non-Euclidean geometry, set theory, computer science.

Item #14—Philosophy of Mathematics: Instrumentalist—Mathematics is an accumulation of facts, rules, and skills to be used in the pursuit of some external end.

Item #15—Role of Teacher: Facilitator—Emphasizing confident problem posing and solving.

Item #16—Use of Resources: Modification of the textbook approach, enriched with additional problems and activities.

The above items were selected by Ingmar on the Mathematics Beliefs Survey, and represented Ingmar's: (a) rationale supporting his decision to teach (item #2); (b) list of the ten Mathematics courses he completed in college (item #9); (c) philosophy regarding Mathematics, Instrumentalist (item #14); (d) preferred role of teaching, Facilitator (item #15); and (e) his preferred use of curricular materials (item#16).

TTI TriMetrix Personal Skills Feedback.

1. Leading Others—The ability to organize and motivate people to accomplish goals while creating a sense of order.
2. Influencing Others—The ability to personally affect others' actions, decisions, opinions, or thinking.
3. Objective Listening—The ability to make many points of view without bias.
4. Teamwork—The ability to cooperate with others to meet objectives.
5. Flexibility—The ability to readily modify, respond to, and integrate change; with minimal personal resistance.
6. Conflict Management—The ability to resolve different points of view constructively.
7. Interpersonal Skills—The ability to interact with others in a positive manner.

The above were Ingmar's seven top personal skills (out of 23) identified by the TriMetrix Talent questionnaire (TTI). Of note was that "leading others" ranked as his top skill area and major strength. The seven skills highlighted Ingmar's well-developed capabilities, and revealed that he was most effective when focusing his time (Bonnstetter & Suiter, 2008b).

TTI TriMetrix Personal Interests, Attitudes, and Values (PIAV) Feedback.

1. Theoretical—Ingmar valued knowledge, continuing education and intellectual growth.
2. Individualistic/Political—Ingmar valued personal recognition, freedom and control over his own destiny and others.
3. Utilitarian Economic—Ingmar valued practical accomplishment, results and rewards for his investments, time, resources, and energy.

The above represented Ingmar’s top three (out of 6) personal interests, attitudes, and values, as identified by the TTI TriMetrix talent questionnaire. The understanding was those identified areas were what would motivate him to be successful on the job. Those values were important to Ingmar, and needed to be satisfied through the nature of his work for personal reward (Bonnstetter & Suiter, 2008a).

TTI Behavioral Hierarchy.

1. Frequent Interaction with Others—Ingmar had a strong people orientation, and he was able to deal with multiple interruptions on a continual basis; always maintaining a friendly interface with others.
2. Customer Oriented—Ingmar had a positive and constructive view of working with others, and he was able to successfully work with a wide range of people from diverse backgrounds to achieve “win-win” outcomes.
3. Versatility—Ingmar is multitalented and easily adapts to change with a high level of optimism.

himself; and was cautious about how would proceed in teaching. When taken together, I/D indicated that Ingmar was obliging and concise; and, he persuasively and emotionally looked toward people for support and inner-satisfaction more than as a way to reach his personal goals (Bonstetter & Suiter, 2004).

Pre-student teaching.

Rationale for the decision to teach. Ingmar's decision to become a secondary Mathematics teacher was born out of his love for Mathematics, and his perception that he always helped his peers with their Mathematics courses. Ingmar was placed in an accelerated Mathematics program in elementary school, where he experienced learning Mathematics along with "average" students who he described as "not too great with Mathematics," and that were a year ahead of him in school. The participant believed early on that he could do a better job teaching than his high school Mathematics teachers. Despite his perception of being superior to his Mathematics teachers, the interviewee claimed he was inspired to teach by his AP calculus teacher, who he considered a role model, i.e., that teacher exhibited the teaching style that Ingmar aspired to adopt. The participant claimed the calculus teacher's lessons were great, and deemed him to be a teacher who was very down- to-earth; and talked to the students (and not just about Mathematics). Those attributes, Ingmar believed, made that teacher effective as a professional.

Helping students find the joy in learning Mathematics that Ingmar had experienced was the participant's goal in becoming a Mathematics teacher. However, Ingmar pictured his role as a teacher as extending beyond the classroom, and into other student-oriented venues. The participant reported that he loved to coach lacrosse, and

believed that there was a strong connection between coaching and relating to students. After a pre-student teaching observation in middle school, Ingmar decided he would prefer to teach at the middle level because he believed that a lot of students “give up” learning at a young age in middle school. However, Ingmar was torn because, ideally, he would like to coach high school lacrosse, which meant that he would need to secure a high school teaching position.

Ingmar’s response to Mathematics Beliefs Survey (MBS) item #2 supported his narrative about how he decided to become a secondary Mathematics teacher—because he always wanted to teach, and Mathematics was his best subject. “Leading Others,” “Influencing Others,” “Teamwork,” and “Interpersonal Skills” were the participant’s TTI TriMetrix Personal Skills that supported his rationale for deciding to enter the teaching profession, i.e., as a coach he had the ability to: organize and motivate people to accomplish goals; personally affect others’ actions, decisions, opinions, or thinking; cooperate with others to meet objectives; and interact with others in a positive manner (Bonnstetter & Suiter, 2008b).

Mathematics beliefs. Mathematics beliefs, as defined by Thompson (1992), included a teacher’s conception of the nature and meaning of Mathematics, i.e., philosophy; on their mental models of teaching and learning Mathematics, i.e., how an individual perceives they best learn Mathematics; an individuals’ preference for types of problems they like to solve; how Mathematics instruction is presented to the individual; and the individual’s perceived difficulties in learning Mathematics. Ingmar’s beliefs were presented as his philosophy, how he believed that he best learned Mathematics, his preference for types of Mathematics problems he liked to solve, the delivery of

instruction he perceived helped him better understand Mathematics, and difficulties he encountered learning Mathematics.

Ingmar dreaded being asked to define Mathematics, and describe his philosophy of Mathematics. The participant admitted that he paraphrased a definition of Mathematics that he referenced in the dictionary, i.e., Mathematics uses symbols, expressions, and shapes to help solve real life problems. The interviewee believed that the following quote from a former high school Mathematics teacher about Mathematics indirectly supported his philosophy of Mathematics: “The moment you stop taking Mathematics classes is the moment that you hear the door of opportunity closing.” From his Mathematics Beliefs Survey results, Ingmar selected his strongest Mathematics philosophy as:

Instrumentalist—Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end. The participant’s belief about the philosophy of Mathematics is supported by his Mathematics Learning Style Inventory (MLS) dominant “Interpersonal” profile, i.e., Ingmar liked Mathematics problems that focused on real-world applications. The participant’s top TTI TriMetrix PIAV was “Theoretical.” This value motivated him to meet with success in the teaching profession, i.e., Ingmar was interested in knowledge, continuing education, and intellectual growth; and saw learning Mathematics as opening doors of opportunity.

Ingmar explained that he “learned Mathematics not the way he wanted to teach it,” and perceived that he learned Mathematics best when he was given a problem, had time to practice it, and then designed his own procedure for solving the problem. The participant believed procedure was the best way to learn Mathematics for him, but as a teacher he needed to make the Mathematics lesson interesting because most students

don't learn procedurally. When Mathematics was made interesting to him he learned it better. Ingmar likened solving problems to formulating a rough draft outline to write an English paper. It should be noted that Ingmar's preference for how he, as a student, learned Mathematics—procedurally, was supported by his “Mastery” dominant teaching style (TLS), i.e., focused on acquisition of skills from a highly organized lesson. In contrast, his understanding of how others might learn Mathematics was supported by his “Interpersonal” Mathematics learning style (MLS), where students learn best when their teachers pays attention to their success and struggles; i.e., most students do not learn Mathematics procedurally.

Role of teaching attributes. Ingmar believed that students learned at different rates and that Mathematics classes contained many levels of student ability. Therefore, to be effective a teacher needed to meet the challenge of crafting instruction for a diverse group of learners. To meet this challenge the participant listed attributes that could be observed in an effective teacher, viz., the teacher: related to the students; used real life applications of Mathematics to create lessons; provided student-centered activities; did not talk down to the students; and was not overly authoritarian. Ingmar believed that the role of the Mathematics teacher was to provide a learning environment where students became independent learners. The Mathematics teacher should be able to do a lot of student-centered work, scaffold instruction, and help students to set individual goals of learning. Ingmar's portrayal of effective teaching was supported by two of his TTI TriMetrix Behavioral Hierarchy areas, “Customer Oriented” and “Versatility,” i.e., the participant advocated a positive and constructive view that a teacher needed to have when working with a wide range of students from a diverse background to achieve “win-win”

academic outcomes; and was easy to adapt to change, maintaining a high level of optimism in order to foster independent learning. “Facilitator” was the role that Ingmar chose to be most important on the Mathematics Beliefs Survey (MBS); and this supported his narrative on how teachers need to develop independent learners – by teaching students to pose and solve problems.

Ingmar believed that he harbored the attributes of an effective teacher, and saw himself as a clone of his high school calculus teacher, i.e., as designing lessons “outside the box.” Ingmar considered his high school AP calculus class was his best taught course because: (a) the teacher related calculus to real life applications; (b) students did projects and presentations; (c) the teacher applied the course to what was going on in our life at the time; and (d) students worked in groups. The participant’s dominant Mathematics Learning Style (MLS) style, “Interpersonal” supported his narrative explanation of effective teacher attributes, i.e., providing instruction that fosters dialog and collaboration (discussions among a community of problem solvers; group projects) on solving Mathematics problems, and problems that focus on real-world applications and how Mathematics helps people.

Perception of the school culture. Ingmar posited that school culture changed from school to school, and that schools do harbor very diverse cultures. The participant believed that school cultures needed to include everyone and be accepting to student differences. The interviewee attributed his view of school culture to his upbringing in a diverse school district, where he experienced conflict between diverse populations in his high school. Ingmar’s belief that a school culture needs to accept diversity was supported by one of his top TTI TriMetrix Personal Skills, “Conflict Management,” i.e., it indicated

his ability to resolve different points of view constructively (Bonnstetter & Suiter, 2008b).

Ingmar was less complimentary about the influence of teachers on the school community. The participant believed that the majority of teachers currently in secondary schools were “coasting,” i.e., they used the same lessons every year, and did not change their instruction; they did not keep up with current educational research; and they did not try to improve their practice. Mediocrity of the teaching practice today was one of the reasons why Ingmar wanted to enter the teaching profession. He considered himself a lifelong learner, and believed that he wanted to be the teacher that students could talk, in areas other than just Mathematics. Ingmar’s TTI TriMetrix PIAV, “Theoretical” interests supported his requirement that teachers needed to be lifelong learners, i.e., he valued continuing education.

Ingmar did not elaborate on the students as part of the school culture, but characterized their parents today as being “unaware.” The interviewee elected not to comment on the role of administrators in the school culture because of his limited contact with school administrators, but conjectured administrators as making sure that everyone in the school was doing what they were supposed to do.

Preparation for student teaching. Ingmar believed that he was not prepared to teach by his college teacher education program. The interviewee commented that he did not understand when he would ever use the high level abstract Mathematics courses that his college required for his teaching degree when developing lessons based on the NYSED Mathematics standards. He believed that he would never use these courses in his teaching practice. Ingmar’s TTI TriMetrix PIAV, “Utilitarian/Economic” supported

his narrative on the usefulness of high level Mathematics classes in the teaching profession; i.e., Ingmar valued practical accomplishments, results, and rewards for his investment of time, resources, and energy into his education.

Ingmar lauded his college for offering a course he took that focused on how to teach special education students. He considered this being the most helpful. The course helped show Ingmar how to organize lesson plans, and how to teach at all different levels. The participant realized that in the teaching practice he will be dealing with many levels of ability in his classes, and he is concerned that he will not be able to “reach” all his students. The interviewee would like to have seen more college courses offered that connected secondary Mathematics courses to real-life applications.

Ingmar’s DISC scores supported his concern about designing instruction to reach a class of students with diverse learning abilities. The participant had high I (Influence) scores and low D (Dominance) scores in both his adaptive (D = 29, I = 84) and natural (D = 35, I = 74) behaviors, which indicated that he was very enthusiastic about teaching, and optimistic that he would do an excellent job. Ingmar portrayed himself as inspiring, persuasive, and warm; as indicated by his high I score. The participant’s low D score indicated that, at times, he can be unsure and hesitant about himself, and is cautious about how he would proceed in teaching. The interviewee exhibited a high I score and a Low D score that, when conjoined (I/D), indicated that Ingmar’s behavior was obliging and concise, and he persuasively and emotionally looked toward people for support and inner-satisfaction more than as a way to reach personal goals.

Post-student teaching.

Assignment. “A predominantly White, affluent middle school” was how Ingmar described his first student teaching placement. The participant was assigned to teach five 8th grade Mathematics classes—two general education and three accelerated classes. The interviewee described the student population as “all willing to learn.” Ingmar reported that the classes were homogeneous in student ability as a result of a tracked Mathematics program. The middle school was rich in teacher resources, as there was an interactive whiteboard in every classroom, and a wide variety of extra-curricular activities were offered. Ingmar liked the fact that the middle school had a lacrosse program, and he had the opportunity to attend student sports events. He claimed he used the opportunity to attend the students’ games as a way to better get to know them. He believed that showing genuine interest in his students fostered his teaching practice.

In contrast to his first placement, Ingmar’s second placement was in a large high school with a diverse student population. The participant was assigned to teach three classes of 9th grade integrated algebra and two classes of 10th grade honors trigonometry. The interviewee described the high school students as unmotivated and difficult to teach. The high school classes were homogeneous in student ability as a result of a tracked Mathematics program. The large size in student population of the high school warranted a large Mathematics department comprised of twenty Mathematics teachers. Ingmar liked the fact that he was able to be in an office with six other Mathematics teachers. The resources in the high school were limited, however, and the participant did not have access to an interactive whiteboard, i.e., his resources included textbooks and chalkboards in each classroom.

Ingmar was afforded the opportunity to work with special needs students in both the high school and middle school. The participant reported that the middle school cooperating shared the special needs student IEPs with him in their entirety from day one of his teaching in the middle school. In comparison, the data sharing was sparse in the high school. Ingmar was made aware of the high school students who had IEPs, but the modifications for instruction were never shared with him by the high school staff. Not knowing the IEP information for his special needs students frustrated Ingmar because he was not able to plan for modifications of his lessons for these special needs students.

Perception of student teaching experience. Ingmar perceived his overall student teaching experience as good because he was placed in two schools with diverse cultures. The participant perceived that the middle school students were easier to teach (it was difficult for him to get the high school students to come up to the board). The interviewee described that in both locations his best teaching days were when he was having fun with the students. Ingmar compared the two student teaching experiences (small, wealthy, all-white middle school; large, diverse, low socio-economic populated high school), and reported that the benefit of teaching in a wealthy district was having access to interactive whiteboards and “lots of resources” that were made available to him in the middle school. Ingmar liked the convenience of going into different middle school classrooms and being able to project his lessons (which he kept on a flash drive) on the interactive whiteboards as he moved from classroom to classroom.

Ingmar preferred the middle school setting to the high school. He perceived the middle school faculty to be “great,” and was able to speak to the principal every day about coaching. Ingmar was even able to secure an interview with the school

administration for a teaching position for the fall, 2010. He liked being invited to attend IEP meetings.

Attributes of cooperating teachers and school culture. Ingmar portrayed his cooperating teachers as both supportive and confident with his instruction. The participant reported that he had the freedom in both placements to teach, and had the opportunity to observe both cooperating teachers, as well as other teachers. The interviewee believed that his visit with his middle school cooperating teacher prior to his September, 2009 placement was proactive in sharing with her what he expected from the student teaching experience. At the meeting, the participant requested from his mentor teacher that he start teaching immediately because he wanted to experience what it was like to teach on the first day of classes. The interviewee also requested that he be able to develop his own grading system. That participant liked the concept suggested by his middle school cooperating teacher that he would be introduced as a co-teacher, and not a “student” teacher.

In contrast to the micro-managing by his middle school cooperating teacher, Ingmar described his high school cooperating teacher as letting him “do his own thing,” and gave him little instructional advice. The participant attributed the “hands off” approach of the high school cooperating teacher to the teacher’s coaching responsibilities. Due to the coaching responsibilities of his mentor teacher, Ingmar claimed that he was virtually left alone in the classroom with his students. Ingmar described his high school cooperating teacher as a “nice guy,” someone the students loved because of his sense of humor.

Outside of the classroom, however, the cooperating teacher made fun of his students' abilities to learn Mathematics; a behavior that perplexed Ingmar. The participant perceived that his high school cooperating teacher's negative view and low expectations of his students achievement impeded the students' progress. Adding to the negativity of the school culture, Ingmar was also surprised at the negative view of the students' academic achievement held by the high school principal. The participant reported that in the high school the negative view of the students was pervasive, and believed that this negativity contributed to Ingmar's description of the faculty as "just trying get through teaching each day." The interviewee noted that the climate in the high school was not conducive to learning, and only students in accelerated classes were perceived to achieve.

Impact on making instructional decisions. Ingmar perceived that he was free to design lessons in both placements. However, the participant reported that his middle school cooperating teacher required that he use her materials and lesson plans to teach. The participant reported that his middle school cooperating teacher assisted Ingmar with his lesson design. "She would give me the lessons and I would kind of tweak them," commented Ingmar. The interviewee identified his middle school cooperating teacher's teaching style as "Mastery," and reported that he had to tweak her lessons so that the student would have to work more cooperatively in groups, a more collaborative setting. The participant explained that his mentor teacher was supportive of his decision to develop cooperative learning experiences for the students. As a result of the cooperating teacher's support, Ingmar was able to design a discovery lesson on the rules for multiplying binomials (FOIL) for the accelerated Mathematics classes. Ingmar noted the

discussion he had with his cooperating teacher where he claimed she wanted him to teach FOIL in one procedural way. The participant decided to use the quadrant method to teach FOIL, in addition to the traditional method required by his mentor teacher.

At the middle school placement, Ingmar reported that he was able to develop his lessons around the NYSED Mathematics standards. The lessons format he described was the traditional procedural strategy, i.e., Ingmar began the lesson with a “Do Now,” gave the students some definitions, reviewed the homework, introduced the lesson, provided problems for the students to do in class, assigned homework, and ended the lesson with exit slips to assess the effectiveness of the lesson. To assist the at-risk students in his general education Mathematics classes, Ingmar used copies of his PowerPoint lesson slides as guided notes for the special needs students. The participant instructed students to use highlighters to identify important items (e.g., equations) on the guided notes in the classroom, and it saved time for the at-risk students who had difficulty copying the notes. Ingmar realized that he was spending a lot of time Xeroxing the guided notes materials; but that by investing time in duplicating the guided notes for his classes, he had more time for instruction.

The high school culture suppressed Ingmar’s instructional decisions. The participant reported that he did not attempt to teach methods other than the traditional procedural format, i.e., he did not get to practice cooperating learning in the high school placement, even though he was left on his own to teach. The participant attributed his decision to keep the traditional teaching format to the fact that when he arrived (8 weeks into the semester), the students were already impacted by his high school cooperating teacher’s procedural format.

Ingmar reported that the high school classes that were assigned to him were composed of the lowest achieving students in the school. To help with instructing the at-risk students, Ingmar wanted to use the same guided notes method he used in his middle school assignment. Ingmar shared the rationale for using the guided notes (that this would help these students understand Mathematics concepts and organize their thoughts) with his cooperating teacher. To his shock and dismay, Ingmar reported that his cooperating teacher discouraged him from using guided notes because the teacher had tried the “guided notes methodology” one time, and was unsuccessful. During the remaining time that Ingmar taught in the high school, he admitted that he taught in the traditional lecture style. Ingmar believed that within that culture it was difficult to teach the at-risk students because they did not care about Mathematics.

Ingmar did not attempt group work with the high school students because he believed that they[the students] could not “handle” group work; only his high school honors students were able to “handle” group work, since Ingmar believed “they chose to be in honors.” Ingmar added that not having access to interactive whiteboard technology in the high school impacted his ability to deeply engage the students in learning. Even though Ingmar had limited resources in the high school, he reported that he was able to use algebra tiles with his high school at-risk students. He also reported that he lack of shared student data (state assessments) by his high school cooperating teacher made it difficult for him to assess the students.

To summarize, Ingmar’s middle school student teaching experience was more supportive of Ingmar’s learning the teaching practice. In both placements, the teachers were traditional; but in the middle school Ingmar was able to convince his cooperating

teacher to let him integrate group work methodologies. In the middle school, Ingmar perceived that his group work went well, but realized that he could not do group work every day. He was able to successfully develop and deliver a discovery lesson to his advanced middle school students. Fielding Mathematics content questions was not an issue for Ingmar, although he said that he would make sure that he was confident in knowing his Mathematics content 100% before he would teach a lesson.

Reflection on practice. Ingmar believed that he met with better success with the middle school students because he started the school year with them, they were willing to learn, and middle school students were eager to please the teacher. The participant deemed that he did not meet with success (according to him, his performance was substandard) in the high school, and he attributed his performance to the fact that the students were already indoctrinated for eight weeks by his high school cooperating teacher's traditional format. Ingmar gauged his limited success in the high school by the number of students (very few) who would come for extra help after school.

If Ingmar was assigned a group of at-risk high school students in a teaching position, he would use the guided note method with them. The participant would persist, and not give up on his at-risk students. Ingmar described his teaching experience (getting students to learn) in the high school as "like pulling teeth." Not having the technology available to engage the high school students, and his cooperating teacher's aversion to guided notes, impeded Ingmar's success with the at-risk high school students. The participant reflected that teacher beliefs and expectations of what students can learn impact student success.

Ingmar leaned that classroom management was key to making teaching easier. In his own teaching practice he would ban cell phones in his classroom, a rule that was lax in the high school, but strict in the middle school. He was bothered by that fact, and didn't understand why his cooperating teacher never addressed the cell phone issue in his high school classes. The participant would run a much "tighter ship."

Ingmar liked the small school setting, and reported the large school to be impersonal. The participant envisioned himself more like his middle school cooperating teacher because she really cared about the students. The participant considered the only similarity he had with his high school cooperating teacher was that they both had the same sense of humor; but did not condone his mentor teacher calling students "idiots."

Outcomes of student teaching. Ingmar liked the small school setting of the middle school because the instruction could be more focused on an individual student. He had never heard of differentiated instruction, but could articulate varied instructional strategies that he would incorporate based on student ability, readiness, and interest. The participant expressed that he would continue to take courses and workshops to improve his practice, i.e., methods courses that would teach him instructional strategies for engaging at-risk students in learning Mathematics. Ingmar perceived the critiques of his teaching practice by his cooperating teachers as constructive and very helpful. He agreed that he needed to improve his articulation, to make his delivery of instruction more clear, and that he needed to "dumb down" his vocabulary and use simpler words.

Being a Facilitator was Ingmar's image of himself in the role of teaching prior to his student teaching experience. After the experience he believed that he needs to create more of a balance between teacher-centered and student-centered instruction. Ingmar

remained optimistic about the education system, even though he has seen teachers and administrators that have “given-up” on students.

Summary.

Section I provided an in-depth narrative of the factors (beliefs, reflection on teaching, social context) that determined the Phase II participants’ autonomy prior to their student teaching placement; and the impact the student teaching experience had on how the Phase II participants made instructional decisions. The Section II narrative compared the level of autonomy reached by the Phase II participants (with the same Mathematics MLS learning style) to the instructional decisions they made during their student teaching experiences. The level of autonomy was determined by the ability of the participants to implement their ideas about instruction into their lessons.

Section II—Qualitative Comparison of the Participants with the Same Mathematics Learning Style

Styles and behaviors supported by study instruments (MLS, TSI, and DISC) scores. Table 72 provides the scores for each Mathematics Learning Style Inventory (MLS) and Teaching Style Inventory (TSI) scored by the Phase II Participants. The bolded scores represent the dominant styles of the participants: “Mastery,” “Understanding” (Under), “Self-Expressive” (Self-Expr.), and “Interpersonal” (Intpr).

Table 72

Mathematics Learning Styles/Teaching Style Inventory Scores

Name	MLS				TSI			
	Mastery	Under	Self Expr	Inter	Mastery	Under	Self Expr	Inter
Mary	67	58	45	28	58	31	11	26
Mark	79	44	34	41	57	23	20	26
Selma	24	52	72	50	23	39	46	18
Seth	24	62	67	45	8	37	43	38
Ursula	52	81	42	23	64	34	12	16
Upton	22	87	70	19	29	58	28	19
Ingmar	47	46	45	60	46	32	8	40

Both the MLS and TSI provide comfort level ranges for each score as follows:

Mathematics Learning Style Inventory Comfort Level

- 90-110 A very strong preference; almost total comfort when using this style.
- 65-89 Comfortable when using this style.
- 40-64 Moderately comfortable when using this style.
- 20-39 Little comfort when using this style.
- 0-19 A very weak preference; uncomfortable when using this style.

Teaching Style Inventory Comfort Level

- 57-70 Very Comfortable in the style.
- 43-56 Comfortable in the style.
- 29-42 Low Comfort in the style.
- 0-14 Very Low Comfort in the style.

Table 72 revealed the comfort level for all four of the Mathematics learning styles (Mastery, Understanding, Self-Expressive, Interpersonal) and the Mathematics teaching styles (Mastery, Understanding, Self-Expressive, Interpersonal) for each of the Phase II participants. For example, Mary was comfortable when using the Mastery style to learn Mathematics (her score of 67 fell in the range 65-89), and very comfortable using the

Mastery teaching style (her score of 58 fell in the range 57-70). Mary felt moderately comfortable learning Mathematics using the MLS Understanding (58) and Self-Expressive (45) styles, and was slightly comfortable using the MLS Interpersonal (28) style to learn Mathematics. Mary's score for the three non-dominant TSI styles of teaching, Understanding (31), Self- Expressive (11), and Interpersonal (26), revealed that she exhibited a low to very low comfort level using those styles to deliver Mathematics instruction.

Table 73 provides the scores for the Phase I participant's DISC scores. The natural behavior scores (Nat) are juxtaposed with the adaptive behavior scores (Adapt). The score of 50 marks the border between high DISC (over 50) and low DISC (under 50 scores).

Table 73

TTI TriMetrix DISC Natural/Adaptive Scores

Name	Nat				Adapt			
	D	I	S	C	D	I	S	C
Mary	13	18	93	98	20	20	91	85
Mark	23	39	82	75	29	41	91	62
Selma	13	86	82	51	29	91	32	62
Seth	92	39	25	33	89	51	23	51
Ursula	58	86	11	51	48	80	41	62
Upton	92	62	2	61	89	41	16	72
Ingmar	35	74	56	41	29	84	59	51

In Section II, the qualitative and quantitative results were compared for the female and male participants having the same dominant Mathematics learning style. It should be noted that the student teaching placement cultures and the relationships between the participants and their cooperating teachers differed. However, the learning/teaching environments reflected the traditional lecture/procedural Mathematics style of instruction.

Section I reported interview information pertaining to each participant with a focus on the impact that the student teaching experiences had on the teaching participants' autonomy, i.e., their "ability to see themselves as [instructional] authorities, evaluate materials, and practice in terms of their own beliefs and practices; and be flexible in modifying their beliefs when faced with disconfirming evidence" (Cooney & Shealy, 1997, p. 88). The descriptions were predicated on each participant's perceptions and respective artifacts confirming the factors (beliefs of Mathematics, beliefs about how Mathematics was learned, reflections on instructional strategies, and behaviors incurred by the social constraints of the school culture) that impacted their autonomy.

The goal of the narrative, Section I of this chapter, was to depict the complexity of the interaction of the factors associated with autonomy; i.e., connections between perceptive behaviors and the perceived actions that were reported by the participants. For example, a participant who held an "Instrumentalist" philosophy of Mathematics, a "Mastery" dominant learning style, a "Mastery" dominant teaching style, and a high DISC score in compliance (C) natural/adapted behavior and was placed in a traditional school instructional setting, likely would have perceived the student teaching experience to be positive. A participant with a "Problem Solving" philosophy, an "Understanding" dominant learning style, an "Understanding" dominant teaching style, a high dominance

(D) natural/adapted behavior, probably would have viewed a similar experience with frustration.

The goal of Section II was to compare the impact on the autonomy of the participants with their Mathematics learning style (MLS) dominant profile. Insight was sought to reveal how or why participants with identical Mathematics learning styles reported different student teaching experiences when immersed in a traditional procedural Mathematics instruction teaching environment.

Mastery Dominant Mathematics Learning Style Cases

Mary. “Mastery” was Mary’s MLS dominant Mathematics learning style (see Table 72). With a score of 67 for the “Mastery” style, the participant was rated as comfortable when using this style to learn Mathematics (see Mathematics Learning Style Inventory, (Bonnstetter & Suiter, 2008c).Appendix A) She believed that she learned Mathematics best by computation of modeled problems and by memorizing definitions and theorems; categories that support the “Mastery” (MLS). For example, Mary liked computer programming because she could decipher and fix programs. The participant’s “Platonic” philosophy of Mathematics supported her belief that Mathematics needs to have some application to real world problems. She did not like solving Mathematics problems that were abstract, and had difficulty with learning non-Euclidean geometry at the college level.

“Mastery” was Mary’s (TSI) dominant teaching style (see Table 72). She scored a 58 for “Mastery,” indicating that she was rated as very comfortable teaching in that style (see Teaching Style Inventory, Appendix A). The participant preferred a teaching environment that provided instruction in an organized and methodical manner; like the

instructional routine set forth by her first cooperating teacher. The participant described her cooperating teacher as procedural, and able to engage the students in learning Mathematics.

“Alert and ready to adapt to respected systems and procedures,” was verbiage used to describe Mary’s natural and adaptive DISC behaviors in the school culture. For example, the participant’s high Compliance (C), and steadiness (S) scores (see table 69) indicated the participant’s acceptance of her student teaching assignment, despite knowing that it was not going to allow her to practice her instructional skills. Mary accepted her placement in three inclusion classes that were structured to use three teachers to deliver instruction collectively, but they did not allow her to lead a lesson for her entire first placement. Mary admitted that she used her cooperating teacher’s notes to plan her lessons, and did not teach one lesson on her own.

Mary described her student teaching placement to be in a traditional setting with one non-traditional component, the 80-minute block period. In her pre-service interview, Mary could identify alternative instructional strategies that could be implemented for the 80-minutes, but did not advocate to her cooperating teacher her desire to implement those strategies. Instead of asking how to design instruction for the block, the participant thought that extra time afforded by the block schedule should be filled with activities, such as using manipulatives.

Mary was able to describe “good instruction” in her pre-student teaching interview as integrating alternate instructional strategies (use of technology, manipulatives, visual representation, exit slips, journaling, differentiated instruction based on student interests) into lessons, but was not able to implement those strategies

into her teaching practice. The participant confessed that she did not have the confidence to execute alternate instructional methodologies. She attributed her failure to implement strategies to the fact that the methodology was not modeled by her pre-student teaching methods courses, or by her cooperating teachers.

When faced with disconfirming evidence about how to teach properties of quadrilaterals, Mary was not able to comprehend the constructivist instructional approach, or ask her cooperating teacher to explain the constructivist strategy. For example, the participant could not identify the rationale for why her cooperating teacher did not want her to share the formulas for quadrilaterals with the students before they understood the properties of quadrilaterals. Mary's lack of understanding of why students need to construct an understanding of geometry may be related to her belief that Mathematics is difficult when abstract; and best learned by memorization.

Even though the participant could identify alternate teaching strategies, the impact of the student teaching experience on Mary's autonomy confirmed her belief the traditional procedural manner is how Mathematics needs to be taught. Mary condoned the procedural instructional style of her middle school cooperating teacher, and would like to maintain a traditional classroom in her practice.

Mark. "Instrumentalist" was chosen by Mark (on the Mathematics Beliefs Survey) to be his strongest view of a Mathematics philosophy, even though he could not articulate his Mathematics philosophy when interviewed. The participant's philosophy choice was supported by his dominant learning style. "Mastery" was Mark's MLS dominant learning style (see Table 72). The participant's "Mastery" score of 79 indicated that he was comfortable when using this style to learn Mathematics, i.e., he learned Mathematics best

by computation of modeled problems and characterized calculus as difficult, due to its abstract nature. The participant's favorite course was algebra because of its problems, which he perceived could always be worked out like solving a puzzle and thereby always made sense.

A "Mastery" score of 57 on Mark's TSI indicated that he was very comfortable using the "Mastery" teaching style to develop and deliver instruction. The score was supported by the participant's narrative where he described a step-by step (traditional mastery instruction) lesson format in both his pre- and post-interview, and stated that he believed that Mathematics lessons needed to be focus primarily on drill and practice. In his pre-student teaching interview, Mark identified a limited number of alternative instructional strategies, i.e., groups, students teaching students, and designing lessons based on student interest. The unit plan the participant submitted as an artifact represented the traditional procedural Mathematics worksheets, with many practice problems.

"Especially wary of making change, which may damage long-standing relationships and/or was contrary to deeply ingrained techniques and procedures" was the verbiage used to describe the behaviors exhibited by an individual like Mark, with a high C (Compliance) and High S (Steadiness) (see Table 73). The participant adapted to teaching an 80-minute block lesson, but did not condone the practice, i.e., the participant believed that 80-minute periods were too long for 7th graders to learn Mathematics. The participant complied with the block program and did not inquire about what the rationale was for the school to provide only the 7th grade students with a block schedule.

Mark reported that he spent 100-hours of observations of Mathematics classed that were all a traditional setting. The participant never experienced alternative teaching methods, as he was placed in traditional instructional settings for his pre-student teaching field experiences and both of this student teaching experiences. The only alternative strategy implemented by Mark was the cooperative learning lesson he designed and was required to teach. However, the participant had difficulty transferring the collaborative instructional methods (like cooperative learning) into designing instruction for 80-minute block periods. The participant's "Master" teaching style fit into the traditional instructional school settings, as supported by Mark's comment that his cooperating teacher reported that her transition back into class after Mark left was seamless; indicating that he had duplicated her traditional style.

The impact of the student teaching experience on Mark's autonomy was supportive of the traditional procedural manner in how Mathematics was taught, i.e., he was making instructional decisions. The participant constructed "packets," a curriculum resource requirement of his middle school and high school placements, which did not afford him the opportunity to design his own lessons and curricular material, implement alternative teaching methods, or explore textbook resources.

Mark and Mary shared TTI TriMetrix PIAV "Social" and "Individualistic /Political" values, i.e., they both valued opportunities to be of service to others and contribute to the well-being of society; and they valued personal recognition, freedom and control over their own destiny and others. The participants reported that the students they taught were respectful and appreciative of their efforts as teachers. Mary's students did not want her to leave because she reported she was able help them, and Mark was

able to engage the at-risk students in Mathematics, despite their personal problems.

Mary and Mark's DISC score graphs were similar, placing them in the DISC categories of "Supporter/Coordinator" that described the participants as accommodating, disliking confrontation, adaptable, and slow to change. Mark had the advantage of being placed in two traditional instructional school settings with cooperating teachers that had "Mastery" traditional teaching styles. If Mary had encountered a cooperating teacher in her second placement that had a "Mastery" traditional style of teaching geometry by memorization, the participant likely would have remained to finish her second placement. The participant made instructional decisions in her second placement based on her Platonic belief of Mathematics, her "Mastery" dominant learning style, and "Mastery" teaching style, such as providing formulas for her students to use to calculate the area and perimeter of quadrilaterals. Her traditional instructional decisions led to conflict with her cooperating teacher's instructional beliefs. Mary exhibited a low level of autonomy, as she was not able to modify her beliefs when faced with disconfirming evidence presented by her cooperating teacher.

Understanding.

Ursula. An "Instrumentalist" Mathematics philosophy was selected as her strongest view by Ursula on the Mathematics Beliefs Survey (MBS). The participant's definition of Mathematics as being a "study of numbers, like counting, measurements, logic, [and] shapes" supported her choice of philosophy on the Mathematics Beliefs Survey (MBS).

It is not uncommon for individuals to have dominant Mathematics learning styles different from their dominant teaching style. A high score for "Understanding" (81), on

the Mathematics Learning Style Inventory (MLS) indicated that Ursula was very comfortable when using this style to learn Mathematics. The participant's pre-student teaching interview description of how she learned Mathematics and how she would teach Mathematics indicated an "Understanding" dominant style. For example, Ursula wanted to construct the meaning of Mathematics concepts for Mathematics students, just as she needed to do for herself when she learned Mathematics. In her student teaching practice, her teaching style did not support her learning style. A high score of 64 for the "Mastery" teaching style (TSI) indicated that Ursula was very comfortable in delivering Mathematics instruction in a highly structured environment, emphasizing the acquisition of skills and information. Ursula exhibited the "Mastery" teaching style (lecture, drill, and practice worksheets) when she prepared two sets of worksheets for the 80 minute block schedule in her first placement, based on a topic that was given to her the night before by her cooperating teachers.

Ursula exhibited a difference between how she perceived Mathematics should be learned and taught (i.e., student understanding of Mathematics concepts and the teacher explaining the concepts) and how she delivered instruction in her 8th grade Mathematics placement (i.e., procedural worksheets). Ursula was aware of her beliefs about how she learned Mathematics and how she would teach Mathematics, but she did not act on her beliefs. The "Instrumentalist" philosophy did not support the participant's description of how she learned with an "Understanding" style Mathematics, but was supported by how Ursula believed that Mathematics should be taught in a "Mastery" style.

Ursula's withdrawn behavior due to the social constraints of the school culture of her first placement was born out of frustration with her relationship with her cooperating

teacher. Her DISC scores (High I, Low S) indicated that she was people-oriented, optimistic, and trusting. Being isolated from both her cooperating teacher and the middle school faculty may have prevented her from deciding to use the 80-minute block schedule for crafting lessons using non-traditional learning strategies in her lesson design.

Ursula's autonomy was impacted by the social constraints of the high school culture. The participant's TTI TriMetrix PIAV "Theoretical," "Utilitarian/Economic," and "Individualistic/Political" were compromised by her isolation, i.e., she was not engaged in "learning" how to teach, a reflection of her "Theoretical" value; she did not see any results and rewards for her invested time, resources, and energy—a reflection of her "Utilitarian/Economic" values; did not experience personal recognition by her cooperating teacher; and did not have freedom and controls over her classroom—a reflection of her "Individualistic/Political" values. As a result, Ursula's level of autonomy was stunted, as she did not have the freedom to make instructional decisions in her first placement and was not able to design instruction that was standards-based in her second placement.

Upton. "Problem solving" was selected by Upton on the Mathematics Beliefs Survey (MBS) as his strongest view for his Mathematics philosophy. The participant strongly supported his philosophy by providing an exact appellation, "formalist," for his Mathematics philosophy, and by explaining how the "formalist" philosophy was integrated into Mathematics education. Upton was able to connect his philosophy on Mathematics with how he learned Mathematics best, i.e., posing questions to find "why" a solution to a Mathematics problem worked, and with how he intended to teach

Mathematics as a facilitator through discussion (emphasizing problem posing and solving, leaving the students to wonder “why”).

Upton had a dominant “Understanding” profile for both his Mathematics learning and teaching styles. The participant’s high MLS score of 87 for “Understanding” indicated that he was comfortable using this style to learn Mathematics, and was supported by his belief that as a philosophy major he had insight into his understanding of Mathematics. In his pre-student teaching interview he was able to connect the “Problem Solving” view to how he learned Mathematics, i.e., by asking the “why” theorems, rules, and laws that were used in Mathematics were created.

A high TSI score of 58 for his “Understanding” profile indicated that Upton was very comfortable with this teaching style. His dialogue in his pre-student teaching interview supported his “Understanding” styles, as he believed that an effective Mathematics teacher instilled understanding of Mathematics concepts rather than teaching to a test (i.e., NYSED Regents exam). Upton believed that learning Mathematics was most valuable in improving critical thinking in students.

Upton’s “Understanding” styles were evident in his student teaching practice, and led to his frustration with the traditional school instruction. For example, he explained how he was disillusioned when his cooperating teacher pushed him to cover the Mathematics content, rather than getting the students to understand the concepts. To add to his frustration, Upton reported that he was isolated from the faculty in his first placement, and had few Mathematics teachers with whom he could consult in his second placement. Due to Upton’s having a clear understanding of what Mathematics meant to him, he saw himself as an authority. As a result of the depth of his understanding, he was

able to evaluate the materials and instructional practices in both placements. In his first placement, for example, he saw an apparent disconnect in the logic of the scope and sequence of the NYSED geometry curriculum with constructing meaning of Mathematics concepts. He was able to accurately formulate how he would design geometry instruction. Upton's high level of autonomy was impacted by the traditional instructional settings of his student teaching placements. He was not able to practice his teaching style or create the type of classroom learning environment that fostered understanding of Mathematics concepts.

Upton commented that he did not view "student teaching" as a realistic situation, but saw it as appeasing the cooperating teachers. Having a high D (Dominance) DISC score indicated that he could be an egocentric problem solver that disliked routine. Combined with Upton's low S (Steadiness) score, these indicated that he was results oriented. Not having the opportunity to be successful at teaching symbolic logic to the non-honors high school students and simultaneously being pushed by his cooperating teacher to rush through the curriculum impacted his instructional decisions, and produced a high level of frustration. He knew what he needed to do to improve his instruction (create a learning environment that fostered student understanding Mathematics), but could not make the change. For example, he realized that he needed to pre-assess the non-honors students before he designed a lesson to ascertain if they had the knowledge, i.e., knowing the difference between the vertical and horizontal axis.

Upton's TTI TriMetrix PIAV values (Theoretical, Utilitarian/Economic) were the same as Ursula's. Both participants' values were compromised by the social constraints of the cooperating teachers and the school culture. Like Ursula, Upton was not able to

discuss with his cooperating teaching the rationale behind the geometry curriculum sequence, a reflection of his theoretical value; did not see any results and rewards for his invested time, resources, and energy, a reflection of his “Utilitarian/Economic” values; and received negative personal recognition by his cooperating teachers and did not have freedom to design curriculum, a reflection of his “Individualistic/Political” values. Like Ursula, Upton believed that he lost confidence in his ability to teach as a result of his student teaching experience.

Upton and Ursula perceived their student teaching experiences to be non-conducive to their development as teachers. They held the same personal interests, attitudes and values (PIAV) that were compromised by the social constraints of the school culture and their poor relationship with their cooperating teachers. The graphs of their DISC scores placed Ursula and Upton in different success categories. Upton was placed in the “Conductor” category, indicating that he was competitive, confrontational, had a sense of urgency and was a change agent. Ursula straddled between “Persuader” and “Promoter,” indicating that she was process-oriented, independent, optimistic, had a high trust level, and projects self-confidence. Both Ursula and Upton might have exuded a perception of themselves as an authority by their strong behaviors; and this might have proved daunting to deal with by their cooperating teachers. It was Upton and Ursula’s conflicted relationships with their cooperating teachers that impacted their instructional decisions.

Self-expressive.

Selma. “Problem solving” was the view that Selma selected on the MBS as her philosophy of Mathematics, supported by her pre-student teaching narrative stating she

believed Mathematics to be a set of rules that gets a person to think abstractly about the world. The participant was able to articulate her beliefs about Mathematics as having many realms connected by logical steps that are an integral part of the culture. And she connected her philosophy with: how she learned Mathematics best, i.e., by creating a visual representation of a problem; and with how she intended to teach Mathematics as a Facilitator – emphasizing problem posing and solving.

Selma held a “Self-Expressive” style as dominant in both her Mathematics learning style and teaching style, determined by a score of 72 on the Mathematics Learning Style (MLS) that indicating she was very comfortable using that style. In her pre-student interview, Selma described how she would visualize problems before she proceeded to solve them. A 58 score for her “Self-Expressive” style on the Teaching Style Inventory (TSI), indicated that Selma was very comfortable teaching in that style. The participant’s identification of the attributes of a good teacher was supported by her “Self Expressive” profile, i.e., she believed that a good teacher brought new ideas into instruction, inspired and challenged students, and identified alternative methods of instructions. As an artifact, Selma submitted as a discovery Mathematics lesson that she deemed successful.

Selma’s perception of the positive relationships she had with each of her cooperating teachers was supported by her DISC scores. The participant had a high I (Influence) and low D (Dominance) score, which indicated that she exhibited behaviors that she was obliging and accommodating; and she persuasively and emotionally looked to people for support and satisfaction more than to help her reach a personal goal. Selma’s TTI TriMetrix PIAV values (“Theoretical,” “Utilitarian/Economic,” “Social”)

were not compromised by the social constraints of the school environments in either of her placements, i.e., she welcomed learning about class management (how to manage difficult students) from her cooperating teacher (support for her “Theoretical” PIAV value). The diverse population caught Selma’s interest about mitigating conflicts in the classroom between Hispanic and Black students (support of her TTI TriMetrix Personal Skill “Social”). The participant perceived her student teaching experience as going beyond her expectations (supporting her “Utilitarian/Economic” PIAV values) in preparing her for teaching.

Selma regarded the *carte blanche* given to her to design lessons as acknowledgment of her as an authority in Mathematics instruction. For example, she was able to evaluate her materials and practices, using the CMP standards based Mathematics program as a resource. The participant exhibited a moderate level of autonomy; i.e., she was able to make instructional decisions regarding accelerated and general education students, but believed that she was unable to successfully create instruction for the at-risk students. As a result of her student teaching experience, she preferred only to teach students of average to above average ability and expressed her belief that teaching at-risk students was a chore rather than a challenge.

Selma’s high I DISC score indicated her behavioral strengths to be socially and verbally aggressive, people and team-oriented, and she was motivated by praise and strokes. However, individuals that have a high I (Influence) DISC score have the possible limitations of being unrealistic in appraising people, a limitation that may have affected Selma’s decision not to implement her discovery lesson to instruct her middle level students or at-risk high school students. Selma believed that the discovery approach was

not suited for the lower level students, who could not “handle” that strategy. Selma’s autonomy was impacted when she did not execute her beliefs (all students can learn) about differentiated instruction strategies for middle level and at-risk students, and implement the discovery method to engage students in learning and understanding Mathematics.

Seth. Seth selected the “Problem Solving” Mathematics philosophy on the Mathematics Beliefs Survey (MBS). Not being able to articulate his concise Mathematics philosophy in his pre-student teaching interview, the participant described Mathematics as “not arithmetic,” and a content area that was applicable to solving real world problems. Seth believed that studying Mathematics and solving problems improved an individual’s ability to think. The participant’s “Problem Solving” philosophy was evident in his rationale for why he chose trigonometry as his favorite course – because the course content demonstrated real life applications of Mathematics.

Like Selma, Seth had a dominant “Self Expressive” profile in both the Mathematics learning and teaching styles. The participant’s high score of 67 on the MLS for “Self Expressive” Mathematics learning style indicated that he was comfortable when using that style to learn Mathematics. The participant’s high score of 43 for his “Self-Expressive” dominant teaching style (TSI) indicated that he was comfortable teaching in the Self-Expressive style, and expressed a great desire to create lessons that caught the interest of his students (see Teaching Style Inventory, Appendix A).

Like Selma, Seth exhibited a moderate level of autonomy when confronted with the teaching practice, but for different reasons. In both teaching situations he had to deal with a pre-arranged curriculum that he struggled with to accept and alter. His decision to

leave the teaching practice before he finished student teaching hampered his enthusiasm for improving his practice. Seth's observations of the teaching routine and the high tolerance his teaching colleagues exhibited for poor student behavior drove him to leave the teaching profession.

Unlike Selma, Seth's DISC scored high in D (Dominance) and low in S (Steadiness). High D scoring individuals, like Seth, tended to be quick to anger, and had a "short fuse." The participant did report that he experienced difficulty in classroom management, and realized that he did not have the patience and energy to discipline unmotivated students. The vision of his role as a teacher (he thought he was a good explainer) was challenged when his students did not understand his explanations of Mathematics definitions and concepts. When Seth revised his explanations he met with frustration when all the students still did not "get it." Not meeting success explaining Mathematics quelled Seth's drive for results (high D attribute), which reinforced his conclusion that there were students that would never learn Mathematics.

Seth's disregard for the NYSED Mathematics curriculum, coupled with his belief that not all students should learn algebra (but rather some other applied Mathematics), dissuaded him from the teaching practice. The participant believed that he was not cut out to be a teacher. He made his decision not to become a teacher during his first placement student teaching assignment, but decided to finish out the entire student teaching assignment in order to complete his teaching certification.

The participant's expressed frustration in the teaching practice was rooted in his motivational values associated with his personal success in the teaching profession.

Seth's motivational values, as identified by the TTI TriMetrix PIAV "Social,"

“Individualistic/Political,” and “Theoretical,” were compromised in that he did not consider himself as being able to serve the needs of the students as a Mathematics teacher (“Social”). He believed that the NYSED Mathematics curriculum was too constricting, and did not afford him the freedom and control over instruction that he believed he needed (“Individualistic/Political”); and he saw the Mathematics curriculum stalling the intellectual growth of the students (“Theoretical”). For example, Seth observed the same topic, polynomials, being taught in successive middle level grades through grade nine. With the same Mathematics topic repeated for each grade, the participant believed that this curriculum practice impeded the intellectual growth and academic achievement of his students.

Selma and Seth had the identical Mathematics philosophy, “Problem Solving” and “Self-Expressive dominate Mathematics and teaching styles. They only differed in one TTI TriMetrix PIAV value: Selma harbored the “Utilitarian/Economic” and Seth the “Individualistic/Political.” They differed in their DISC scores: Selma was high in I (Influence) and Seth was high in D (Dominance), which placed them in different locations on the DISC success insight categories. Seth fell into the “Conductor” category and Selma fell in both the “Promoter” and “Relater” categories. Therefore, there was a difference in the way Seth adapted his behavior to the social context of the teaching practice compared to how Selma adapted her behavior. According to Bonnstetter and Suiter (2004): “Conductors” tended to be competitive, confrontational, results-oriented, and change agents; “Promoters” tended to project self-confidence, have a high trust level, and have good verbal skills; and “Relaters” were team players, cooperative, persistent and were sensitive to other’s feelings. The afore-mentioned behavioral characteristics

indicated how Selma and Seth behaved in the social context of the school system. When placed in the social constraints of the school culture, Selma and Seth had different experiences. Even though both claimed to have had positive experiences with their cooperating teachers, and had the same philosophies and dominant Mathematics learning and teaching styles, what motivated their behaviors produced different outcomes in their decisions to remain in the teaching profession.

Interpersonal.

Ingmar. On the MBS, Ingmar selected the “Instrumentalist” Mathematics philosophy as his strongest view of Mathematics. Not being able to craft a definition of Mathematics, Ingmar used the dictionary to craft his answer. The participant admitted that, at times, he needed to learn Mathematics procedurally, which supported the philosophical view that Mathematics was an accumulation of facts, rules and skills to be used in the pursuance of some external end.

Ingmar’s high score of 67 for the “Interpersonal” Mathematics learning style on the MLS indicated that he was comfortable when using his dominant style for learning Mathematics. The participant admitted that he learned Mathematics best when it was made interesting to him and taught collaboratively, like his high school calculus course. It should be noted that an individual does not always have the same Mathematics learning style and teaching style profile. It is not uncommon to find individuals whose teaching style (TSI) was “Mastery,” like Ingmar’s, being different from their learning style. The participant’s teaching style score was 46 for “Mastery,” indicating that he was comfortable using that style to deliver instruction. The participant, however, did not condone the “Mastery” teaching style in his interviews both pre- and post-student

teaching, and he did not support a straight lecture method. Another contrary piece of data was Ingmar's choice of Facilitator as his role as a teacher. "Mastery" teaching style was indicative of him embracing the lecturer teaching role, contrary to Ingmar's belief that hands-on projects, portfolios, collaboration, and reciprocal coaching, as the most valuable instructional strategies that teachers used to deliver instruction as a Facilitator.

Ingmar's teaching actions in his student teaching assignments provided evidence for his natural and adaptive behaviors within the social context of the school culture. The participant's high DSIC score for I (Influence) supports his ability to persuade people. He was team and people-oriented. For example, Ingmar was able to persuade his middle school cooperating teacher to let him start teaching his classes the first day in September, 2009. Ingmar was able to get his cooperating teacher to agree to let him use student-centered, collaborative instructional strategies in his lessons. Based on his coaching experience, he did consider himself as somewhat of an authority on group learning. Therefore, in the participant's middle school placement, with the support of his cooperating teacher, Ingmar was able to implement non-traditional instruction.

Ingmar exhibited a moderate level of autonomy in that he was able to make instructional decisions with average and high ability level classed, but when placed in a high school setting with at-risk students, virtually left alone to teach, he admitted to reverting to teaching the students in a traditional manner, which reflected his "Mastery" teaching style. Ingmar, when left alone with the high school students, was not able to implement alternate instructional strategies that were developed to reach the at-risk student.

Ingmar's DISC scores were graphed, and showed Ingmar's straddled the "Promoter" and "Relater" categories. The participant's natural behaviors placed him in the "Promoter" category, and his adapted behaviors placed him in the "Relater" category. An explanation for Ingmar's split actions may be based on the fact that when individuals are under stress or are very relaxed, their natural behaviors emerge. In between stress and relaxation environments, individuals generally exhibit adaptive behaviors. Either Ingmar was stressed or relaxed at having his cooperating teacher remain in the room during his first student teaching placement, since he exhibited the self-confidence of a "Promoter," i.e., he had a high trust level of the situation and he was able to implement alternate instructional methods. However, the absence in the classroom of his high school cooperating teacher removed the stress of teaching, and Ingmar exhibited the behaviors of a "Relater," i.e., supportive of the cooperating teacher's mastery teaching style, acting as a team player, and accepting the routine that was established prior to Ingmar's arrival.

It should be noted that there was a dearth of female pre-service participants (1 in 4 interpersonal dominant learning styles). One female was student teaching in the second semester, and did not meet the requirements to participate in the second phase of the study, leaving a gap in the comparison of the two participants with an "Interpersonal" dominant Mathematics learning style. It has been the experience of the researcher that the "Interpersonal" Mathematics learning style was the least often represented in Mathematics teachers.

Cross Case Analysis

Regarding research question #4 (To what extent do the open-ended themes of qualitative analysis support and clarify the quantitative survey results?), qualitative and

quantitative results were reported for participants across all the cases in this section. Cross case themes and categories were represented in Table A (Pre-Student Teaching Themes, Sub Themes, and Categories) and Table B (Post-Student Themes, Sub Themes, and Categories). Both tables (Table A and Table B) are to be found in Appendix F The cross case analysis results were reported as narratives for each theme. In addition to the cross case narrative analysis, the researcher included cross case artifact similarities exhibited by the Phase II participants.

The themes and sub themes were listed as follows:

- I. Pre-Student Teaching Cross Case Analysis (Table A) – Themes (Sub Themes)
 - A. Rationale for Teaching – (personal connection to real world experience, preferred grade level).
 - B. Attributes of the Role of Teaching – (good teaching, attributes reflective of the participant's dominant Mathematics learning style, poor teaching).
 - C. Mathematics Beliefs – (how Mathematics was learned by the participant, how Mathematics was learned by others, favorite Mathematics course attributes, application of Mathematics to life, definition of Mathematics, philosophy of Mathematics).
 - D. Perception of School Culture – (students as learners, school learning environment).
 - E. Perception of the Teacher Program Preparation for Student Teaching Experience – (content preparation, methodology, observer teaching practice, student teaching expectations and concerns).

II. Post-Student Teaching Cross Case Analysis (Table B) – Themes (Sub Themes)

- A. Perception of the Student Teaching Experience – (overall culture of the placements, opportunity to teach, opportunity to plan instruction, use of data, IEPs/NYSED Mathematics standards to assess students).
- B. Cooperating Teacher Attributes – (perceived relationship, perceived cooperating teacher teaching style).
- C. Impact on Instructional Decisions – (instructional strategies implemented by the participants, instructional strategies impeded by the student teaching experience).
- D. Perceived Impact on the Participant’s Teaching Practice – (instructional practices, format for lessons, developing lessons for the future teaching practice).
- E. Summary of Outcome Suggestions for Teacher Preparation Programs

Pre-student teaching.

Rationale for decision to teach. The decision to become secondary Mathematics teachers by the seven participants in Phase II, multiples-case study, was supported by their TTI PIAV motivator values. Six (Ingmar, Mary, Seth, Selma, Upton, Ursula) of the participants’ inner drives were motivated by their theoretical values of knowledge, continuing education, and intellectual growth. Six (Ingmar, Ursula, Seth, Mark, Mary, Upton) of the participants harbored “Individualistic/Political” motivating values: personal recognition, freedom and control over their own destiny and others. Five (Seth, Selma,

Upton, Mary, Mark) of the participants had “Social” motivation that indicates the passion to assist others.

The secondary Mathematics teaching practice provided the workplace environment where the aforementioned TTI TriMetrix PIAV values supported the cross case theme’s rationale for teaching as having an interest in Mathematics for five of the participants (Mary, Ursula, Selma, Mark, Upton); and viewing teaching as a positive experience for four of the participants (Ursula, Selma, Seth, Ingmar). The “Social” TTI TriMetrix PIAV motivator was supported by the cross case theme “Role of Teaching,” i.e., students needing role models was a factor in three participants’ decision to teach (Selma, Ingmar, Mark). It should be noted that 16 of the Phase I participants (N = 30) on the Mathematics Beliefs Survey (MBS) item #2 identified interests in Mathematics and having a positive experience teaching others as the reasons for entering teaching. Only one of the Phase I (N = 30) participants listed “wanting to be a role model” as their rationale for teaching.

None of the Phase I participants identified that teaching Mathematics offered more opportunity for employment as a reason to decide to teach. The economy may have been a motivating factor, as three of the multiple case Phase II participants (Mary, Upton, Seth) mentioned the need for Mathematics teachers in the job market as helping them with their decision to teach Mathematics. All seven of the Phase II multiple case studies’ participants were able to connect their decision to become a Mathematics teacher to their real world job markets (computer science, market research, professor, sports, mentoring, coaching) that represented salaried positions.

Mathematics beliefs. The “Mathematics beliefs” system encompassed three levels: an individual’s perception of what Mathematics is (i.e., how they defined Mathematics and their respective philosophy of Mathematics); how an individual perceived they learn Mathematics (e.g., step-by-step, creating and solving problems, visualization, and discussion); and how Mathematics is taught (e.g., focused on clear outcomes, student interest, intellectual challenge, and exploring creative possibilities). The center of the belief system, the individuals’ philosophy of Mathematics, impacts the Mathematics learning belief and teaching style beliefs (Ernest, 1989). For example, an individual that harbored a strong “Problem Solving” philosophy may exhibit dominant “Understanding” or “Self-Expressive” learning and/or teaching styles. Likewise, an individual with an “Instrumentalist” philosophy may exhibit dominant “Mastery” or “Interpersonal” learning and teaching styles. The following cross case results identified critical aspects of pre-service secondary Mathematics teachers’ Mathematics belief systems that related to their definition and philosophical view of Mathematics.

Five participants (Mary, Ursula, Selma, Mark, Ingmar) found that defining Mathematics and positing their Mathematics philosophy was the most difficult question to answer in the interview. It should be noted that the seven multiple-case Phase II participants had access to the pre-student teaching interview questions two-weeks prior to the scheduled interview. The researcher provided the opportunity for the interviewees to raise any questions about the interview process or content. The participants admittedly deferred to dictionaries for their definitions, and were able to craft the following definitions of Mathematics: a “system of numbers, logical and special relationships used in everyday life,” or “a set of rules that gets a person to think abstractly.” Mark and Seth

were able to conjure up a definition of Mathematics, but could not articulate a clear philosophy. Seth defined Mathematics as “not arithmetic.” Upton was able to describe what Mathematics meant to him by defining Mathematics in his own words and selecting a philosophy, “Formalist.” He had the opportunity in his pre-service studies to glean understanding of how to relate a philosophy to a definition. Upton’s ability to philosophize was linked to his passion for studying logic and making real world connections.

It should be noted that an individual Mathematics learning style profile was comprised of all four learning styles. Each participant was able to identify a category that aligned with their learning style, and identified the other profiles. Participants believed that they learned Mathematics by computation of modeled problems (Mary, Selma, Ursula, Mark ,Upton, Ingmar); by visualizing problems (Ursula, Selma, Seth); by memorizing definitions, theorems, and proofs (Mary, Upton); by collaborating and reciprocal coaching and creating their own problems (Ursula, Upton). The aforementioned list reflected not only the participants’ dominant Mathematics learning styles, but supported the profile of their other three Mathematics learning styles, i.e., categories represented the four Mathematics learning styles: MLS—“Mastery” (computation of modeled problems, memorizing definitions, theorems, proofs); “Understanding” (creating your own problems); “Self Expressive” (visualizing problems); and “Interpersonal” (collaboration). All participants agreed that the results of their MLS inventory identified their dominant Mathematics learning style.

All seven of the multiple case Phase II participants were able to identify learning strategies that were different from how they learned Mathematics: by hands-on projects,

portfolios, manipulatives (Mary, Ursula, Ingmar); by engaging in solving real world problems and discussing Mathematics in a group (Seth, Ingmar); and by interest (Mark, Seth, Ingmar). The participants articulated the application of Mathematics to the fields of science and engineering (Mary, Ursula, Selma, Mark, Seth, Ingmar). Three participants identified Mathematics as useful in solving everyday life problems such as finances, budgeting, and purchasing items (Selma, Mark, Upton).

All seven participants provided examples of their favorite course attributes that supported their learning styles: Mary and Mark, as “Mastery” style Mathematics learners, liked computer programming and high school algebra (respectively) and the step-by-step solving of problems; Ursula and Upton, as “Understanding” Mathematics learners, preferred college geometry and symbolic logic (respectively) for the abstract discovery learning posing of problems; Selma and Seth, as “Self-Expressive” Mathematics learners, preferred pre-calculus and trigonometry because of the new Mathematics content and the visual nature of the courses; and Ingmar, an “Interpersonal” Mathematics learner, liked his high school AP calculus course because it was taught collaboratively.

Role of teaching attributes. All of the participants were able to identify one of their dominant Mathematics learning style characteristics as their preferred role in considering teaching attributes. A good teacher needed to: be organized and methodical (Mary, “Mastery”); explain why (Ursula, “Understanding”); bring new ideas into instruction (Selma, “Self- Expressive”); know their Mathematics content (Mark, “Mastery”); teach understanding of Mathematics concepts (Upton, “Understanding”); provide visual representations of problems (Seth, “Self-Expressive”); and provide collaborative opportunities to discuss Mathematics (Ingmar, “Interpersonal”).

Six of the participants (all but Seth) said that good (effective) teaching was related to the relationship a teacher established with his/her students, and by providing an emotionally safe, respectful classroom climate. Six (all but Selma) of the participants perceived that a good (effective) teacher designed lessons that related to student interests. Included in the list of attributes of good teaching were: the ability to develop lessons that demonstrated real life application of Mathematics (Mary, Seth, Ingmar); the ability to provide instruction that inspired and challenged all students (Mary, Ursula, Mark); the ability to respect learning differences (Mary, Upton); and the ability to make learning Mathematics creative and fun (Mary, Selma).

Poor teaching practice was characterized by four (Mary, Ursula, Selma, Upton) multiple- case Phase II participants as primarily lecturing, and providing worksheets for students with no explanation as to how the Mathematics concepts they (the students) were learning were applied to the real world. Teachers who were insensitive to student interests and differences were considered inept (Mary, Selma, Seth, Upton, and Ingmar). Teaching to the test was considered poor teaching because it impacted teaching for understanding (Mary, Selma, and Mark).

It should be noted that the participants based their beliefs about good and poor teaching practices on how a teacher needed to differentiate instruction based on student interest (student- centered), not about the teaching style of the teacher. It should be noted that all seven of the multiple-case Phases II participants received their Teaching Style Inventory (TSI) scores prior to their pre-student teaching interview. Not one participant referred to their dominant teaching style, even when asked to reflect on their TSI results by the researcher.

Perception of school culture. The school culture was comprised of four components—students, teachers, administrators, and parents. The culture, defined as the social context, was the result of the dynamics that are created by all human facets engaged in educating the school community. The researcher purposefully designed the questions referring to the school culture as open-ended, so as to construct a baseline of the participants' perceptions of school culture. The participants were forthcoming in verbalizing their perceptions of the school culture regarding students and teachers, but did not come forth readily in identifying administration and parents as part of the school culture. The multiple-case Phase II participants were able to formulate learning environment parameters of the culture; i.e., an environment where all students could learn Mathematics (Mary, Selma, Mark, Seth, Ingmar); and realized that not all students like to learn Mathematics (Ursula, Upton); and that students learn at different rates and levels (Mary, Selma, Ingmar).

The participants articulated conditions of the school environment as related to student learning and safety, i.e., the school environment was not considered as conducive to learning (Mary, Ursula, Selma, Upton); needed to be safe for all students (Selma, Mark, Seth); was impacted by socio-economics (Mary, Ursula, Ingmar); and needed to be collaborative (Mary, Ursula, Ingmar).

In general, the participants were hesitant to comment on the school culture because they lacked experience of working in a school district for an extended period of time. Only two participants (Upton and Ingmar) affirmed that school cultures were different, and attributed their opinion on their K-12 schooling experience. The multiple-case Phase II participants were not clear on how the administrators of the school fit into

the culture (Ursula, Upton, Ingmar), but believed that administrators needed to offer support for the culture (Mary, Selma, and Seth). Parents were considered part of the culture (Mary, Ursula, Upton, and Ingmar).

Post-secondary preparation for student teaching. Four participants (Ursula, Upton, Seth, and Ingmar) reported being confident in knowing the Mathematics content and attributed their post-secondary institution for their training in the content area. However, when it came to how to instruct Mathematics, five participants (Mary, Ursula, Mark, Seth, and Ingmar) commented that they were introduced to a variety of instructional methods in their courses, but they did not have the opportunity to practice those strategies or observe the methods modeled. There was no preparation by the teacher training programs on how to integrate resources (textbooks, graphing calculators) into instruction (Selma and Mark), and some of the college training involved technology (Mary and Mark).

Despite the fact that six participants (Mary, Selma, Mark, Upton, Seth, and Ingmar) provided detailed description of their observations and teaching experiences in middle and high schools prior to student teaching, there were concerns about their being confident in their teaching abilities. Three participants (Mary, Ursula, and Selma) expressed their expectations of the student teaching experience to include building confidence in varied instructional methods. Two (Selma and Upton) participants were concerned about time management of lessons (Selma, Upton). Three participants (Mary, Upton, and Ingmar) believed they had been poorly prepared by their post-secondary institutions for their teaching practice.

Post-student teaching.

Perception of student teaching experience. Four multiple-case Phases II participants (Selma, Mark, Seth, and Ingmar) reported that their overall teaching experience was “good.” Despite the fact that all the participants perceived that they forged “good” relationships with their students, three participants (Mary, Ursula, and Upton) deemed their overall student teaching experience as “disappointing,” and destroying their teaching confidence. Two participants (Ursula and Upton) perceived the experience to be “unnatural” and contrived. The amount of paperwork (creating worksheets and filling out student reports, grading papers, and recording data) required to follow-up on students was overbearing to three participants (Ursula, Mark, and Ingmar).

All of the participants had at least one placement where they considered the school culture conducive to learning. Three participants (Mary, Ursula, and Upton) had one placement where they deemed the school cultures isolating and unfriendly. It was the negative experiences that colored the student teaching experience as “disappointing” for three participants (Mary, Ursula, and Upton). One participant (Seth) had two positive experiences in both student teaching placements, but decided to leave the teaching practice nevertheless.

All of the participants had opportunities to teach with the presence of the cooperating teacher observing them. However, it should be noted that not all participants (Mary, Ursula, Upton, and Ingmar) were able to observe their cooperating teacher teach one lesson. Three participants (Mary, Selma, and Ingmar) were able to observe other teachers (other than their cooperating teacher) during their student teaching practice, and found that experience helpful in formulating their teaching style.

Four participants (Ursula, Upton, Seth, and Ingmar) started their September, 2009 student teaching placements teaching classes the first day of class. Six participants (Mary, Ursula, Selma, Mark, Upton, and Seth) had the experience of easing into at least one of their student teaching placements. Ingmar was the only participant that reported being responsible for a full teaching program in both student placements.

The seven Phase II participants reported that none of the cooperating teachers required them to craft a format lesson plan. The participants reported that only the college field placement office requested that the participants provide a formal lesson plan when being observed by their supervising field instructor. The participants did not have the opportunity to submit lesson plans in a formal format that was required by the school districts.

Five of the participants (Mary, Ursula, Mark, Upton, and Ingmar) referred to their cooperating teachers' lesson plans/resource packets when planning their daily lessons in at least one placement. Three participants (Selma, Seth, and Ingmar) were given the freedom to design their own lessons. Six participants (Mary, Ursula, Mark, Upton, Seth, and Ingmar) reported that in at least one of the student teaching placements, their cooperating teacher provided a school-created rendition of the Mathematics curriculum, but did not explain the rationale for how the curriculum was constructed (i.e., how it was aligned with the NYSED Mathematics standards). Six participants reported that their cooperating teachers did not require them to include the NYSED Mathematics standards in their lessons.

Regarding student assessment, three of the participants (Selma, Seth, and Ingmar) reported IEP/NYSED assessment scores were made available, and were shared with the

teachers. Two participants (Mary and Ursula) reported that no student data was available to be shared with them.

Attributes of cooperating teachers and school culture. All of the participants reported that they experienced a good professional relationship with at least one of their cooperating teachers. Three (Mary, Ursula, and Upton) perceived that they had no professional relationship with their cooperating teachers. For two participants (Mary and Mark), this was the first time their cooperating teacher had a student teacher. Both of the first time cooperating teachers worked with the respective participants in middle school placements. Three participants (Mary, Ursula, and Mark) reported that their cooperating teachers in their middle school placement did not clarify their expectations for student teachers in their school. Three of the participants (Mary, Ursula, Upton) reported that their cooperating teachers in their high school placements were abusive, and berated them personally and professionally.

Five (Mary, Mark, Upton, Seth, and Ingmar) of the participants identified their cooperating teachers' teaching styles as lecture and procedural "Mastery," in at least one or both of their placements. Four (Mary, Ursula, Selma, and Ingmar) reported that their cooperating teachers in one or both placements were able to engage their students in learning Mathematics. Three (Ursula, Selma, and Ingmar) reported that one or both cooperating teachers showed compassionate towards their students.

Student teaching impact on instructional decision. The participants reported on the various instructional strategies they were able to implement. All participants used the traditional lecture style as their primary strategy. Five participants (Mary, Selma, Mark, Seth, and Ingmar) were able to implement cooperative learning in the format of a group

Mathematics game that students played during the class lesson. The cooperative learning lesson was a requirement by some of the colleges. Two participants (Selma and Ingmar) were able to implement a constructivist lesson. One lesson was submitted as an artifact, the other lesson was described in the post-student teaching interviews. Both lessons were designed and taught to advanced students. Two participants (Mark and Ingmar) described using algebra tiles and paper construction materials as manipulatives. Two participants (Selma and Upton) used exit slips to assess student understanding of their instruction. Four participants (Mark, Seth, Upton, and Ingmar) used interactive whiteboards as instructional tools. Two participants (Mark and Ingmar) used guided notes as support resources for teaching their at-risk students.

Attempts by the Phase II participants to implement alternative methods were thwarted by their cooperating teachers. Six of the participants (Mary, Ursula, Selma, Mark, Upton, and Ingmar) reported that they did not have the opportunity to implement differentiated instructional strategies that were based on student interests. Two participants (Ursula and Upton) wanted to develop instruction for understanding Mathematics concepts but were dissuaded by their cooperating teachers. Those teachers were characterized by the participants as test-score oriented, and they pushed through the Mathematics content. Two participants (Mary and Selma) wanted to use manipulatives in their instruction. Mary was advised by her cooperating teacher not to use the algebra tiles. Selma decided not to use algebra tiles with her at-risk students, due to their attitude about learning. Four participants (Mary, Ursula, Selma, and Upton) were concerned about the lack of homework policies; students did not do homework that was assigned.

The participants' student teaching experiences had an impact on their developing instruction for at-risk students. Five of the participants (Mary, Ursula, Selma, Upton, and Ingmar) reported that they did not have the training to identify the strategies they needed to develop lessons for at-risk students. The inclusion, bilingual, low ability tracked classes provided instruction for at-risk students that the participants judged as neither challenging nor time efficient.

Teaching in an 80-minute block period proved to be a challenge for the participants. Three (Mary, Ursula, and Mark) reported difficulties comprehending the rationale behind block scheduling and designing instruction for the block. Their cooperating teachers did not guide them on how to develop lessons for the block.

Perceived impact on future teaching practice. The participants identified the impact that student teaching had on their intended teaching practice. Four participants (Mary, Ursula, Mark, and Seth) said the 80-minute blocks were a challenge for planning instruction. They were not clear on the rationale for having the 80- minutes, and would have liked to learn how to design instruction for the block.

Three of the participants (Ursula, Upton, and Seth) were concerned with the seemingly fragmented curriculum that did not address student interest, was not logical, and was crammed for the test by the Mathematics teachers. Two participants (Selma and Ingmar) believed that it would be a challenge to see a variety of methodologies for at-risk students. They were not clear on how they would vary their instructional strategies. Three participants (Selma, Mark, and Upton) wanted to integrate textbooks into their instruction but were dissuaded by their cooperating teachers.

Two of the participants (Mary and Mark) would maintain a traditional classroom routine of lecture and procedural learning, and three (Ursula, Upton, and Ingmar) would not use lecture as their primary strategy. Two of the participants (Mark and Ingmar) wanted to incorporate more technology into their instruction. Two participants (Ursula and Ingmar) wanted to develop a more structured, logical curriculum. Three participants (Mary, Selma, and Upton) wanted to learn how to use a variety of assessments to identify student Mathematics strengths and weaknesses; and would like to develop more challenging problems for their students at-risk. Four participants (Mary, Ursula, Upton, and Ingmar) were adamant they would not be like their cooperating teachers.

Outcomes. The participants were forthcoming with suggestions for improving the preparation for the student teaching experience. Colleges need to focus more on pedagogy and best practices. And alternative instructional strategies need to be modeled for pre-service teachers. There needs to be more courses on how to instruct at-risk students. The courses for at-risk students need to include understanding different cultures; how to engage non-motivated students; how to deal with special needs students, and how to design instruction for inclusion classes to include the wide range of student abilities.

Student teaching placements need to be designed so that pedagogical ideas and theories can be employed by a student teacher, and caution should be exercised to ensure that a cooperating teacher demonstrates instructional practices, especially those that are alternative strategies to straight lecture. A student teacher needs to emerge from the student teaching experience feeling confident in designing curriculum, units, and lessons;

and believing that they can be effective in delivering the instructional strategies germane to the goals for instruction.

The next chapter addresses the findings reported in Chapters IV and V and expands upon implications from this research. Directions for future research round out Chapter VI.

Chapter VI

Discussion

Overview

But what makes a good teacher? There have been many quests for one essential trait, and they all have come up empty handed. Among the factors that do not predict whether a teacher will succeed: a graduate degree, a high score on the SAT, an extroverted personality, politeness, confidence, warmth, enthusiasm, and having passed the teacher certification exam on the first try. When Bill Gates announced recently that his foundation was investing millions to improve teacher quality in the United States, he added a rueful caveat, “Unfortunately, it seems the field doesn’t have a clear view of what characterizes good teaching,” Gates said, “I’m personally very curious.” (NY Times Sunday Magazine March 7, 2010 ‘Can Good Teaching be Learned’ by Elizabeth Green, p. 33)

Know thyself. (Socrates)

In Chapters IV and V the quantitative and qualitative data from this study was analyzed using deductive and inductive inquiry, respectively. Those findings were used as the basis for describing the pre-service teachers’ beliefs about Mathematics and the practice of teaching Mathematics, and their behaviors within social constraints of a secondary school culture, according to the institutions in which they did their student teaching. In this chapter the researcher used abduction (uncovering and relying on the best set of explanations for interpreting the results) to interpret the “mixing” of the quantitative and qualitative results (Johnson & Onwuegbuzie, 2004).

Ernest (1989) posited that teaching reforms cannot materialize unless teachers’ deeply held beliefs about Mathematics and Mathematics teaching changed. As pre-service teachers transition into their teaching practice they need to hone their ability to examine currently held beliefs and practices, deciding what elements no longer serve the practice well, and integrate new ideas and methods into their instruction (Goldsmith & Shifter, 1997). The researcher identified the aforementioned “ability to examine currently

held beliefs and practices” as a component of the transition practice that connected the autonomy factors by subscribing to the process of abduction. In so doing it became possible to identify deficiencies in a pre-service teacher’s ‘ability to examine currently held beliefs’.

This chapter is divided into the following sections:

1. Overview—Identified how the student teaching experience did not provide a bridge from theory to practice for the seven Phase II participants. Strikingly, theory did not translate into practice for the participants and thus it impacted their autonomy negatively.
2. Connecting the Mathematics Beliefs, Reflective Practice and Social Constraints—This section allows for providing a graphic interpretation of how each factor (beliefs, reflective practice, and social constraints) was connected to a participant’s student teaching experience.
3. Interpreting and Mixing of the Quantitative and Qualitative Results—The central question and three sub-questions were discussed.
4. Discussion of the Research Issues—Provided a discussion on how the mixing of the quantitative and qualitative data provided an in-depth understanding of a pre-service teacher’s autonomy.
5. Implications and Recommendations—Provided a discussion that explained how the study results were used to create a beliefs baseline for future research.
6. Conclusion—Provided an overview of the Discussion chapter and stated specifics based upon the findings from this investigation.

7. Recommendations—Results of the study are used to suggest additions and revisions to post-secondary teacher preparation programs.

It is reasonable to believe that pre-service teachers have been schooled in Mathematics content and provided with ideologies of successful instructional practice in their methods courses. The conventional approach to preparing pre-service teachers of the 21st Century include having them observe 100-hours of teaching by a credentialed professional in their field of study, and to some degree become engaged in teaching a lesson or assisting classroom students on a one-to-one basis, if appropriate. Ostensibly such pre-service teachers emerge from teacher preparation programs with the basic pedagogical and content knowledge. Strikingly, the researcher uncovered that the pre-service teachers involved in this research did not have a viable understanding or defensible position on how to reflect on their practice. Thus there was a serious and provocative disconnect between the process of preparing future educators and the practice; an issue addressed later in this chapter.

The quantitative and qualitative data analysis identified the potential beliefs systems (Mathematics Beliefs Survey for Philosophy of Mathematics; MLS for Mathematics, Mathematics Learning and Teaching, TSI for Reflective Practice) and Social Behaviors (TTI TriMetrix Talent Questionnaire for DISC Natural and Adaptive). The seven multiple case studies (qualitative analyses) revealed a lack of understanding, by all of the pre-service teachers, pertaining to knowing their teaching styles and using that knowledge to reflect on their practice. The researcher determined that the transition into the teaching practice (student teaching) impacted the ability of a pre-service teacher to make instructional decisions and be flexible in modifying beliefs when faced with

disconfirming evidence. Extrapolation of such a finding heads toward the premise that there would be little to no infusion of new ideas or practices by such persons if and when they assume professional educator roles.

At the end of all teacher preparation programs comes the practice teaching (student teaching) experience. Presumably it is designed with the intent of honing the instructional skills of a pre-service teacher. To achieve that end postsecondary training programs prepare pre-service Mathematics teachers with information gleaned from 21st Century research efforts: cooperative learning, “hands on” lessons, discovery methods, differentiated instruction, etc. The expected outcome should be persons prepared to assume the responsibilities associated with providing cutting edge instruction to the students entrusted to them. To that end the findings from this investigation supported the claim by Darling-Hammond (2003) that American colleges seem to produce a pool of qualified teachers; i.e., the participants in the study were armed with content knowledge and pedagogy. But, and it is a major but, the participants in this study did not have the in-depth understanding of themselves pertaining to: their beliefs about Mathematics, reflecting on their practice, and being aware of their behavior when immersed in a socially constraining environment (a school culture). Being sensitive to these three issues (beliefs on Mathematics, reflection on practice, and awareness of social behaviors) and their relationships to personal autonomy is pivotal for how a teacher makes instructional decisions (Bonnstetter & Suiter, 2004; Ernest, 1989, 2004; Silver et al., 2005; Thompson, 1982, 1984, 1992).

Twenty-first Century Mathematics pedagogy encourages teaching practice to engage students in critical thinking. It seeks to foster individual creativity in a learning

environment (classroom and school) by being proactive about activities, tools, and methodologies without endangering existing conventions. Essentially, the objective is to present good citizens able to engage in meaningful and worthy work that helps further improve a culture and climate of learning. Based upon the findings from this study it was apparent that pre-service teachers could identify good instructional practices and had a healthy conception of good teaching. However, the qualitative findings allowed for claiming that when pre-service teachers were immersed in a school culture the inclination was to acquiesce to an existing procedural flow and that typically was for what would be termed traditional Mathematics instruction. The result is to neglect or avoid implementing knowledge based upon recent and current research. In essence, pre-service teachers find the instructional *status quo* of secondary schools to be contrary to the beliefs they developed during matriculation through their respective training programs and subsequently they experience difficulties transitioning into practice. In baldest terms, there was not a meaningful bridge between theory acquired during participation in their programs of study and the realities of professional work. Theory did not translate into practice, and that begged for asking questions related to the causality for such a ruptured relationship.

Quantitative and qualitative information. Chapter IV addressed the quantitative analysis of the study and uncovered the following information:

1. Univariate results confirmed similar types of data (Belief, Social Context, Reflection), and ANOVAs were conducted in the multivariate analysis. The results reported in Tables 5-11 (Chapter IV) characterized the factors of autonomy (Beliefs about Mathematics, Reflection on the teaching practice,

Social Constraints of a school environment) for the Phase I participants (N=30), and led the researcher to make generalizations about the autonomy factors (Beliefs about Mathematics, how Mathematics is learned and best taught; Reflection on the role of teaching; and Behavior Skills needed to navigate the Social Constraints of a school environment) of the pre-service secondary Mathematics teachers who presumably were available to enter the profession in the fall of 2010.

2. The results reported for the Mathematics Beliefs Survey (MBS), the Mathematics Learning Style Profile (MLS) and Teaching Style Inventory (TSI) were used to provide the demographic information about the participants, and to quantify their philosophy of Mathematics, conception of roles envisioned as Mathematics teachers, how they planned to use curricular materials, and how they believed Mathematics was learned.
3. It was found that Phase I participants:
 - a. Held a moderate (46.7%) to strong (36.7%) set of beliefs about the Instrumentalist philosophy of Mathematics (Mathematics was an accumulation of facts, rules, and skills used in the pursuance of some external end) and that reflected what was deemed to be the usage of traditional Mathematics programs in high schools;
 - b. Exhibited all four Mathematics learning styles, with Mastery (Mathematics is best learned procedurally; step-by-step) as the most frequent style;

- c. Believed (N = 11, 36.7%) that Mastery was the dominant Mathematics learning style (MLS) for the general student population (Silver, Thomas, & Perini, 2008);
 - d. Claimed that Mastery (N = 17, 56.7%) was the dominant teaching style (TSI) of the 30 participants;
 - e. Intended to exhibit compliant and steady behavior within the social context of a school environment (N = 18, 60%), according to the TTI TriMetrix Talent Questionnaire results.
4. ANOVAs were conducted for ten independent variables to learn if there were meaningful relationships between pre-service teachers' Mathematics education background and their respective beliefs about Mathematics and Mathematics teaching. The multivariate data analyses led to the decision that the most potent influence(s) on a person's Mathematics beliefs, envisioned roles as a Mathematics teacher, and choice of curricular materials were the number of successfully completed experiences in college and high school Mathematics courses. The more college Mathematics courses completed, the less the participants believed in an Instrumentalist style (procedural, step-by-step, Mathematics instruction focusing on skills and practice) for when they would become an instructor. Instead, there was evidence that participants with more Mathematics courses completed were apt to view embarking upon creation of relevant instructional materials as being of greater importance than adhering to a prescribed sequence of materials; and those persons seemingly embraced the role of being a Facilitator/Explainer.

The qualitative analysis was conducted on the seven multi-case studies, Phase II participants. There were two sets of analysis; one comparing participants with the same Mathematics learning style; and, the second was the cross case analysis of the pre-student teaching and post student teaching interviews. The analysis revealed:

1. Participants were prepared in the theoretical pedagogy of Mathematical instruction but were unable apply the theory to their level of satisfaction in the student teaching practice;
2. An apparent inability by the participants to articulate distinctly and meaningfully their respective philosophy of Mathematics; and
3. The apparent levels of autonomy experienced by the participants when making instructional decisions during their student teaching experiences.

Quantitative and qualitative analysis was mixed in Phase II of the study after the cross case analysis and narratives were written for each participant. The quantitative results reported in Phase I were identified for each Phase II participant and used to support the factors of Autonomy (Mathematics Beliefs, Reflective Practice, and Social Context of secondary school systems) as was reported in the subsequent multi-case narratives. A more in-depth discussion on the mixing of the quantitative and qualitative results is addressed later in this chapter. It was important that the apparent connections among the factors of Autonomy be explained prior to embarking upon the in-depth treatment of mixing the quantitative and qualitative results.

Connecting the Mathematics Beliefs, Reflective Practice, and Social Constraints

The researcher considered Autonomy as a system of factors that worked symbiotically, like a wheel and an axle. The axle of the wheel would be considered the

Mathematics philosophy held by a pre-service secondary Mathematics teacher and serve as the support for the wheel, and it influenced a pre-service Mathematics teacher's beliefs on how they learn and taught the subject matter. The wheel would be comprised of three concentric circles, or levels that emerged from the central (axial) Mathematics philosophy. From the center out the first concentric circle would be housed the Mathematics learning beliefs (MLS—beliefs on how Mathematics was learned), with a person's dominant belief used to identify that initial level. The second concentric circle contained the teaching style belief (TSI Reflective Practice), with a person's dominant style being the identifier. The third and outer level of the wheel encased the dominant social behavior style as it related to a School Culture (TTI TriMetrix—behaviors in the work place). Figure 5 depicts the operations of the model.

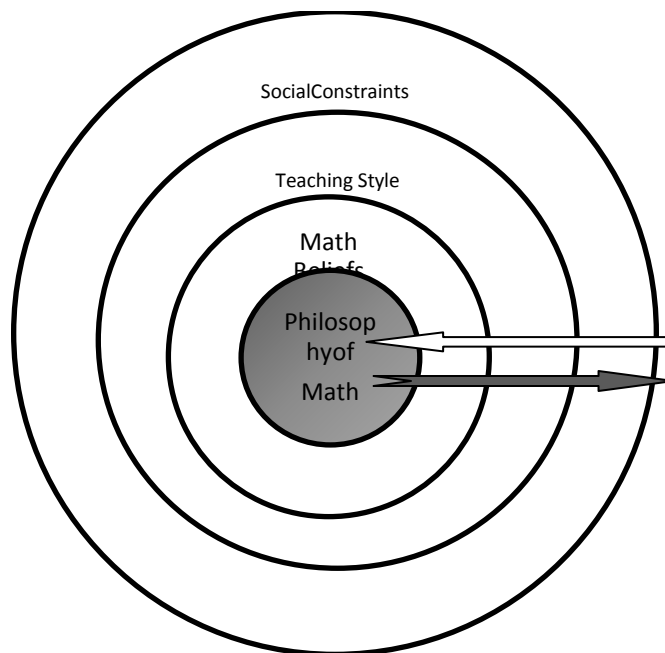
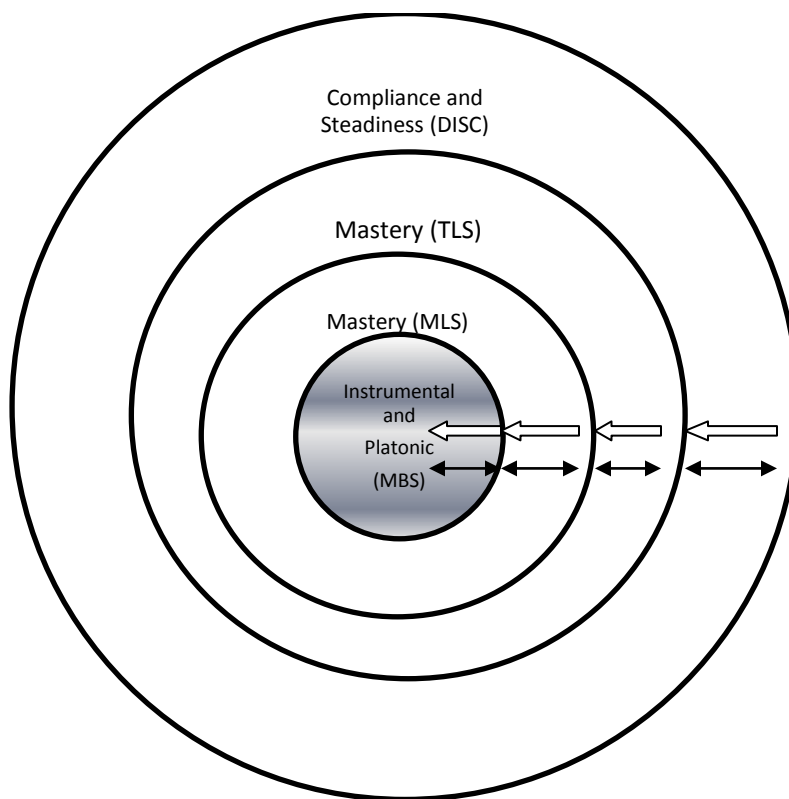


Figure 5. Wheel and axle connections of beliefs, reflective practice, and social constraints (autonomy factors).

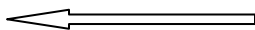
An arrow emanating from the center of the wheel represents a pre-service teacher's autonomy factor system (\Rightarrow). Likewise, the arrow pointing inward represents the school's cultural constraints (\Leftarrow). The pre-service teachers' factor system (philosophy of Mathematics, Mathematics beliefs about learning and how Mathematics should be taught, teaching style, adaptive and natural behaviors) may or may not agree with the traditional cultural constraints as represented in Figure 6.

Beginning with the outside circle, the traditional school culture promotes a steady and compliant environment represented by a TTI TriMetrix high Compliant (C) and Steadiness (S) DISC scores. The traditional school culture fosters the Mastery Teaching Style (lecture, practice skill and drill) and Mastery Mathematics Learning Style (procedural, step-by-step). The axle (Philosophy of Mathematics) of the traditional school culture constraints is represented as Instrumentalist and/or Platonic philosophy (Mathematics is a set of unrelated but utilitarian rules and facts; an accumulation of facts, rules, and skills to be used in the pursuance of some external end; Mathematics is a static unified body of knowledge, a crystalline realm of interconnecting structures and truths, bound together by filaments of logic and meaning. Mathematics is not discovered but created).

Each multiple case study thus is depicted on the wheel, and for the participants in this study the relevant information is presented in Table 74.



Key: Arrow toward center indicates constraints of a traditional school environment [Social Constraints (Compliance and Steadiness); Teaching Style (Mastery); Mathematics Learning Style (Mastery); and Philosophy of Mathematics (Instrumental and Platonic)]



Arrow (→) or (←) indicates a participant's philosophy of Mathematics (MBS); Dominant Mathematics Learning Style (MLS); Dominant Teaching Style (TLS); Adaptive and Natural Behaviors in Social Context (DISC).

Note: When a participant's Mathematics Philosophy, Mathematics Learning Style, Teaching Style, and /or Adaptive /Natural Behavior agree with the traditional autonomy factor the arrow points toward the center (←), meaning the pre-service teacher's instructional decisions will be supported by a school culture. Disagreement with the traditional autonomy factor is indicated by an arrow pointing in the opposite direction (→), meaning a pre-service teacher will experience lack of support for their instructional decisions.

Figure 6. Constraints of the traditional school environment.

Table 74

Autonomy Factor

Participants	Axle MBS/Interview Philosophy	Circle 1 MLS dominant Mathematics learning style	Circle 2 TSI dominant teaching style/MBS Preferred Style	Circle 3 DISC dominant behavior adaptive/natural
Mark	Instrumentalist/Could not articulate the philosophy	Mastery	Mastery/ Facilitator	Steadiness/Steadiness
Mary	Platonic/ Systems of numbers used in everyday life	Mastery	Mastery/Explainer	Compliance/Compliance
Upton	Problem Solving/ . . . gets a person to think abstractly	Understanding	Understanding/Facilitator	Dominance/Dominance
Ursula	Instrumentalist/Syste ms of numbers. . . used in everyday life	Understanding	Mastery/Explainer	Influence/Influence
Seth	Problem Solving/ . . . could not articulate philosophy	Self- Expressive	Self- Expressive/Facilitator	Dominance/Dominance
Selma	Problem Solving/ . . . gets a person to think abstractly	Self- Expressive	Self- Expressive/Facilitator	Influence/Influence
Ingmar	Instrumentalist/Syste ms of numbers...used in everyday life	Interpersonal	Mastery/ Facilitator	Influence/Influence
Traditional Mathematic s Teaching Practice Culture	Instrumentalist and-or Platonic/Systems of numbers...used in everyday life	Mastery	Mastery/Lecturer and orExplainer	Steadiness and-or Compliance/Steadiness and-or Compliance

The dynamics of the pre-service teachers' autonomy is illustrated in Figures 7 through 9.

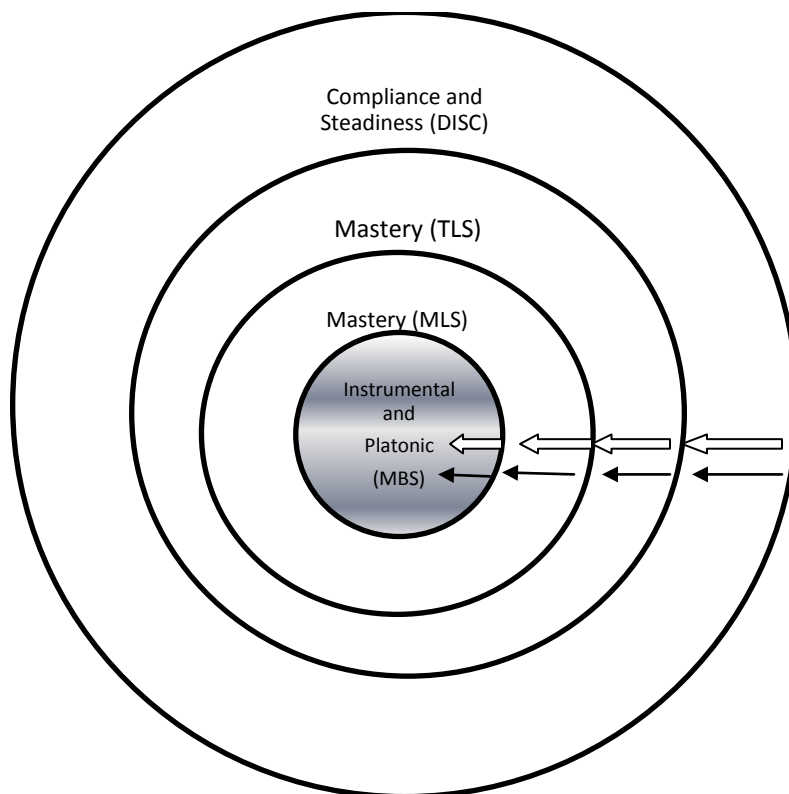


Figure 7. Agreement of Mary's autonomy factors with the traditional setting.

Mary's autonomy factors (Platonic Mathematics philosophy, Mastery dominant Mathematics Learning Style, Mastery dominant Teaching Style, Compliance as a natural and adaptive behavior) all agreed with the traditional factor constraints of the school environment. Thus the school setting positively influenced Mary's instructional decisions when she was placed in a traditional setting (e.g., her middle school student teaching experience).

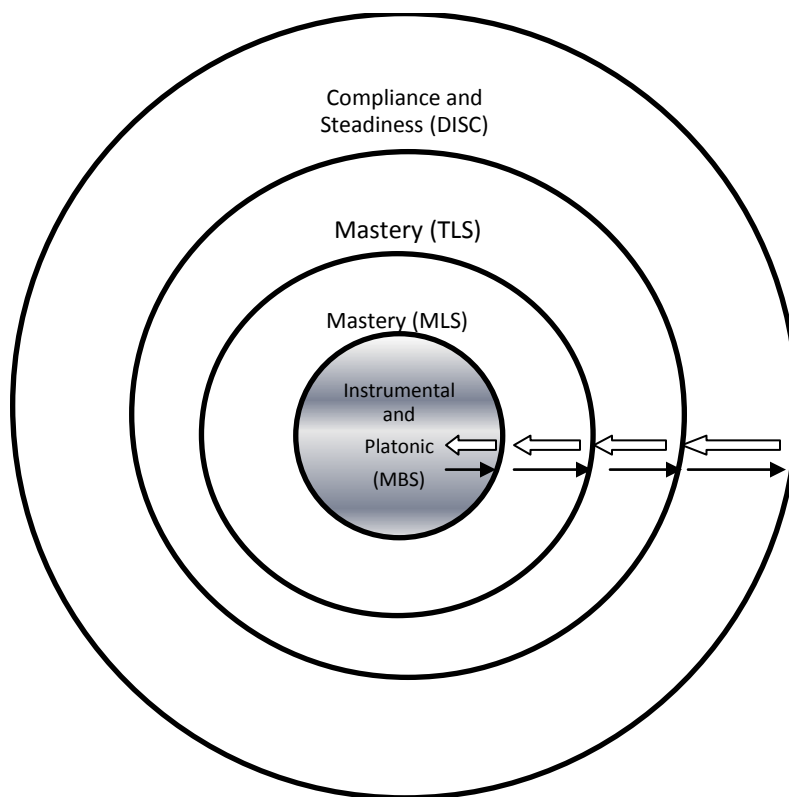


Figure 8. Disagreement of Upton's autonomy factors with the traditional setting.

Upton's autonomy factors (Problem Solving philosophy, Understanding Dominant Mathematics Learning Style, Understanding Dominant Teaching Style, Dominance as his adaptive and natural behavior) were opposite to the traditional school setting. The outcome was that it (school culture/setting) negated/nullified instructional decisions he desired to implement, such as teaching geometry for understanding. Instead, he was required to provide such instruction predicated upon rote work so students could then respond with theorems according to repeatedly similar situations.

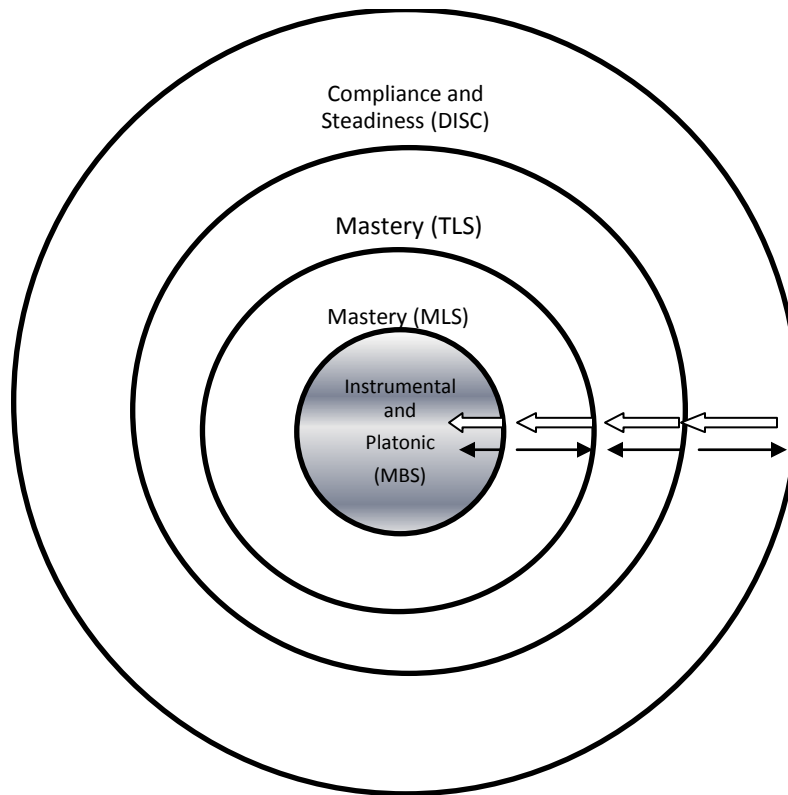


Figure 9. Agreement/disagreement of Ursula’s autonomy factors with the traditional setting.

Ursula’s autonomy factors (Instrumental Mathematics philosophy, Understanding Dominant Mathematics Learning Style; Mastery Dominant Teaching Style, Influence as a Natural and Adaptive Behavior) had an overall positive force in the traditional direction. As a result, Ursula’s desire to teach for understanding was overtaken by the conventional setting and her lessons reflected traditional instruction.

Mark and Mary held an Instrumentalist and a Platonic Mathematics philosophy respectively. Those beliefs were deemed common to a traditional Mathematics philosophy. Parenthetically, it bears noting that 46.7% (N = 14) of all 30 participants from Phase I in this study claimed to hold a Platonic Mathematics philosophy as a

strongly held belief. Also, 36.7% (N = 11) of those 30 participants revealed having strong Mastery Beliefs in how they learned Mathematics and 56.7% (N = 17) expressed similar views on themselves as teacher practitioners.

Mark's and Mary's dominant behaviors were Steadiness and Compliance respectively. They fit well into a traditionally taught Mathematics school culture, believing in the routine, the curriculum, and compliance by not questioning the 80-minute block schedule or use of their cooperating teacher's lessons as resources.

Upton, Seth, and Selma held Problem-Solving philosophies. For two (Upton and Seth) participants the curriculum they were expected to teach did not make sense because they wanted to be facilitators of learning in a classroom teaching students; to understand and apply Mathematical concepts and they were stymied in so doing because the Understanding (Upton) and Self-Expressive (Seth and Selma) teaching styles were not in accord with the lecture/explainer styles of a traditional Mathematics instructional culture. Parenthetically, these three participants preferred to teach upper/advanced level Mathematics courses, and claimed to have had successes in such endeavors.

Upton and Seth had their highest DISC behavior score in the Dominance area, and Selma's was in Influence. The importance of those differences underscored the fact similarities in global scores tended to obscure potentially meaningful individual variations. Yet each of those three participants experienced career-changing decisions upon completion of their respective student teaching experiences. Upton and Seth had angst with a traditional school Mathematics program, and it so distressed Seth that he left the teaching practice. Upton believed he would not meet with success in practice

teaching because he did not find logic in the prevailing Mathematics curriculum and was frustrated with the “teaching to the test” instructional practice of the school culture.

Selma, on the other hand who had a dominant DISC behavior of Influence, was able to overcome the traditional setting probably because of her social and verbal aggressiveness and optimism. Conceivably that participant (Selma) might have been viewing her experience(s) through rose colored glasses leading to an unrealistic opinion about the school culture (Bonnstetter & Suiter, 2004). Importantly, it needs to be recognized these statements are conjecture made by the researcher but in this chapter (Discussion) such liberty is allowed and encouraged.

Having an identical learning style in both the MLS and TLS does not always occur. Ingmar and Ursula had different Mathematics learning styles, Interpersonal and Understanding respectively, but they presented Dominant Mastery teaching styles, an Instrumentalist Mathematics philosophy, and both were comfortable with the Mastery instructional styles of their cooperating teachers. Both of those student teachers were people and team-oriented; and motivated by praise and positive strokes (Bonnstetter & Suiter, 2004). Notably, Ingmar had a supportive teacher in a collaborative cultural setting for both of his student teaching placements.

Ursula’s first student teaching placement was explained as limiting due to a cooperating teacher who provided only negative feedback. By the time she transitioned to her second student teaching placement she claimed that her confidence in teaching had been undermined. Juxtaposing Ursula’s profiles to that initial experience allowed for saying it did not provide for Mastery, that the cooperating teacher did not project an Instrumentalist philosophy, and did not provide the support needed for considering that

initial placement as being an aberrant representation of a true student teaching experience. Parenthetically, Ursula apparently followed her Mastery style of teaching in the first placement, and possibly in her second placement. Importantly, neither student's (Ingmar and Ursula) teaching practica allowed for refining their respective "Explainer" role as teacher, nor was it possible for them to design instruction for their students in a manner that fostered an understanding of Mathematical concepts. Furthermore neither of those two participants was able to engage in preferred teaching practices with the sequel being both said they believed students derived only a modicum of learning. Ingmar and Ursula claimed to have derived minimal satisfaction from their experiences.

In summary, when considering the axle and wheel concept for autonomy integration, it was the last circle on the wheel, social constraints of a school culture, which markedly impacted how teachers made their instructional decisions. Pre-student teaching experience(s) should have provided opportunities to address content employing appropriate pedagogical ideology and encouraged the participants to construct lessons addressing students' instructional needs.

Apparently the barriers for displaying professional autonomy were too high for all of the participants to overcome. Crossing the bridge from personal confidence in teaching that presumably had developed during matriculation in coursework at a home institution to live methodological practice was equivocal. Too many trolls lived under those bridges. Expression of autonomy was contingent on school culture and cooperating teacher social behaviors (Circle 3).

Mark and Mary talked about using alternate instructional methodologies and pedagogy during their pre-student teaching interviews, but those beliefs reportedly were

at odds with instructional decisions made during their student teaching placements. Mark claimed to have been restricted in creating learning materials by virtue of a district policy related to creating procedural packets as instructional resources. He acquiesced and embraced the packets as a sound instructional strategy, electing to not quarrel with how such material aligned with the Mathematics standards. Mary's fear of teaching Geometry (related to her insecurity with college-level Mathematics courses focusing on abstractness) ostensibly inhibited her from embracing the Constructivist discovery learning strategy employed by her cooperation teacher. Both of those participants were considered to have low levels of autonomy.

Selma, Ingmar, and Ursula had mid-levels of autonomy. The first two identified alternate instructional strategies and convinced their cooperating teachers that they were authorities in the methods (Selma with Discovery learning, and Ingmar with Cooperative learning). But neither was able to fully grasp the why and how of integrating Discovery and Cooperative learning strategies into instruction for their at-risk populations.

Ursula's cooperating teacher provided her the opportunity to create learning experiences with minimal instructional guidance on how to teach in an 80-minute block. That freedom was appreciated, but Ursula voiced frustration because she believed teaching for understanding was the ultimate goal of teaching Mathematics and providing students with "hands on" activities would have been more conducive to foster conceptual understanding of how to achieve the goals of the NYS Mathematics Standards. Instead, the approach advocated during those extended periods was to ensure the time was filled with work that supposedly kept the students occupied following a predetermined

protocol. Ursula stated that little time or effort was devoted to cultivating conceptual understandings.

Upton and Seth reflected evidence of a higher level of developed autonomy. Both pre-service students reportedly were able to evaluate their respective curricula and explain how and why they sought to change their instruction practices from the prevailing approach utilized by their cooperating teachers. Their disappointments with the student teaching experiences resulted from social behaviors. Presumably adequate coaching on their social behaviors might have led them to seeking different forms of employment before entering teaching, or possibly helped them navigate the “mine field” of student teaching, as it was characterized by Upton.

Interpreting Quantitative and Qualitative Results

The central question for this study was: How is the autonomy of pre-service teachers influenced after completing student teaching? The following three sub questions were addressed.

Sub-question 1: Do pre-service teachers’ systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching? There was no indication that the seven participants who provided information for the qualitative component altered their respective philosophies on Mathematics as a consequence of their student teaching experiences. The crucial finding from this study was that six of the seven participants had not reflected on what they believed Mathematics meant. The researcher used probing questions during the pre-student teaching interviews to extract personal definitions of Mathematics and each person’s philosophy on Mathematics (how it was learned and how it should be taught).

Conceivably those six interviewees were atypical in their inability to articulate a philosophy, but that absence of information meant it was not possible to ascertain if their beliefs changed as a result of their student teaching experiences. The exception was Upton, who had reflected on his philosophy of Mathematics as being Formalist. It bears reminding that Upton had a Philosophy background prior to embarking upon the study of Mathematics. The student teaching experience reportedly reinforced his philosophy of Mathematics, but constrained him to follow a traditional Instrumentalist and non-logical Mastery teaching approach. He claimed that was frustrating and resulted in his disappointment with the teaching profession.

The multi-case study participants identified the teaching style of each of their cooperating teachers as the typical procedural “step-by-step” approach to the teaching of Mathematics, and characterized as: (a) Mathematics was viewed as Instrumental: an accumulation of facts, rules and skills to be used in the pursuance of some external end; (b) Mathematics students’ mastery style was supported primarily by like problems being presented in a step-by-step manner that had a single solution and used a set procedures; and (c) Teachers served as the primary information source and maintained highly-structured and organized classroom environments that emphasized the acquisition of skills (Ernest, 1989; Silver, Hanson, & Strong, 2005).

Mark and Mary, with a Mastery dominant style in both their MLS and TLS, accepted the existing classroom routines as what they would incorporate into their practice. Those two participants’ beliefs were supported by the lecture/procedural style employed by their cooperating teachers. The qualitative analysis allowed for stating that each had their instructional beliefs validated. Interestingly, both participants said they

would have liked to use alternate instructional methods in their teaching practice but had not seen the practices modeled and were not confident venturing into another instructional style.

Mark mentioned that it was difficult for him to understand why the 80-minute block schedule was implemented in his middle school placement but he did not pursue an explanation. By accepting the status quo that participant tacitly acknowledged complacency with the Mastery approach.

Mary's second placement was in a high school Geometry class with at-risk students. Her cooperating teacher wanted her to design Constructivist lessons scaffolding concepts and leaving algorithms until last. An impasse occurred because that student teacher did not understand what her cooperating teacher requested and thus she floundered. The explanation for that dilemma was found in Mary's belief that Geometry was memorized rather than understood. Thus, when confronted with instructional information that was unclear or disconfirming to what she believed, Mary was not able to reflect on her practice, and ultimately unable to survive in the high school placement.

Selma and Seth had self-expressive Dominant styles in both their MLS and TSI. Selma's initial student teaching placement was in a school with at-risk students. That created problems for her because she did not have opportunities to experience alternate methods to the traditional way Mathematics was taught. Her experiences had been on learning class management strategies. Thus it could be claimed that Selma's preparation for student teaching was less than adequate.

Subsequently Selma did student teaching in a tracked program at a middle school. She said that experience validated her belief that students could learn Mathematics and at

different levels; advanced students embraced Constructivist lessons but the average and at-risk students were unable to handle thinking about Mathematics on their own. This interviewee said she was not convinced that the Connected Mathematics Program (CMP) (a Mathematics NCTM standard textbook resource) was a useful resource to teach Mathematics regardless of the CMP Constructivist instructional design. Another point she made was that alternate methods to the lecture approach might have been successful with the at-risk students but that she did not have the opportunity to try such practices as she was too busy learning how to manage at-risk students in a classroom. Finally, she said that it was unlikely that she would consider a position that had the potential for her to work with at-risk students because of the effort involved with needing to cope with their varied interests and learning capabilities. Perhaps most importantly was her claim to have been bored with the level of Mathematics she would have to maintain to teach such students.

Seth was confronted with the same issue of classroom management. He followed the prescribed Mathematics curriculum and the analyses revealed that his beliefs about learning and teaching Mathematics had not changed. That was an interesting discovery because Seth said the district Mathematics curriculum prevented him from teaching what he believed would be useful and applicable Mathematics to the students.

Prior to student teaching, Seth believed he wanted to teach middle level students. Subsequently he stated a preference for upper high school and college level students because they were more motivated and easier to discipline. He continued his initial reservations about the traditional Mathematics curriculum not being relevant to students, and reported that he had been unable to comply with the instructional climate of the

student teaching assignment in secondary Mathematics. The outcome was his decision to withdraw from seeking a job as a professional teacher.

Upton and Ursula had Understanding Dominant MLS styles; Seth's was an Understanding TSI style and Ursula's a Mastery TSI style. Both claimed to have been frustrated with their cooperating teachers' push to cover the Mathematics curriculum, leaving the goal of students' understanding of Mathematics concepts suspended from lesson plans. Both student teachers believed that Mathematics needed to be taught for understanding, which apparently did not happen.

Ursula's second student teaching placement was easier to navigate because her cooperating teacher's style was Creative (a self-expressive style trait). Ursula and Upton claimed to have been disappointed in their respective student teaching experiences due to the fact neither was able to practice teaching the subject matter for understanding. Both contended they were disenchanted with their student teaching experiences and said that their confidence as a teaching practitioner had been negatively affected.

Ingmar had an Interpersonal dominant MLS style and a Mastery TSI style. He believed that the best way to teach Mathematics was via collaboration between and among all involved. Interestingly, despite believing that he learned Mathematics best by replicating procedures in practice problems, his instructional choice of lesson design was Discussion and Collaboration in groups. Ingmar identified his cooperating teachers' style as Mastery and envisioned himself as having a different style. In his high school placement, Ingmar acquiesced to the cooperating teacher's traditional lecture style, explaining that the cooperating teacher had set the tone of the classroom as a traditional procedural style; an obvious minimization of autonomy.

Summary of beliefs. Each of the seven participants (Mark, Mary, Seth, Selma, Ursula, Upton, and Ingmar) was given their MLS and TSI scores with explanations prior to their pre-student teaching interviews. They had time to review the instruments and ask questions about the results. In those interviews all of the participants agreed that the instruments identified their Mathematics learning and teaching style and nobody raised questions about any aspect of the protocol or tools. The researcher purposefully did not pursue the participants understanding of the TSI and MLS instruments since the tools served as benchmarks for a participant's beliefs.

Also, the researcher did not ask the participants to clarify their definitions of Mathematics or to further articulate their respective philosophies of Mathematics. The rationale was to establish a baseline level of belief awareness with the participants. The seven interviewees evidenced some ability to examine currently held beliefs and practices, and all were able to identify their dominant styles. None demonstrated an ability to examine those beliefs in relation to their teaching practice. When asked during the post student interview if the Mathematics Learning Style Inventory (MLS) and Teaching Style Inventory (TSI) dominant styles rang true for their respective experiences, none of them was able to comment on or connect the instruments to their first time teaching practice.

The following examples provide evidence for each interviewee's agreement of style and apparent inability to examine their beliefs and be flexible in modifying those beliefs when faced with disconfirming evidence.

- Mark was perplexed by the 80-minute period and did not comprehend the rationale for giving students more time to explore Mathematics. He had a

Dominant Mastery (MLS) Mathematics learning style; Mathematics was learned best when instruction focused on modeling new skills and there was ample practice solving problems they had solved previously using set procedures. That participant perceived the 80-minute period as too long a time period to keep students engaged in drill and practice.

- Mary was not able to investigate alternate ways for teaching Geometry. Having a Dominant Mastery (MLS) Mathematics learning style, Mary experienced difficulty learning when the subject became too abstract. Teaching Geometry using the Constructivist strategy to lesson design used an abstract approach.
- Selma did not expand her Constructivist instruction to the middle level and lower level students or students considered at-risk. Having a Dominant Self-Expressive (MLS) Mathematics learning style, Selma learned best when she was invited to use her imagination and engage in creative problem-solving. That participant perceived the middle level and lower level Mathematics student to be lacking the skills needed to solve problems and found that the re-teaching of basic skills to at-risk students as boring and unimaginative.
- Seth was not able to translate his understanding of learning Mathematics into what he perceived was being done to comply with the New York State Mathematics curriculum. Having a Self- Expressive (MLS) Mathematics learning style, Seth tended to have difficulty when the subject was focused on drill and practice, which was how he had been assigned to teach.

- Ursula could not use her mantra of “explainer” to design lessons for an 80-minute period that would give students time to think about Mathematics problems. Instead, she developed two procedural style worksheets that students would work on, 40-minutes for each one. Having a Dominant Understanding (MLS) style, Ursula liked problems that asked her to explain, prove, or take a position. Her cooperating teacher viewed class discussions as too noisy and not conducive to learning Mathematics, leaving Ursula unsupported in her development of instruction that allowed students to explain and support their rationale for solving problems.
- Upton was unable to tailor his teaching practices to comply with the instructional practices presumably advocated for preparing students to perform successfully on the New York State Regents exams. Having a Dominant Understanding (MLS) Mathematics learning style, Upton wanted to understand why the Mathematics he had learned worked. His cooperating teacher wanted Upton to focus on “covering” the topics, resulting in the student teacher unable to create instruction that supported understanding of concepts in a timely manner.
- Ingmar could not move away from the traditional instructional style used by his high school cooperating teacher despite having been given a *carte blanche* opportunity to design his own lessons. Having a Dominant Interpersonal (MLS) Mathematics learning style, Ingmar liked to learn information through dialogue, collaboration, and cooperative learning. That participant perceived that he could not employ collaborative learning strategies because his

cooperating teachers had indoctrinated the students into a traditional learning style.

In summary, the seven multiple case studies appeared to be adequate representatives of all participants in the quantitative Phase I of this study. There were no major changes in Mathematics beliefs or beliefs on how the subject matter was to be taught between the pre and post-student teaching experiences. Analyses of data from the multiple case studies led to the claim they represented varying combinations of: the three philosophies of Mathematics (Instrumentalist, Platonic, and Problem-Solver), the four Mathematics learning styles (Mastery, Understanding, Self-Expressive, and Interpersonal), and the four teaching styles (Mastery, Understanding, Self-Expressive, and Interpersonal).

Notably 20% (N = 6) of the Phase I participants envisioned themselves in a role of Instructor (Item #15 MBA) placing the main emphasis on Mathematics skills with correct performance. No interviewee self-identified in the role of teacher as an Instructor, and there was no female student teacher in the fall of 2009 whose Dominant Mathematics learning style was Interpersonal.

1. Thus, the first Research Question [**Do pre-service teachers' systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?**] could not be answered definitively since the multi-case participants lacked awareness of their beliefs about their philosophy of Mathematics and how Mathematics was best learned and taught. Without “knowing thyself” the participants were unable to “knowingly” make instructional decisions based on their beliefs.

2. **How does the social context of student teaching impact the ability to make instructional decisions?** The TTI TriMetrix talent questionnaire was used to identify the 30 quantitative participants' typical social behaviors in natural and adaptive situations. The DISC (Dominance, Influence, Steadiness, and Compliance) provided data that was viewed as follows. High scores in the S (Steadiness) and C (Compliance) indicated that a person likely would be resistant to change (S) and a similar score in C meant that a person tended to be respectful and could be expected to be supportive of conventions. In the teaching practice, high S and C scores meant being resistant to change (i.e., Mathematical reform) and supportive of the workplace rules (i.e., traditional instructional practice).

Twenty-nine participants from Phase I had relatively high mean scores in S and C for both the Adaptive behavior (S = 58.34, C = 66.76) and Natural behavior (S = 66.03, C = 60.03). Adaptive behavior is the identification of a person's responses to their environment—what behavior an individual believes they need to exhibit in order to survive and succeed at the job. Natural behavior is the identification of an individual's basic behavior, the core, “the real you” (Bonnstetter & Suiter, 2004).

It should be noted that there were high scores for I Natural (61.21) and I Adaptive (57.34) behaviors indicating that such a person was: trusting, sociable, and able to convince others to support a point of view. Based upon the central tendency data it was logical to conclude that the sample likely would: comply with a traditional school structure, support instructional conventions advocated by a system, and be amenable to the instructional strategies of their host school.

Two of the interviewees (Mark and Mary) had high S and C scores for both their Natural and Adaptive Social behaviors. The TTI TriMetrix DISC scores supported their apparent willingness to accept and support traditional instruction of procedurally taught Mathematics. Mary did not take or make an opportunity for teaching a lesson but followed her cooperating teacher's lesson plan(s), sometimes embellishing upon the already developed lesson. Mark acquiesced to using the instructional packets developed by his cooperating teachers and the Mathematics faculty in both student teaching placements. Those participants were: diplomatic, passive, patient, cautious, and conventional. Neither student sought to use resources such as manipulatives and textbooks in their instruction.

Seth and Upton exhibited low S and C Natural scores. Their Social behaviors (independent, unsystematic, opinionated) were indicative of a noncompliance attitude toward the rules and procedures of the secondary school work environment. However, their C Adaptive scores were high, enabling them to adapt to the constraints of their student teaching experiences. Both disagreed with observed conventional instructional practices, and when charged with crafting lessons aligned with the expectations of their cooperating teachers and the pre-set New York State mandated Mathematics curriculum they did so with noted reservations. They claimed to have altered conventional instruction as much as the system would allow, while acknowledging that such adjustments did not provide instruction in a manner considered to be maximally effective.

Parenthetically it bears noting that some novice teachers tend to be imbued with ideas about how to rectify and improve existing systems for instruction and neglect to account for their absence of in-the-field experiences. This comment is not meant to

denigrate those ideas but to highlight an important fact; theory needs to be juxtaposed against experience for practice to improve.

Ingmar had high I scores in Natural (74) and Adaptive (84). Those numbers supported the fact he was sociable, enthusiastic, optimistic, and sought opportunities for and was able to influence others. Ingmar was able to convince both of his cooperating teachers, whom he identified as traditional (Mastery) in teaching style, that he wanted to integrate cooperative learning into his lessons. Subsequently he realized that teaching in groups was going to be his main *modus operandi* for lesson design. The social context of Ingmar's first placement was open and conducive to his instructional decisions. His second placement cooperating teacher was not supportive of Ingmar's decision to use guided notes for the at-risk students.

Ursula had high S and C scores for her Natural behaviors and a high I and C for her Adaptive behaviors. She reported that her first student teaching placement was isolating and cold. It was diametrically opposite her profile of being warm, social, and trusting with a desire to influence others. The sequel to that placement was she did not have an opportunity to try alternate instructional methodologies. Instead she reverted to using lecture and traditional worksheets as her teaching strategies.

Selma exhibited a high I in her Adaptive (91) Natural (86) scores. Fortuitously, she reported being comfortable in both of her student teaching placements and was able to develop instructional alternatives, but not for the at-risk students in her first placement.

The relationship between a cooperating and a student teacher is important for fostering confidence to make instructional decisions. A good relationship with a

cooperating teacher fostered by constructive feedback is important to the ability of a student teacher to reflect on practice and on navigating the social context of a school.

Mary, Ursula, and Upton believed they had detrimental relationships with their cooperating teachers. Conceivably those perceptions impaired their confidence and presumed ability to make instructional decisions. Ursula said that her first placement cooperating teacher gave only negative feedback on her lesson design. Mary reported having been chastised for making an instructional decision presumably contrary to what her cooperating teacher expected. Upton said that he made an instructional decision that allowed students to come up to the chalk board, but was not allowed to justify that decision.

Mary, Ursula, and Upton were isolated from their Mathematics faculties and claimed that their respective cooperating teachers were responsible for them having being cloistered. Not having access to other members of the Mathematics faculties restricted the student teachers from exploring potentially important resources.

Selma, Ingmar, Mark, and Seth claimed to have had positive relationships with their cooperating teachers, and access to the respective faculty members in the Mathematics area. Each cited having been exposed to a computer local area network (LAN), SmartBoards, and Internet technology. Those participants said they believed they had been treated like colleagues during their student teaching placements; sharing lessons with faculty members and having opportunities for reviewing lesson plans crafted by those faculty persons.

Summary social context. Each of the seven participants from Phase II had reviewed the results from their respective testing, but apparently did not do an in-depth

review of their social behaviors as identified by the TTI TriMetrix and MBTI. They claimed to be satisfied with the information from the pre-student teaching MBTI (one to three pages in length), saying it was an accurate portrayal of their personalities, but were equivocal on understanding the TTI TriMetrix Talent Questionnaire (17-page description). No effort was expended to assist them with that task.

The social context of a school can provide a climate of instructional support or impede development for student teachers. The participants in the multiple case studies that reported a compromised social context (negative relationship with a cooperating teacher; isolation from school faculty and staff) perceived that they did not get constructive criticism when they made instructional decisions based on pedagogy they had learned in methods courses. Their experiences tended to deteriorate and in some instances markedly affected future employment plans.

Participants believing they had been accepted into the social context of their schools were comfortable that their instructional decisions were valid. However, where participants were complacent and accepting of traditional Mathematics instruction their instructional decisions were influenced strongly by the cooperating teachers.

Sub-question 2: How does the social context of student teaching impact the ability to make instructional decisions? Thus, the second Research Question was answered by saying that the social context had a considerable impact on the ability of the Phase II participants to make their own instructional decisions. For the most part, the participants set aside using alternate instructional strategies they had been introduced to during their pre-service teacher training programs. That happened particularly when the participants were confronted with at-risk students for whom the non-traditional

instructional strategies ad been developed. In those instances the participants chose the traditional procedural methods for their lessons. Conceivably, had the participants embraced their TTI TriMetrix Talent questionnaire results, they might have been able to navigate the social constraints of their student teaching experience and made more of their own instructional decisions.

Sub-question 3: How is the level of reflection on teaching practice impacted by the student teaching experience? Table 75 presents the Teaching Style Inventory (TSI) four styles (Mastery, Understanding, Self- Expressive, and Interpersonal) and the identified behaviors and activities exhibited by reflective practice in teaching. The Attribute Categories list the reflective practice areas of focus for teachers to consider when developing their lessons. The Teaching Style Inventory (TSI) results for the participants (N = 30) in Phase I included all four dominant teaching styles. The Mastery teaching style was identified as dominant for 17 participants, and is considered to be the traditional teaching style.

The Teaching Style Inventory (TSI) for each participant was represented by a score in all four styles, with one style being dominant. But it bears noting that it is not uncommon for teachers to reflect on their practice and cite behaviors and activities regarding their practice from all four styles. Also it is not uncommon for a teacher to have a Mathematics Learning Style Inventory (MLS) Dominant style different from their Teaching Style Inventory (TSI) Dominant style. Some of the 30 participants in Phase I had the same MLS and TSI dominant styles and others had different MLS and TSI dominant styles.

Table 75

TSI Learning Behaviors and Activities by Styles

Attribute Categories	Mastery Sensing/Thinkers	Understanding Intuitive/Thinkers	Self-Expressive Intuitive/Feelers	Interpersonal/Social Sensing/Feelers
Teachers may be characterized as:	Trainers Information givers Instructional managers	- Intellectual challengers - Theoreticians - Inquirers	- Facilitators - Stimulators - Creators/originators	Nurturers Supporters Empathizers
Learners may be characterized by:	Realistic Practical Pragmatic	Logical Intellectual Knowledge-oriented	Curious Insightful Imaginative	Sympathetic Friendly Interpersonal
Curriculum Objectives Emphasize:	Knowledge Skills	Concept development Critical Thinking	- Creative expression - Moral development	Positive self-concept Socialization
Settings (Learning Environments) emphasize:	Purposeful work Organization/ Competition	Discovery Inquiry/ Independence	Originality Flexibility/ imagination	Personal warmth Interaction/ collaboration
Operations (Thinking and Feeling Processes) include:	Observing Describing Memorizing Translating Categorizing	Classifying Applying Comparing/contrasting Analyzing	Hypothesizing Synthesizing Metaphoric expression Divergent thinking Creating	Describing feelings Empathizing Responding Valuing

Table 75 continues

Attribute Categories	Mastery Sensing/Thinkers	Understanding Intuitive/Thinkers	Self-Expressive Intuitive/Feelers	Interpersonal/Social Sensing/Feelers
Teaching Strategies include:	Command - Task - Graduated difficulty - Direct instruction - Interactive lecture	- Concept attainment - Inquiry - Concept formations - Expository teaching - Problem Solving	- Creative problem solving - Moral Dilemmas - Metaphoric expression - Divergent thinking - Knowledge by design	Circle Peer Tutoring Team Game Tournaments Group Investigation Role Playing
Student Activities include:	Workbooks Drill and repetition Demonstrations Dioramas Competition	Independent study Essays Logic problems Debates Hypothesizing	Creative art activities	Group Projects “Show and Tell” Team Games Directed art activities Personal sharing
Assessment Tasks call for	Making charts/maps Developing sequences/timelines Repairing/debugging Reporting Constructing Defining/describing	Comparing/contrasting Making a case Conducting an inquiry Explaining Analyzing Classifying Debating Interpreting	Speculating- What –if? Hypothesizing Creating Metaphors Inventing/designing Using artistic media to express ideas	Performing community service Decision making Relating Reflecting Empathizing Keeping a journal

In Phase II all seven participants identified teaching strategies (see Table 75) that represented each teaching style. For example Interactive Lecture was used as a teaching strategy by Mastery style teacher; Group Investigations was used by an Interpersonal style teacher, Creative Problem-Solving was used by a Self-Expressive style teacher, and Expository Teaching by an Understanding style teacher.

Each of the seven Phase II participants had experience implementing one teaching strategy outside of their dominant teaching styles. Mary, Mark, Seth, Selma, Ursula and Upton were able to develop a cooperative team game. Ingmar was able to develop an expository problem-solving lesson with his advanced middle school students. All of the participants were able to reflect on the successes of their lessons using strategies outside of their dominant teaching style; where the lessons worked and where they did not work. For example, Selma used manipulatives with both her advanced and average level students. She was able to identify her success with the lesson and provide a rationale for why the strategy might not work for the at-risk students.

Formative assessment has been identified as a key skill needed by teachers to design instruction (McTighe & Tomlinson, 2006). In Phase II of this study, assessment was the one area of reflective practice that rarely was experienced by the participants during their student teaching assignments. In general, all of the participants did not have any introduction to pre-assessing student Mathematics knowledge, understanding, or skills. Upton was the only participant who reported using exit slips in his lesson design to formatively assess the effectiveness of his lesson.

There were few incidents where state or ability tests were shared with the participants by their cooperating teachers, Mathematics department chairpersons, or guidance counselors. The participants held a misconception that pre-assessment were the IEPS that were used to modify

instruction for special needs students. In particular, Mary had no opportunity to pre-assess her students during her first placement where all of her classes were inclusion classes. Mary commented that the testing and re-testing of the special needs students was pervasive throughout her middle school student teaching experience. That participant reported there was little evidence that allowing special needs students to retake a test was effective for improving their academic achievement.

Pre-assessment of student understanding of Mathematics concepts has been identified as key to teachers' development of differentiated instruction, which could be differentiated based on student ability, interest, readiness, or learning profile (McTighe & Tomlinson, 2006). The participants in the multiple case studies reported few incidents of cooperating teachers providing opportunities to pre-assess students' knowledge, concepts and skills. As a result there were few opportunities for the participants to observe differentiated lessons let alone design such a lesson. Selma perceived her second placement cooperating teacher to develop differentiated lessons and reported that her cooperating teacher used ability and readiness of the students to design differentiated lessons. Ingmar had never heard the term differentiated instruction. Ursula reported that her second placement cooperating teacher did not correctly identify differentiated instruction strategy.

Summary of reflection on practice impacted by student teaching. A thoughtful curriculum, unit and lesson design, and the NCTM standards contribute to the framework needed for a teacher to reflect on their practice. Without a background framework for instruction it is difficult to identify reflective practice. The question arises as to what the participants reflected on?

- There was no formal lesson plan structure required by the schools hosting the multiple case study participants.
- The participants were not presented with a curriculum for their courses. At most the participants were given a course scope and sequence with a pacing chart for the topics that were expected to be covered.
- The participants perceived the cooperating teachers as minimally addressing the NCTM and New York Mathematics standards. Upton and Ursula were given by the standard they were to teach the night before the lesson. Standards were not integrated into the lesson plan nor were the standards always aligned with the scope and sequence.

Ursula reported that her second placement cooperating teacher had never seen a copy of the NYS Mathematics standards. All participants reported that they needed to include the standards on their formal lesson plans required by the college, but not by the secondary cooperating teachers.

All but two of the secondary schools that hosted student teachers used textbooks as resources for instruction. All current textbooks seek to align Mathematics curricula with the NYS Mathematics standards and it is an important part of a teachers' reflection process to design viable and meaningful performance tasks to assess students' achievements on the NYS Mathematics Standards.

All seven participants struggled with making instructional decisions regarding at-risk students (i.e., special needs, low ability). They claimed to not having been prepared adequately for working with such students and voiced interest in learning strategies that they could use to engage at-risk students in their lessons.

Thus, the third Research Question [*How is the level of reflection on teaching practice impacted by the student teaching experience?*] was answered by saying that the level of reflection on the teaching practice shifted away from focusing on curriculum objectives, instructional strategies, and assessment tasks (see Table 71) that were to be practiced and implemented. The participants expected their student teaching experiences to help them learn how to reflect on their practice, such as learning how to successfully create lessons that would engage at-risk students. Instead, the Phase II participants' reflections on their teaching practice was focused on relationships with their cooperating teachers instead of on the value of the student teaching experience, and all of them questioned the Mathematics curriculum presented to the students.

Mixing the quantitative and qualitative results. The researcher used Ernest's (2004) identification of how the absolutist and fallibilist epistemologies were integrated when infused into the social constraints of a school environment. Ernest (2004) posited that instructional practice was contingent upon the resonances and sympathies between different aspects of a teacher's philosophy, ideology, values and belief-systems. "These form links and associations and become restructured in moves towards maximum coherence and consistency, and ultimately towards integration of personality" (p. 13). Lacey (1977) considered Mathematics instruction as "strategic compliance" when in the realm of the absolutist, status quo, Instrumentalist-Platonic, constructs of the prevailing traditional methods that dominate current Mathematics instruction (Boaler, 2008; Ernest 2004).

The researcher elected to use Lacey's (1977) explanation of today's traditional Mathematics teaching to replace the absolutist epistemology with the Instrumentalist-Platonic traditional philosophy and the fallibilist epistemology with the Problem-Solving philosophy. The

researcher's rationale for using Lacey's explanation was based on 13-years of observable practice as a supervisor of teachers in secondary public school systems. During those years Mathematics was considered to be a content area reserved for students who exhibited ostensibly high ability to understand and retain algorithms. Tracking students was *status quo* for secondary Mathematics programs. Mathematics reform in New York State required that all students (regardless of their ability in the domain) would take and pass NYSED Mathematics Regents exams. Thus the fallibilist philosophy was introduced into the school culture. The researcher was responsible for providing staff development to professional teachers who embraced alternate instructional strategies associated with Mathematics reform, such as how to develop critical thinking skills to improve students' problem-solving abilities. Regrettably such in-servicing did not reach a majority of the professional educators and their respective building administrators. That disappointment was evidenced by the apparent preference of the cooperating teachers, in this study, to hew closely to so-called traditional modes of teaching despite the promulgations from advocates of Mathematics reform.

Conventional teaching of Mathematics has been characterized by tracking courses using students' Mathematics ability to homogeneously group them (advanced, general, low achiever). Separated values were considered beliefs that only select groups of students could/should study Mathematics (Ernest, 2004). Connected values argued that all students can learn Mathematics even when they were ability grouped heterogeneously. Figure 10, illustrated below, shows the value-position role of a secondary Mathematics teacher in curriculum development. The intent of the figure is to depict the context of a school environment when conflict arises between personal philosophies of Mathematics and the image of Mathematics as communicated in a classroom. Figure 10 is a description of how the model works.

Key to arrows and directions

↓ representing the most straight forward relationships.

↘ representing the straight path taken after crossing over ↘ from Instrumentalist/Platonic Philosophies of Mathematics.

↙ representing the straight path taken after crossing over ↙ from the Problem Solving Philosophy of Mathematics.

↖ ↗ representing the constraints of the Problem Solving Philosophy of Mathematics connected view of school Mathematics that is often forced by strategic compliance to move to traditional instruction.

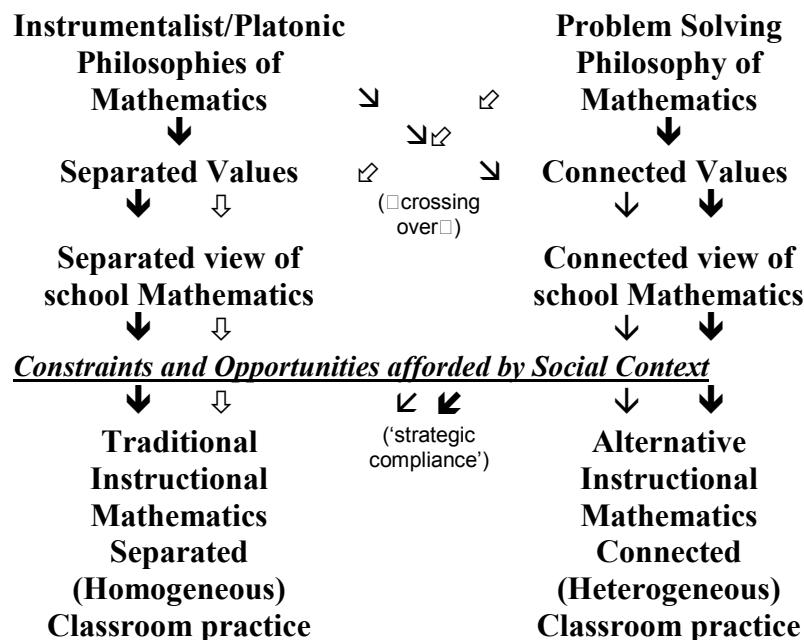


Figure 10. Mixing of quantitative and qualitative data using the simplified relations between personal philosophies of Mathematics, values and classroom image of Mathematics.

Based on 36-years of teaching Mathematics and 13-years of supervising teachers, the researcher identified five instructional design paths teachers can take in their teaching practice that incorporate their factors of autonomy (beliefs, reflective practice, social context of the

school environment). The complexity of how the factors of autonomy interact can be viewed using five basic paths that teacher instruction can take. It should be noted that any teacher might experience all five paths, but path number (1) represents a traditional secondary Mathematics program. The paths end in either a traditional or alternate instructional classroom environment and are described as follows:

1. Instrumentalist-Platonic philosophies combined with separated values and subject to the social constraints of a school can foster a separated Mathematics classroom practice (↓ representing the most straight forward relationships between Instrumentalist-Platonic philosophies, values, and Mathematics practices)
2. A Problem-Solving philosophy combined with connected values and amenable to similar social constraints can create a humanistic Mathematics classroom practice (↓ representing the most straight forward relationships between Problem-Solving philosophy, values, and Mathematics practices).
3. Crossing over represents a deep commitment to the ideals of progressive Mathematics education [Mathematics reform using alternate instructional methods] that can and frequently does coexist with traditional beliefs in the objectivity and neutrality of Mathematics among educators. Parenthetically, Problem-Solving commonly is associated with progressive Mathematics education reform (↘↗).
4. The Instrumentalist-Platonic philosophies if combined with the connected values can give rise to a connected view of school Mathematics. With due regard for existing social constraints it can create a connected view of school Mathematics (↓).

5. The Problem-Solving philosophy if combined with separated values can give rise to a separated view of school Mathematics. With due regard for existing social constraints it can create a separated view of school Mathematics (\Downarrow).

The researcher mixed the quantitative and qualitative results to determine the level of the Phase II participants' respective autonomy as impacted by the constraints and opportunities afforded by the social context of a student teaching school environment. The participants exhibited some degree of crossing over (path 3) by identifying, designing, and attempting to implement alternative instructional methods in their practice. Six of the participants created a cooperative learning lessons that engaged the students in a Mathematics game or modeling task. But the impression conveyed was that all of the participants arrived at the traditional (separated) Mathematics classroom practice despite their desire to implement alternate methodologies. Notably, all of the student teaching settings had homogeneously ability grouped classes.

The seven interviewees subscribed to the first (Instrumentalist-Platonic) and fifth (Problem-Solving) paths when making their instructional decisions. Mark and Mary followed Path One. When situated in a school setting that harbored separated values (advanced courses and inclusion settings) they complied with the school traditional instructional settings. Ingmar and Ursula presented a mixed set of beliefs and profiles. Both held to the traditional Instrumentalist Mathematics philosophy and traditional Mastery teaching Style but differed in their Mathematics learning styles. Being in traditional instructional settings (separated values/homogeneous ability grouped classes) encouraged them to follow Path One; strategically adhering to the school instructional setting.

Seth, Selma, and Upton held Problem-Solving philosophies and Self-Expressive and Understanding Mathematics learning styles (MLS) and teaching styles (TSI) respectively. Thus

they supported the design of non-traditional instruction that would engage students at all ability levels. Those three participants followed path five despite efforts to implement alternative instructional strategies that were thwarted by the social constraints of the schools. Selma was not able to implement alternative methods to her at-risk students citing classroom management as her aegis. Seth and Upton did not implement alternative strategies, citing curriculum issues, and a lack of support from their school cultures.

Discussion of Research Issues

Pursuit of answers to the following three questions led the researcher to identify each and provide bulleted points that supported claims.

1. Do pre-service teachers' systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?
2. How does the social context of student teaching impact the ability to make instructional decisions?
3. How is the level of reflection on teaching practice impacted by the student teaching experience?

Evidence supporting claims to question one.

To what extent do the quantitative and qualitative data converge to provide an understanding of the status of pre-service secondary Mathematics teachers' autonomy prior to and after their student teaching experience? The response to this sub-question was the converged quantitative and qualitative data was used to ascertain each participant's factors of autonomy (beliefs, social context, reflection on the teaching practice) prior to student teaching and the level of autonomy they attained post student teaching.

The qualitative and quantitative data converged as follows:

1. Prior to the student teaching experiences the researcher used the quantitative data (Mathematics Beliefs Survey, Mathematics Learning Style Inventory, Teaching Style Inventory, Myers Briggs Type Indicator, TTI TriMetrix Talent questionnaire) beliefs, reflective practice, and social constraint results to support participants pre-student teaching narratives that addressed: (a) rationale for their decision to become Mathematics teachers; (b) Mathematics beliefs; (c) envisioned role as a teacher; and (d) perception of the school culture.
2. Post-student teaching, the researcher used the quantitative data TTI TriMetrix Talent questionnaire scores to support impact of the social constraints of the student teaching experience on the participants' ability to make instructional decisions.
3. The researcher used the quantitative data from the 30 Phase I participants to support the themes and sub themes of the cross case analysis from the pre-student teaching interviews [(a) Rationale for teaching, (b) Attributes of the Role of teaching, (c) Mathematics Beliefs, (d) Perception of School Culture, and (e) Perception of the Teacher Program Preparation for the Student Teaching Experience].
4. The post-student teaching interviews allowed for identifying participants' [(a) Perceptions of the Student Teaching Experiences, (b) Cooperating Teacher Attributes, (c) Impact on Instructional Decisions, (d) Perceived Impact on a Participant's Teaching Practice, and (e) suggestions for improving teacher preparation programs].

Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching? The response to this sub-question was there was an explainable relationship between a pre-service

teachers' Mathematics education backgrounds and beliefs about Mathematics and Mathematics teaching that were attributed to the number of college Mathematics courses completed, the number of applied high school Mathematics courses completed, the number of high school science courses completed, and the participants' High School GPA.

Utilizing the quantitative data from the 30 persons from the initial phase of the study, the researcher chose to conduct a series of one-way ANOVA's to analyze possible relationships among the pre-service teachers' Mathematics backgrounds, their beliefs about the subject matter, and Mathematics teaching. The sample of 30 was too small to conduct linear regression analysis. In a very limited number ANOVAs of this study there was not ample power to calculate some of the results.

1. The quantitative data results allowed for stating that philosophy choice of a participant was dependent on the number of college Mathematics courses completed. Person with fewer courses were more likely to express the strongest views about the Instrumentalist philosophy. Two of the Phase II participants, Selma and Upton, had listed on their Mathematics Beliefs Survey 11 or more college Mathematics courses they had completed. Both of participants chose Problem-Solving as their philosophy of Mathematics. Upton was able to articulate clearly his Problem-Solving philosophy.
2. The respective high school backgrounds influenced how the Phase I participants viewed their role as teachers and how they expected to design curricula. The more high school science courses completed the greater was a person's inclination to claim weakness about their role as an instructor, and the more likely they were to rank a teacher or school constructed curriculum as second in rank of importance. The two other categories that the Phase I participants were asked to rank in order as how they

- were going to use curricular materials were: (a) A strict following of a text or theme, and (b) A teacher or school construction of the Mathematics curriculum.
3. The number of applied Mathematics courses taken in high school influenced how the participants ranked the role of teacher and how they expected to choose to use curricular resources. The more applied Mathematics courses (2-7) completed by the Phase I participants in high school, the greater was their tendency to rank an Instructor as least important with regard to the role of teacher. Persons who took more applied Mathematics courses in high school were more apt to rank the statement “Modification of the textbook approach, enriched with additional problems and activities” closer to first in terms of importance.
 4. Higher high school GPAs (3.6-4.0) influenced how the participants ranked the role of a teacher. Participants in Phase I with higher high school GPAs were more likely to rank instructor teaching role as least important.

In summary there was an apparent connection between high school background (number of science courses, number of applied Mathematics courses, high school GPA) and perceptions of how a teacher should instruct students and creating instructional materials. A most important finding was the connection between the number of Mathematics courses completed in college and a participant’s philosophy of Mathematics.

Thus, Question One [*Do pre-service teachers’ systems of beliefs about Mathematics and its teaching and learning change after they experience student teaching?*] there was no change in the teacher’s beliefs about Mathematics its teaching and learning after the Phase II participants experienced student teaching.

Evidence supporting claims to question two.

To what extent do the same types of data (belief, social context, and reflection) confirm each other? Thus this sub-question was answered as the types of data (beliefs, social context, and reflection) confirmed each other.

1. The narratives developed from the seven multiple case study interviews confirmed the quantitative scores. The qualitative data yielded themes and sub themes (see Tables A and B, Appendix F) that confirmed the belief and social context, and reflective characteristics identified by the TTI TriMetrix and MBTI (Social Context), MLS and TSI (Beliefs about Mathematics), and TSI (Reflection on Teaching).
2. The Mathematics Learning Style Inventory (MLS) constructs for the Phase I (N= 30) participants were validated by the reliability of the Mathematics Belief's survey questions. The constructs of the MLS were aligned with the Mathematics Beliefs' Survey items 17-21. The Mathematics Beliefs Survey (MBS), items 17-21, sought to identify the participants' view of how Mathematics was best learned and best taught. The four Mathematics learning styles (Mastery, Understanding, Self-Expressive, and Interpersonal) were represented in the MBS questions (17-21) developed for each of the five MLS constructs [(a) focus on Mathematics instruction; (b) approach to problem solving; (c) assessment of Mathematics understanding; (d) teachers' approach to Mathematics instruction; and (e) best classroom environment to learn Mathematics]. The Cronbach's Alpha (.71) was calculated for items 17-21, and provided an estimate of the internal consistency of the instrument's scores with a single administration. A Cronbach's Alpha equal to or greater than .70 was deemed acceptable reliability (Gliem & Gliem, 2003).

To what extent do the open ended themes of qualitative analysis support and clarify the quantitative survey results? This sub-question was answered as saying there were similarities in the open ended themes that clarified the quantitative results with one major difference that was uncovered.

What similarities and differences existed across the levels of analysis?

1. The multiple case study participant data analysis mirrored the quantitative participant analysis as follows:
 - a. 57% of the multiple case study participants (4 out of 7) had Mastery as the dominant style for the TSI.
 - b. For the 30 participants 57 % were dominant in the Mastery TSI style.
 - c. There were no differences between genders on the dependent variables of: Mathematics philosophy, role of the teacher, and use of materials.
2. Differences were uncovered between Phase I participants' identification of their philosophy of Mathematics. When asked to articulate a Mathematics philosophy, the qualitative data revealed difficulties because only five persons provided a viable explanation and four of them were tepid. Two persons were not able to articulate any philosophy. One individual was clear and concise. Whether it was the same person who subsequently participated in the interviews was not known since identifying information was not retained.

Question Two (*How does the social context of student teaching impact the ability to make instructional decisions?*) was answered as saying the social context (cultural beliefs, traditional instructional environment, opportunity to reflect on practice) of the student teaching experience had the most impact on the pre-service teachers ability to implement alternate (to the traditional

procedural lecture) instructional strategies (cooperative learning, differentiated instruction) especially when developing lessons for at-risk students.

Evidence supporting claims to question three

How do autonomy factors relate to pre-service teachers' perceptions on the practice of teaching? This sub-question was answered by saying the lack of the pre-service teachers' understanding of their beliefs, the school culture, and how to implement alternate instruction often lead to a negative perception to the practice of teaching all student ability levels Mathematics.

Pre-service participants were able to:

1. Describe their beliefs about learning and teaching;
2. Provide a limited description of the school culture (they all anticipated it was collaborative);
3. Could not articulate how they would design a lesson for an unmotivated student short of talking to such a student.

Do teachers restructure belief systems in practice? This sub-questions was answered by saying that pre-service teacher do not restructure belief systems in practice.

In this study the pre-service teachers did not exhibit an in-depth understanding of their beliefs. They showed no interest in discussing the results from the four instruments (TTI, MLS, TSI, MBTI) and how the results might be used to provide insights into respective reflection on their practice. Consequently the researcher was not able to identify any reconstructed beliefs.

What factor (s) of pre-service teacher autonomy is (are) impacted the most by a student teaching experience? The response to this question was that the pre-service teacher's reflection

on implementing alternative instructional methodologies was the most impacted by the student teaching experience.

The ability of a pre-service teacher to reflect on practice was impacted most by the student teaching practicums. Placing pre-service teachers into traditional procedural teaching climates and expecting them to become confident in their ability to implement a variety of instructional strategies was a glaringly unrealistic expectation.

Question Three [*How is the level of reflection on teaching practice impacted by the student teaching experience*] was addressed by claiming pre-service teachers were not able to develop their ability to reflect on their proposed instructional strategies but rather acquiesced to the traditional methodologies imbedded in the social constraints of the school environment where they student taught.

Re-iteration and clarification of limitations and delimitations. Prior to presenting advisements based upon the analyses of information culled from this investigation it is important to re-state the limitations and delimitations from Chapter I with additional thoughts.

Limitations. The limitation to this mixed method design was the inconsistency in the context of the teaching environment where the participants were placed to do their practice teaching. School districts where student teachers were placed varied in size, socioeconomics, school culture, and programs. Also of importance was that it had to be presumed that the educational and instructional competencies and beliefs about Mathematics instructional practices varied among in-service teachers selected to supervise the student teachers. In this study the sample of cooperating teachers might have been unusual and so they caused the students to have the strange experiences. However, in all the multiple case studies the participants perceived the

instructional settings to be traditional and were able to identify the traditional teaching attributes of their cooperating teachers.

Delimitations. The results of this study were based on data and analysis of New York State pre-service teachers selected from the State University of New York. Results might be different for persons from other locales and from other state university post-secondary institutions. However, it should be noted that the sample ($N = 30$) of teachers were selected from all four corners of the New York State. Therefore, the results might be different for persons from private post-secondary teacher preparation programs (New York State) and out of state post-secondary institutions. Based upon four decades of working in the profession and the breadth of the sample space (selectees from 10 institutions) lead the researcher to believe that the sample to be a reasonably accurate one and representative of the 102 students in the SUNY cohort.

Implications and Recommendations

To the extent the participants in both phases of this investigation responded candidly to all aspects of the data collecting processes, this study identified apparent Mathematics and teaching belief systems from 30 pre-service teachers, selected from 102 potential participants, who were to be graduated from 8 SUNY secondary Mathematics' teacher education programs. The qualitative phase of this study was used to capture the impact of the student teaching experience ($N = 7$) on those beliefs.

This study results were construed as viable for crafting a beliefs baseline for future research on what was believed about Mathematics, how it was learned, and should be taught. The purpose of the student teaching experience presumably was to immerse a person into a real world teaching situation with an experienced cooperating teacher. Regrettably that practicum

was deficient in nurturing prospective teachers in the use of instructional practices based on cutting edge research. The lack of a nexus between the academy and the world of school teaching was disturbing. It was tantamount to saying that when the rubber meets the road there was glare ice and a driver has no understanding of how to manage the vehicle. Outcomes in such instances tend to be disastrous, and in some respects that can be how the student teaching experiences materialized for the seven participants in Phase II.

The quantitative data analysis described the 30 participants' potential factors of autonomy. The qualitative data analysis, completed after student teaching experiences, probed how autonomy had been impacted by the student teaching experience and gave veracity to the constructs of the beliefs and social behavior. The researcher concluded, through a process of abduction, that the 30 persons in Phase I were deficient in knowing and understanding how their beliefs and social behaviors might affect their abilities to reflect on their practices. That lacuna needs attention from training institutions.

Viewing the system of autonomy as a wheel is essential when crafting pre-service Mathematics teacher courses. It should be where a philosophy is cultivated, formulated, and an understanding developed as to how different persons learn the subject and what variations existed on how to best provide learning experiences so all students might benefit maximally. Knowledge of Mathematics beliefs and social behaviors impact the autonomy of a teacher at least in the following three ways:

Pre-service teachers who complete more Mathematics courses tend to shift their philosophy. The result of the ANOVA led to the conclusion that persons completing fewer college Mathematics courses were more likely to subscribe to the Instrumentalist philosophy (Mathematics was an accumulation of facts, rules, and skills to be used in the pursuance of some

external end). It should be noted that the descriptive statistics kurtosis for the number of such courses was $K = -2.12$. In statistical work the variability around a mean score is important because it reveals the extent of extreme scores. Higher kurtosis means that the frequency curve was impacted by a number of extreme scores. Of note is that in this study the kurtosis could be related to the small sample size of the participants ($N = 30$).

Seth perceived that he changed his philosophy of Mathematics as a result of having taken more college Mathematics courses. He said that the subject was best viewed as a problem-solving philosophy; a change from his earlier instrumentalist view.

Upton attributed his problem-solving view to having studied Philosophy and also because of the number of Mathematics courses he took in college. Mary and Mark found that study of non-Euclidean Mathematics and calculus were too abstract and held to their initial beliefs of Instrumentalist (Mark) and Platonic (Mary) philosophies. Ingmar's Instrumentalist philosophy apparently hampered his ability to consider developing instruction aimed at helping students construct meaning when dealing with Mathematical concepts.

Pre-service teachers that view Mathematics with a problem-solving philosophy make decisions to use alternative methods of instruction to design instruction. Selma held a problem-solving Mathematics philosophy. She liked to take courses that brought new ideas into instruction, and had developed and implemented a Constructivist lesson (artifact) for her advanced students and implemented "BLUFF"; a cooperative learning game for her at-risk students. Upton was firm in his attitude about developing instruction for students that would foster understanding concepts. His adamancy was viewed as reflective of his problem-solving philosophy cultivated from the formal study of Philosophy.

In contrast, Ingmar and Ursula held an Instrumentalist philosophy. In her pre-student teaching interview Ursula said she was interested in developing hands-on discovery lessons. But when confronted with an 80-minute class period she planned her lessons in a traditional style using worksheets and lecture. I

Ingmar had the opportunity to develop group activities with his at-risk high school students. Interestingly, his high school cooperating teacher left him alone to teach the class, and when that happened Ingmar reverted to a Mastery approach of teaching the at-risk students.

Pre-service teachers that are aware of their social behaviors are able to implement their instructional decisions. Ingmar was aware of his ability to coach students and the need to form correct relationships with them. He believed that getting to know the students, in and out of class, was basic to enhancing student engagement on a classroom lesson, and he was able to convince his first cooperating teacher to let him modify the traditional lesson structure to include cooperative learning. This participant viewed himself as an authority on cooperative learning and shared with the researcher his work on how a teacher's impression about a student's ability affected the achievement of the student in that teacher's class.

The three factors, enumerated above, impacting autonomy are connected by individuals understanding themselves in the areas of; recognizing and implementing Mathematics beliefs; being aware of how personal social behaviors might collide with conventional mores in an educational environment; and how teaching and learning styles reflect instructional design. Pre-service teachers need to become sensitized to the fact they present a matrix comprised of all four styles, and learners of Mathematics also possess all four styles. The implication is there is no one best way to teach and learn Mathematics.

Conclusion

This study revealed findings that may be expressed as a “whole” that is greater than the sum of its parts. The original intent of the study was to research the effects of student teaching on pre-service Mathematics autonomy. A mixed methods sequential explanatory design was developed in two phases, quantitative and qualitative. Phase I set out to quantify the three factors of autonomy (beliefs about the philosophy of Mathematics, how Mathematics is learned; reflection on instructional practice; social constraints of the public school setting). Phase II selected seven volunteers from Phase I to interview pre and post their student teaching experiences in order to gain a more in-depth study of the autonomy phenomenon.

The qualitative analyses enabled the researcher to uncover the fact pre-service teachers could not articulate their beliefs about Mathematics. That was deemed to be a glaring weakness in the preparation of the student teachers. That finding had a pervasive impact on this research, because it is critical that a teacher of Mathematics know and be able to articulate a viable philosophy of the subject matter. Lacking such information leads to the belief that it is doubtful that such a person could coherently and persuasively communicate meaningful and important information to students?

It was determined that the more college Mathematics course a pre-service teacher completes the more that person will move away from the traditional Instrumentalist/Platonic philosophy and toward the Problem-Solving philosophy. Pivotal in this consideration is that such pre-service persons must be capable of conceiving their own philosophical orientation toward the learning and subsequent teaching of Mathematics. By extension it needs to be recognized that the Problem-Solving philosophy is harmonious with the Mathematics reform initiatives reflected in the NCTM standards (Ernest, 1989, 2004; Lacey, 1977). Parenthetically it

can be stated that completion of more Mathematics courses broadens a prospective teacher's philosophy of the subject and concurrently helps the person to become a better Mathematician. It bears repeating that a regrettable finding of this investigation was that pre-service Mathematics teachers were inept at articulating what Mathematics meant to them and how they believed it should be taught.

The study also revealed that there was a need for Mathematics teachers to learn about themselves in relation to how they best learned the content, how it might be taught best, and how they might interact (their natural and adaptive behaviors) within the social constraints of the teaching profession. The apparent lack of interest into what their scores might indicate, by all of the 30 participants in Phase I, was disheartening. Furthermore, none of the participants from Phase II sought clarification or feedback of any form pertaining to how the testing information (Mathematics Learning Style Inventory, and Teaching Style Inventory) might help them enhance their instructional practices.

The most neglected aspect of a teacher knowing themselves was the ability of the pre-service teachers to understand their adaptive(exhibited behaviors needed to survive and succeed at the job) and natural behaviors (identification of an individual's basic behavior, the "real you") when navigating the social constraints of a school. Pivotal to pre-service teachers' transition into practice is having a professional relationship with their cooperating teachers. As in life, the pairing of a pre-service teacher with a cogent cooperating teacher is not always ideal. The study revealed that the cooperating teacher-student teacher was perceived by the Phase II participants not to be realistic and ideal. Preparing pre-service teachers to understand how they relate with a mentor in a professional setting might prevent conflicts that impact learning about the teaching

practice. Again, the researcher did not receive any inquiries as to the nature the TTI TriMetric Talent questionnaire and how the scores related to the teaching practice.

In summary in order to better craft instruction for all learners, at-risk students included, it is imperative that the pre-service teacher understand how knowledge of their beliefs and their adaptive and natural behaviors relates to their autonomy. Giving teachers a better understanding about Mathematics philosophy and how Mathematics is learned and taught seems to be one of the most deficit and important issues found in this study. Absent understanding who they were and how they related to a professional context meant the student teachers, potential future practitioners, were at risk before venturing into a classroom. Carrying such an albatross created barriers impairing their potentials for becoming effective instructors and likely raised the barriers to an insurmountable height when confronted by a need to content with non-traditional practices. Extrapolation of such circumstances meant that artificial containment and practical limitation more than likely would lead to personal professional displeasure and less than maximal student achievement. Perhaps the glaring arena where such an imbalance might be disclosed would be with at risk students. The data were interpreted to mean that the pre-service Mathematics teachers had their most difficulty when confronted with developing instruction for the at-risk students.

Recommendations

Based on the results of this study the following seven recommendations are presented for the preparation of pre-service teachers.

1. *Knowing Who You Are in Relation to Teaching Mathematics*—Create a teaching practice coaching component at the college level and integrate sensitivity to soft skills component in pre-service teacher methods courses. Those soft skills would focus on

how beliefs about Mathematics, social behaviors, and reflection on practice impact the transition into practice.

The manner for infusing such important information into a curriculum would need to depend upon the creativity inherent at respective institutions, but the use of a seminar format could be considered starting as early as possible. It is suggested that the battery of instruments used in this study be employed and special attention be given to the issue of autonomy and how it relates to teaching of Mathematics.

2. *Creating Mathematics Philosophy*—It is imperative that pre-service Mathematics teachers formulate a meaningful and defensible philosophy of the subject matter and be able to personalize how it relates to learning and teaching. Conceivably there should be a base number and type of Mathematics courses required.

Importantly there needs to be opportunities for a pre-service teacher to experience and learn how the abstract college Mathematics courses are related to what is taught in the middle and high school levels. An extension of this point is that there needs to be an alignment of what prospective student teachers learn in college with the New York State Mathematics Curriculum.

3. *Providing “Real Time” Methodology*—Methods courses need to present pedagogical ideologies that support design of instruction for at-risk students and also provide opportunities for observing those strategies modeled and then the students need to practice with those strategies. This is tantamount to saying that discussing pedagogical ideology is superficial in the absence of understanding the philosophy behind pedagogy, watching the pedagogy implemented, and then demonstrating it to peers and instructors.

4. *Collaboration*—Postsecondary training programs for Mathematics teachers should be working with schools to ensure there is a plan and method for implementation in place giving student teachers experiences with different forms of instruction (Constructivist Discovery Learning, Cooperative Learning, Lecturing, and Differentiated Learning) and the appropriate use of alternative methods. Ideally, such approaches should be introduced during a program of studies and extend for two-years before the student teaching experiences.
5. *Making the Student Teaching Program Realistic*—Revise the student teaching experience by creating a consistent set of expectations and rules to include but not be limited to vetting cooperating teachers (perhaps certifying) on how to mentor student teachers. It may behoove the training institutions to indoctrinate cooperating teachers into the autonomy system. As mentioned earlier, it was regrettable that the participating student teachers viewed their cooperating teachers as deficient in cutting edge research as it pertained to the instruction and learning of Mathematics.

Pre-service Mathematics teachers generally surface from high schools where they were taught in advanced Mathematics classes, and seldom have they encountered at-risk students. Tracking, contrary to current research supporting heterogeneous grouping of students, still exists in most middle and high schools. Pre-service Mathematics teachers need methods courses and field work that provides a number of experiences designing instruction for at-risk students. Also of paramount importance is for them to know how to design instruction in a block schedule (80-minute periods).

6. *Assuring Understanding and the Mathematics Standards*—Current NYS Mathematics standards and curriculum are part of the pre-service teacher’s methods class. Bridging the curriculum learned at the college with the actual curriculum that is part of the secondary school program is imperative to the pre-service teacher learning how to develop instruction.
7. *Integration*—Instructional resources need to be integrated into the methods courses so the matriculating students understand how textbook and interactive technology programs support standards and instruction.

Future research. It is suggest that this study be repeated in different states with the following foci:

1. Longitudinal studies be conducted that follow graduates in their professional practice.
Does knowledge of soft- skills increase teacher retention in practice?
2. Do teachers evidencing favorable soft-skills have personal and professional satisfaction working with challenged students?
3. Does the completion of more college-level Mathematics courses enhance autonomy and cultivate a reinforced system of beliefs about the subject matter?

Chapter VII

Summary

Study Design

This mixed methods sequential explanatory study was conducted to identify the impact that transition into the practice of teaching had on the autonomy of pre-service secondary teachers of Mathematics. The study was based on Ernest's (1989) theory that the phenomena of a Mathematics teacher's autonomy depended on three factors: beliefs about Mathematics and how it was learned, reflection on the teaching practice, and the social constraints of a secondary school culture. Thirty study participants were selected from ten State University of New York teacher preparation colleges and universities. The data was collected between January 2009 and March 2010 to ensure that the cohort of teachers entering the teaching profession in 2010 was represented.

In Phase I (Quantitative) the 30 participants completed five instruments used to quantify the three factors of autonomy (the ability of teachers to see themselves as authorities, evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence). In Phase II (Qualitative) seven case studies were purposefully selected by gender and their Mathematics learning styles from the 30 Phase I participants. Each participant was interviewed prior to and subsequent to their student teaching experiences.

Major consideration was given to the Phase II findings and it was determined that the seven multiple case study analyses provided in-verification of the instruments used in Phase I. Plus the interpretations or the cross case studies provided a more thorough understanding of the relationships between factors of autonomy among the participants.

Quantitative Phase

Data collection. In Phase I the data was collected using two web-based instruments (Mathematics Beliefs Survey and the TTI TriMetrix Talent Questionnaire), plus hardcopies of the three inventories (Mathematics Learning Style Inventory, Teaching Style Inventory, and Myers-Briggs Type Indicator). The first two were scored online by Survey Monkey and Target Training International, Ltd. The latter three were administered and scored by the researcher.

Data analysis.

Univariate analysis. Participants' answers to the items on each survey, inventory, and questionnaire were studied using descriptive statistics, frequency counts, and percentages. Demographic information (i.e., GPA range, gender, and science and Mathematics courses completed in high school and college) was culled from the Mathematics Beliefs Survey.

Multivariate analysis. A series of ANOVAS were conducted with the Phase I participants' backgrounds as the independent variables and their beliefs about Mathematics and Mathematics teaching as the dependent variables. The continuous data of academic background (i.e., the number of science courses, number of applied Mathematics course, the number of college Mathematics courses, and gender) were used to address the question: *Is there an explainable relationship between pre-service teachers' Mathematics education background and their beliefs about Mathematics and Mathematics teaching?*

Results. The participants were compared on the following demographic characteristic highlights: gender: 16 (53.3%) were male and 14 (46.7%) were female; Phase I participants held moderate (46.7%) to strong (36.7%) beliefs about the Instrumentalist philosophy of Mathematics (it was an accumulation of facts, rules, and skills used in the pursuance of some external end) reflecting traditional Mathematics programs commonly pursued in high schools; and Mastery

(Mathematics is best learned procedurally; step-by-step) was the most frequent Mathematics learning style (36.7% of the participants). Each learning and teaching style was represented among the 30 Phase I participants

Qualitative Phase

Data collection. Phase II data was secured via 14 one-hour interviews. Each of the 7 interviewees participated in an hour-long interview pre- and post-student teaching. Juxtaposing of information from both phases occurred when Phase I artifacts were employed to support the analysis of autonomy for each of the multiple case studies. The results of the two phases were integrated in the discussion section of the study.

Qualitative analysis. Analysis was performed on three levels, within each case, within each learning system, and across the cases. A narrative was developed for each of the seven interviewees using support from the Phase I instrumentation results.

The steps in the qualitative analysis included: (a) member checking the transcripts; (b) preliminary exploration of the data by reading through the transcripts and writing memos; (c) coding the data by segmenting and labeling the text; (d) using codes to develop themes by aggregating similar codes; (e) connecting and relating themes and sub themes; and (f) cross case analysis. The verification procedures included triangulation from different sources, member checking, rich and thick descriptions of cases, and consideration of possible disconfirming evidence.

Findings. The most glaring conclusion was the existence of an apparent disconnect between the academic preparation of secondary level pre-service Mathematics teachers and what transpired during their student teaching experiences. Minimal to no opportunities were provided

for them to make, employ, and then reflect upon instructional decisions predicated upon prevailing reform-based research. Other major findings were:

1. Participants in Phase I who completed more Mathematics courses in college were less likely to embrace traditional beliefs the processes of learning and teaching the subject matter.
2. Participants in Phase I who took more science courses in high school were more likely to consider the traditional role of teacher as Instructor as the weakest approach to instructional practice.
3. Participants in Phase II had adequate knowledge about traditional and alternative instructional strategies but were unable to apply the alternative instructional strategies in their student teaching practices.
4. Participants in Phase II believed they were not prepared adequately by their post-secondary teaching programs for developing and delivering instruction for at risk or challenged students.
5. Phase II participants claimed their student teaching experiences were not beneficial for learning how to develop an instructional teaching style (make their own instructional decisions).
6. It was acknowledged that the participants in this study might not have been accurate samples for pre-student teachers nation-wide, but there was a possibility that theoretical promulgation of facts and reforms apparently do not translate, at least directly, into practice.

Conceivably the traditional approach to fostering improved ability in Mathematics among students in the United States might be better served if less emphasis was given to the input side

(conventional academic preparation) and more to the output side (application of cutting-edge research with selected professional educators who meet stringent qualifications for serving as a mentor). This idea means that the researcher admits to believing many professional teachers of Mathematics are not current with what has been promulgated about how to improve student learning in the subject matter. Or, conceivably a worst case scenario is that there are educators who deny themselves opportunities for continued learning that could translate into improved instructional practices.

Resources for addressing the problems of learning and applying the concepts of Mathematics to everyday living are increasingly scarce and so it behooves those in authority positions to maximize how they use those limited resources. Continuation of the status quo does not appear to be a viable approach.

The findings from this investigation hold implications for: postsecondary institutions preparing potential future professional practitioners who will be teaching Mathematics, collaborative arrangements between postsecondary training institutions and the cooperating schools willing to provide mentoring for future teachers of Mathematics, and departments of education within the 50 states responsible for implementing and ensuring compliance with the latest standards pertaining to Mathematics education.

The adage of trust but verify seems appropriate with regard to ensuring that student teachers are provided with the best possible mentoring from professionals who are current on the most recent research in Mathematics education and demonstrating evidence of complying with its tenants'. Conceivably the aspect of student teaching might need to be re-visited to ensure that student teachers are placed with professionals who will augment and further the learning of the potential teachers. To that end it might be necessary to craft standards for cooperating teachers

to meet and have criteria governing their work with student teachers. Yes, it likely would mean a means for compensating such professionals but the current practice of distributing resources does not appear to be sufficient for ensuring that the best and brightest are entering the profession of teaching.

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Appendix A

Instruments

1. TTI TriMetrix Talent Questionnaire
2. Math Learning Style Questionnaire
3. Teaching Style Inventory
4. Math Beliefs Survey
5. Myers-Briggs Type Indicator

TTI TriMetrix® Talent Questionnaire



TTI TriMetrix® Talent

QUESTIONNAIRE

TTI TriMetrix® Talent**Response Instructions**

Every individual has a unique set of talents. When an individual's natural talents are matched to a job's required talents, success and personal satisfaction are the results. This is the goal of the TriMetrix® System.

The TTI TriMetrix® Talent Report is designed to identify the talents you naturally bring to a job. In the next several screens you will be asked to record your responses in three sections:

Section 1: TTI Personal Talent Skills Inventory® (20 minutes to complete)

Section 2: Motivation Insights® (10 minutes to complete)

Section 3: Style Insights® (10 minutes to complete)

Please follow the instructions contained in each section. Your responses will produce a comprehensive report that will reveal your unique set of talents.

TTI Personal Talent Skills Inventory®

Response Instructions

This survey consists of **two sets** of 18 words or phrases. Each of these words or phrases contains something on which individuals may place different “values,” depending on their own feelings about how “**good**” or “**bad**” it is. **Rank** each of these two sets of 18 words or phrases according to your **feelings** about whether they represent **good** or **bad** to you, personally.

These guidelines apply:

- There is no time limit, but set aside approximately 20 minutes to complete the instrument in a quiet, private setting.
- Consider only how **you** feel about the items - not how society may think you should feel, not how anyone else expects you to respond, etc.
- Do not over-analyze; this is about how **you feel** about these items.
- Complete both lists of 18 at one time, without interruptions and without stopping.

For set 1, number the items in each list from 1 to 18 with 1 as what you value most, 2 as what you value second, etc. Continue until you have ranked all the words or phrases from **best** (1) to **worst** (18).

For set 2, number the items in each list from 1 to 18 with 1 as what you agree with most, 2 as what you agree with second, etc. Continue moving all of the statements in the same way, to show how much you **agree** or **disagree** with them with regards to **your own life right now**, until you have ranked all the phrases from 1 to 18. The 18th statement should be the one you disagree with the most (that is—the one which you feel is least true about yourself today).

Rank the items in each list. Number them from 1 to 18 with 1 as what you value most, 2 as what you value second, etc. Continue until you have ordered all the words or phrases from **best** (1) to **worst** (18). Consider **only how you feel about the word or phrase**.

Set 1 of 2

- A new car
- A scientific experiment
- A misunderstanding
- A blunder
- A wrecked car
- An award for a good deed
- Poisoning the city water
- Imprisoning an innocent person
- A faulty circuit
- A token of love
- A lover's embrace
- Torturing a person to death
- A life of adventure
- A madman
- An assembly line
- Prostitution
- Justice
- A decoration for bravery

Rank the items in each list. Number them from 1 to 18 with 1 as what you agree with most, 2 as what you agree with second, etc. Continue until you have ordered all the words or phrases from agree (1) to disagree (18). Consider only how you feel about your own life right now.

Set 2 of 2

- I like my work—it does me good.
- The universe is remarkably harmonious system.
- The world makes little sense to me.
- No matter how hard I work, I shall always feel frustrated.
- My working conditions are poor, and ruin my work.
- I feel at home in the world.
- I hate my work.
- My life is messing up the world.
- My work contributes nothing to the world.
- My work brings out the best in me.
- I love being myself.
- I hate being myself.
- I love my work.
- The lack of meaning in the universe disturbs me.
- The more I understand my place in the world, the better I get in my work.
- My work makes me unhappy.
- I love the beauty of the world.
- My work adds to the beauty and harmony of the world.

Motivation Insights®

Response Instructions

In the following pages you will see 12 categories, each with 6 items for you to consider. For each category, rank the 6 items by indicating your choices as follows: your first choice is 1, your second choice is 2, etc. Each number (1-6) must be used only once and every box must have a number in it. While responding, keep your focus on those interests, attitudes and values which are important to you and help guide your life. Your response must be completed in one uninterrupted sitting.

For each category, rank the 6 items by indicating your choices as follows: your first choice is 1, your second choice is 2, etc. Each number (1-6) must be used only once and every box must have a number in it.

1. My favorite subjects to study:

- Math/Science
- Political Science
- Theology
- Fine Arts
- Financial Planning
- Sociology

2. My personal interests are:

- Self-reliance
- Sharing my philosophy
- Appreciation of the beauty of nature
- Financial security
- Service to others
- Knowledge

3. Leisure activities that I enjoy:

- Volunteer work
- Studying new things
- Mentoring and organizing others
- Investing/Spending money
- Going to museums
- Spiritual activities

4. Personal motivators for me are:

- Being a leader
- Continuing education
- Traditional values
- Helping others
- Increasing my net worth
- Arts/Crafts

For each category, rank the 6 items by indicating your choices as follows: your first choice is 1, your second choice is 2, etc. Each number (1-6) must be used only once and every box must have a number in it.

5. My career goals:

- Artist
- Researcher
- Business owner
- Lead others
- Spiritual leader
- Social reformer

6. My desire for improvement may include:

- Spiritual growth
- Helping others
- Leadership roles
- Security for retirement
- Additional education
- Beautification of personal surroundings

7. If I were given \$500,000 I would:

- Purchase an art collection
- Take on new challenges
- Give some to charity
- Save some/Invest some
- Take courses to gain knowledge
- Give to a group that supports my beliefs

8. I think our tax money should be spent on:

- Help for the homeless
- Military/Defense
- New technology
- Funding of the Arts
- Improving productivity
- Justice

For each category, rank the 6 items by indicating your choices as follows: your first choice is 1, your second choice is 2, etc. Each number (1-6) must be used only once and every box must have a number in it.

9. People I admire as role models:

- Humanitarians
- Military leaders
- Entrepreneurs
- Artists
- Scientists
- Ethical leaders

10. The way I would like to contribute to society:

- Helping the sick and disadvantaged
- Being a business person
- Doing what is expected
- Protecting natural resources
- Being an inventor
- Being a community leader

11. My personal goals:

- Helping others
- Elected official
- Economic freedom
- Discovering new technology
- Artistic expression
- Sharing my faith

12. My outside interests:

- Research and testing new ideas
- Protecting the environment
- Community projects
- Part-time business
- Politics
- Spiritual activities

Style Insights®**Response Instructions**

In the following pages, you will see 24 groups. Each group contains 4 lines of words. For each group, select one line of words that describes you MOST. From the remaining three lines, select one line of words that describes you LEAST. Repeat the process until complete. While responding, keep your focus on the descriptions that apply to your behavior. Be ruthlessly honest with yourself! Go with your "gut" instinct—do not over-analyze! You should take no more than 10 minutes to respond to the assessment and it must be completed in one uninterrupted sitting.

For each group that follows, select one line of words that describes you **MOST**. From the remaining three lines, select one line of words that describes you **LEAST**. Repeat the process until complete.

1.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Spontaneous |
| <input type="checkbox"/> | <input type="checkbox"/> Contented, satisfied |
| <input type="checkbox"/> | <input type="checkbox"/> Positive, admitting no doubt |
| <input type="checkbox"/> | <input type="checkbox"/> Peaceful, tranquil |

2.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Easily led, follower |
| <input type="checkbox"/> | <input type="checkbox"/> Bold, daring |
| <input type="checkbox"/> | <input type="checkbox"/> Loyal, faithful, devoted |
| <input type="checkbox"/> | <input type="checkbox"/> Charming, delightful |

3.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Expressive |
| <input type="checkbox"/> | <input type="checkbox"/> Daring, risk-taker |
| <input type="checkbox"/> | <input type="checkbox"/> Diplomatic, tactful |
| <input type="checkbox"/> | <input type="checkbox"/> Satisfied, content |

4.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Respectful, shows respect |
| <input type="checkbox"/> | <input type="checkbox"/> Pioneering, exploring, enterprising |
| <input type="checkbox"/> | <input type="checkbox"/> Optimistic |
| <input type="checkbox"/> | <input type="checkbox"/> Accommodating, willing to please, ready to help |

5.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Willing, agreeable |
| <input type="checkbox"/> | <input type="checkbox"/> Eager, impatient |
| <input type="checkbox"/> | <input type="checkbox"/> Methodical |
| <input type="checkbox"/> | <input type="checkbox"/> High-spirited, lively, enthusiastic |

6.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Logical |
| <input type="checkbox"/> | <input type="checkbox"/> Obedient, will do as told, dutiful |
| <input type="checkbox"/> | <input type="checkbox"/> Unconquerable, determined |
| <input type="checkbox"/> | <input type="checkbox"/> Playful, frisky, full of fun |

7.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Adventurous, willing to take chances |
| <input type="checkbox"/> | <input type="checkbox"/> Analytical |
| <input type="checkbox"/> | <input type="checkbox"/> Cordial, warm, friendly |
| <input type="checkbox"/> | <input type="checkbox"/> Moderate, avoids extremes |

8.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Good mixer, likes being with others |
| <input type="checkbox"/> | <input type="checkbox"/> Structured |
| <input type="checkbox"/> | <input type="checkbox"/> Vigorous, energetic |
| <input type="checkbox"/> | <input type="checkbox"/> Lenient, tolerant of others' actions |

9.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Competitive, seeking to win |
| <input type="checkbox"/> | <input type="checkbox"/> Considerate, caring, thoughtful |
| <input type="checkbox"/> | <input type="checkbox"/> Outgoing, fun-loving, socially striving |
| <input type="checkbox"/> | <input type="checkbox"/> Harmonious, agreeable |

10.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Aggressive, challenger, takes action |
| <input type="checkbox"/> | <input type="checkbox"/> Life of the party, outgoing, entertaining |
| <input type="checkbox"/> | <input type="checkbox"/> Easy mark, easily taken advantage of |
| <input type="checkbox"/> | <input type="checkbox"/> Fearful, afraid |

For each group that follows, select one line of words that describes you **MOST**. From the remaining three lines, select one line of words that describes you **LEAST**. Repeat the process until complete.

11.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Stimulating |
| <input type="checkbox"/> | <input type="checkbox"/> Sympathetic, compassionate, understanding |
| <input type="checkbox"/> | <input type="checkbox"/> Tolerant |
| <input type="checkbox"/> | <input type="checkbox"/> Aggressive |

12.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Talkative, chatty |
| <input type="checkbox"/> | <input type="checkbox"/> Controlled, restrained |
| <input type="checkbox"/> | <input type="checkbox"/> Conventional, doing it the usual way, customary |
| <input type="checkbox"/> | <input type="checkbox"/> Decisive, certain, firm in making a decision |

13.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Well-disciplined, self-controlled |
| <input type="checkbox"/> | <input type="checkbox"/> Generous, willing to share |
| <input type="checkbox"/> | <input type="checkbox"/> Animated, uses gestures for expression |
| <input type="checkbox"/> | <input type="checkbox"/> Persistent, unrelenting, refuses to quit |

14.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Sociable, enjoys the company of others |
| <input type="checkbox"/> | <input type="checkbox"/> Patient, steady, deliberate |
| <input type="checkbox"/> | <input type="checkbox"/> Self-reliant, independent |
| <input type="checkbox"/> | <input type="checkbox"/> Soft-spoken, mild, reserved |

15.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Gentle, kindly |
| <input type="checkbox"/> | <input type="checkbox"/> Persuasive, convincing |
| <input type="checkbox"/> | <input type="checkbox"/> Humble, reserved, modest |
| <input type="checkbox"/> | <input type="checkbox"/> Magnetic, attracts others |

16.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Captivating |
| <input type="checkbox"/> | <input type="checkbox"/> Kind, willing to give or help |
| <input type="checkbox"/> | <input type="checkbox"/> Resigned, gives in |
| <input type="checkbox"/> | <input type="checkbox"/> Force of character, powerful |

17.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Companionable, easy to be with |
| <input type="checkbox"/> | <input type="checkbox"/> Easygoing |
| <input type="checkbox"/> | <input type="checkbox"/> Outspoken, speaks freely and boldly |
| <input type="checkbox"/> | <input type="checkbox"/> Restrained, reserved, controlled |

18.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Factual |
| <input type="checkbox"/> | <input type="checkbox"/> Obliging, helpful |
| <input type="checkbox"/> | <input type="checkbox"/> Willpower, strong-willed |
| <input type="checkbox"/> | <input type="checkbox"/> Cheerful, joyful |

19.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Attractive, charming, attracts others |
| <input type="checkbox"/> | <input type="checkbox"/> Systematic |
| <input type="checkbox"/> | <input type="checkbox"/> Stubborn, unyielding |
| <input type="checkbox"/> | <input type="checkbox"/> Pleasing |

20.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Restless, unable to rest or relax |
| <input type="checkbox"/> | <input type="checkbox"/> Neighborly, friendly |
| <input type="checkbox"/> | <input type="checkbox"/> Popular, liked by many or most people |
| <input type="checkbox"/> | <input type="checkbox"/> Orderly, neat |

For each group that follows, select one line of words that describes you **MOST**. From the remaining three lines, select one line of words that describes you **LEAST**. Repeat the process until complete.

21.

- | Most | Least |
|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> Argumentative, confronting |
| <input type="checkbox"/> | <input type="checkbox"/> Adaptable, flexible |
| <input type="checkbox"/> | <input type="checkbox"/> Nonchalant, casually indifferent |
| <input type="checkbox"/> | <input type="checkbox"/> Light-hearted, carefree |

22.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Brave, unafraid, courageous |
| <input type="checkbox"/> | <input type="checkbox"/> Inspiring, motivating |
| <input type="checkbox"/> | <input type="checkbox"/> Avoid confrontation |
| <input type="checkbox"/> | <input type="checkbox"/> Quiet, composed |

23.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Cautious, wary, careful |
| <input type="checkbox"/> | <input type="checkbox"/> Determined, decided, unwavering, stand firm |
| <input type="checkbox"/> | <input type="checkbox"/> Convincing, assuring |
| <input type="checkbox"/> | <input type="checkbox"/> Good-natured, pleasant |

24.

- | Most | Least |
|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> Jovial, joking |
| <input type="checkbox"/> | <input type="checkbox"/> Organized |
| <input type="checkbox"/> | <input type="checkbox"/> Nervy, gutsy, brazen |
| <input type="checkbox"/> | <input type="checkbox"/> Even-tempered, calm, not easily excited |

The First Learning Style Inventory for Math Students!



MATH LEARNING STYLE Inventory™

for Secondary Students
Grades 6 - 12

A **Self-Scoring Tool** for Secondary Students
to Identify Their Preferred
Learning Styles in Mathematics

Based on Carl Gustav Jung's Theory of Psychological Types

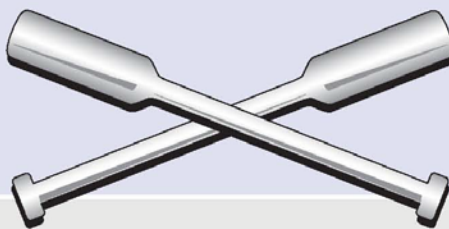
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Developed by Harvey F. Silver, Edward J. Thomas, and Matthew J. Perini

What Kind of Problem Solver Are *You*?

Math is all about problem solving. But not all students and not all mathematicians solve problems in the same way. In fact, even though your textbook might tell you otherwise, there are many different ways to solve math problems. Your own preferences as a problem solver can tell you a lot about how your mind works and how you learn best.

So, how do you go about solving problems in math? Let's conduct a little experiment to find out. Read "The Canoe Problem" below. When you feel ready, use the workspace to solve "The Canoe Problem." But here's the twist: As you are getting ready to solve the problem and as you are doing the work of problem solving, try to look and listen in on your own mind. What is it doing? What is it saying? How is it attempting to solve the problem?



The Canoe Problem

Nineteen campers are hiking through Acadia National Park when they come to a river. The river is moving too rapidly for the campers to swim across. The campers have one canoe, which fits three people. On each trip across the river, one of the three canoe riders must be an adult. There is only one adult among the nineteen campers. How many trips across the river will be needed to get all of the children to the other side of the river?

Now take a look at the next page and how four different students solved "The Canoe Problem." As you read each student's description, think about how much (or how little) each student reminds you of yourself as a problem solver.

How Four Different Students Solved “The Canoe Problem”

Maria

Well, the first thing I did was gather up the facts quickly: 19 campers, 1 canoe, 3 people per canoe, etc. Then – don’t think this is crazy – I used a piece of paper to stand for the boat, with one red pen on it to stand for the adult and two blue pens on it to stand for the children. Using actual objects to simulate the problem really helps me – it makes it easier to grasp the problem.

To solve the problem I moved step-by-step from beginning to end. First, I took the facts I gathered up and set them up carefully on paper. Then, I used basic math to get my answer of 17 trips across the river. Finally, I double checked my calculations to make sure I had done my math correctly.

Giovanni

I was very happy when the teacher said we could work with a learning partner. For me, the best way to learn math and solve problems like this one is to talk. I really like it when the teacher comes around and asks me how I’m doing, and I also like when I can work with friends and share my ideas. The best ideas seem to come when people are talking or working together. Anyway, what I really liked about today’s learning partnership with Jody is that we didn’t just get the answer to the problem right and wait around. We also talked about how we solved the problem and what we might do next time to improve as problem solvers.

Tanisha

I find that problems like this one often have hidden questions or little tricks in them that aren’t always so obvious. For example, I bet some people missed the fact that every time 2 children get across the river, that’s 2 trips across – one there and one back. By looking for the hidden question, I saw the pattern to the problem pretty quickly: 2 out of 18 children get to the other side for every 2 trips across the river. That means it will take 18 trips to get all 18 children across. But here’s another little trick: On the last trip, they only need to go one way and not back again. So the answer’s actually 17.

Anyway, once I figured out the answer, I checked to make sure it made logical sense and that it answered the question posed by the problem. In both cases, it did.

Al

I need to see the problem in my head. I closed my eyes and actually pictured the river and saw the 18 kids and the 1 adult with that 1 canoe. Then, I generated possible answers by sort of playing with the numbers, trying different things out. When I do a problem like this, I try out different ways to solve it. Sometimes, I come up with more than one solution. For this problem, I came up with 9 and 17 as possible answers, so I explored each one to see which one worked. That’s how I came up with 17.

Sometimes, I like to imagine cool twists or variations that would make the problem more interesting. For example, what if the boat held only a certain amount of weight and all the campers’ weights were given? Then we would have to find the best way to load the boat on each trip.

What we do as problem solvers is closely related to the way we learn. Everyone learns, but we don’t all learn in the same way. The differences in how people learn are called **learning styles**. You can see your style in the way you talk, the way you think, and the way you solve problems. Some students, like Maria, solve math problems using step-by-step procedures. Others are like Tanisha. These students prefer to find patterns and discover hidden questions. Students like Al are drawn to problems that are unique and love to speculate on the possible solutions. For students like Giovanni, there’s no better way to solve a challenging math problem than by discussing it with friends and fellow students. Which of these students sounds most like you?

On the next page you will find the beginning of the **Math Learning Style Inventory**. It is designed to help you and your teacher understand how you learn best when it comes to math. Follow the directions and enjoy yourself.

This is not a test, so relax and answer honestly.

What Kind of Problem Solver Are You?

The **Math Learning Style Inventory** is a learning tool that provides you and your teacher with information on which learning styles you prefer the most and which you like the least when it comes to math. This information will help you and your teachers make better decisions about learning and teaching.

The **Math Learning Style Inventory** is not a test. There are no right or wrong answers. If you're having trouble with a word, phrase, or idea, please ask your teacher for help.

Directions for Responding

The **Math Learning Style Inventory** is made up of twenty-two numbered statements about your preferences as a math student, followed by four choices, lettered A, B, C, and D. All you have to do is rank the choices in the order in which you prefer them.

Use the following point system to rank your choices:

- Give your first, or favorite, preference5 points
- Give your second preference3 points
- Give your third preference1 point
- Give your fourth, or least favorite, preference0 points

Remember to assign a different number of points (5,3,1,0) to each of the four choices in each set. Do not make ties.

1. When it comes to math, I want to:

- A. Learn practical information and set procedures.
- B. Know why the math I learn works.
- C. Use my imagination to explore mathematical ideas.
- D. Learn math through dialog and collaboration.

2. When I encounter a difficult problem, I tend to:

- A. Look for any "tricks" or hidden questions.
- B. Visualize the problem in my head.
- C. Let how I'm feeling dictate what I do.
- D. "Roll up my sleeves" and get right to work.

3. A math classroom should:

- A. Encourage spontaneity and curiosity.
- B. Be a place where learning math is fun.
- C. Be focused on helping students remember important math procedures.
- D. Be a place where I can make and validate my own conclusions.

4. I would prefer a math teacher who is:

- A. Friendly and cares about me.
- B. Organized and rewards hard work.
- C. Knowledgeable and respects my ideas.
- D. Enthusiastic about math and uses creative methods to teach.

5. I like math problems that are:

- A. Similar to problems that I've encountered before and that I can use a procedure to solve.
- B. Challenging and require me to think my way through them.
- C. New and interesting and that require me to experiment to find a solution.
- D. About real life.

6. I tend to lose interest in math when:

- A. The teacher doesn't explain the rationale behind learning what we're learning.
- B. We practice the same things over and over again, with little variety or choice.
- C. I can't see how what we're learning is connected to people's lives.
- D. I can't remember the steps I need to follow to solve the problem.

7. I would prefer to:

- A. Write a short story about a mathematical concept.
- B. Work with a group to perform a skit that shows how math helps people solve their problems.
- C. Report on the life of a famous mathematician.
- D. Research and take a position on a controversial topic, such as: Was math discovered, or was it invented?

8. I will work hard when:

- A. My teacher appreciates my effort.
- B. I know how to do the work.
- C. I understand why the math I'm learning is important.
- D. I get a chance to apply math in my own creative way.

9. I would say that problem solving is mostly about:

- A. Applying step-by-step procedures.
- B. Asking questions and discovering patterns.
- C. Generating possible solutions and exploring among the alternatives.
- D. Sharing ideas and collaborating with fellow learners.

10. A great math classroom is like:

- A. A courtroom, where I get to explain and defend my ideas.
- B. A laboratory, where I get to experiment and try out new things.
- C. A book club, where I get to discuss my learning with my teacher and fellow classmates.
- D. A sports practice, where I get to fine tune my skills before they count.

11. My ideal math teacher would:

- A. Allow me to use my imagination and creativity.
- B. Allow ample time for discussion and small group work.
- C. Show me exactly what I need to know and give me time to practice.
- D. Challenge me to think on my feet.

12. The best kinds of math assignments:

- A. Encourage teamwork and involve the whole class.
- B. Let me practice what I already know.
- C. Ask me to use data to prove something.
- D. Have interesting "twists" that make them unique.

13. It's hardest for me to focus when:

- A. There's too much abstraction and not enough time for practicing skills.
- B. There's too much group work and not enough independent thinking.
- C. There's too much routine work and not enough that's new and interesting.
- D. There's too much independent seat work and not enough cooperative work.

14. Show me a square, a rectangle, and a triangle, and I'll show you:

- A. The similarities and differences between the three shapes.
- B. A cool design that uses all three shapes.
- C. Which shape is my personal favorite.
- D. How to find the area and perimeter of each shape.

15. In math class, the most important thing is:

- A. Being able to think "outside the box."
- B. Sharing my successes and struggles with my teacher so I can see how to improve.
- C. Calculating and computing accurately.
- D. Learning how to think and reason for myself.

16. A great problem solver in math:

- A. Is never afraid to consult with fellow problem solvers.
- B. Has a great memory for formulas and procedures.
- C. Plans out his/her problem-solving strategies in advance.
- D. Will look at a problem from a variety of perspectives.

17. No math classroom should be without:

- A. Clear guidelines and expectations.
- B. Some good, healthy debate.
- C. A variety of activities and the chance to choose those that interest me.
- D. Lots of interaction and hands-on learning that involves everyone.

18. I learn best when my math teacher:

- A. Asks thought-provoking questions and lets me think for myself.
- B. Uses interesting problems to teach new concepts.
- C. Encourages me and my classmates to share our ideas.
- D. Gives me immediate feedback on how I'm doing.

19. I would prefer to demonstrate what I know about a math concept by:

- A. Doing a creative project.
- B. Reflecting on my learning in a journal.
- C. Completing a worksheet or taking a quiz.
- D. Conducting further research and writing an essay.

20. I get most anxious in math class when:

- A. I don't see how what I'm learning relates to me.
- B. I encounter open-ended problems that don't have clear answers or procedures for solving them.
- C. There's more focus on working in groups than there is on learning content.
- D. I'm not able to visualize what I'm learning in my head.

21. I would prefer to learn a new math concept by:

- A. Listening to a teacher lecture and taking notes.
- B. Comparing and contrasting the new concept with another concept that's related to it.
- C. Using a metaphor/simile to develop a new perspective on the concept (e.g., Factors are like a family tree because...).
- D. Playing a math game.

22. I like math problems best when they:

- A. Ask me to use logic to solve a challenging problem and to explain my thinking. (See Problem A on page 6.)
- B. Challenge me to use math creatively. (See Problem B on page 6.)
- C. Involve real-life situations and problems people commonly face. (See Problem C on page 6.)
- D. Ask me to find correct answers. (See Problem D on page 6.)

22. (continued)

(Sample math problems)

Problem A

You are given eight golf balls. Seven of the golf balls have the exact same weight, but one ball is slightly lighter (you cannot feel the difference). You have a balance scale, but can only make two weighings. How can you find the lighter ball in only two weighings? Explain.

**Problem B**

In geometry, two lines are parallel if they are in the same plane and never intersect. Take the mathematical concept of parallel lines and apply it to non-mathematical situations or objects. For example, two people might be said to be parallel if they live in the same town but never come in contact with one another. Think of at least three more examples of things that are, figuratively speaking, parallel. Be sure to explain how each example can be considered parallel.

Problem C

As class social chairperson, you order 256 T-shirts for the class trip. After checking the number of shirts carefully and placing them into the storeroom, you tell the section leaders to each pick up $\frac{1}{4}$ of the shirts to distribute to their class section.

Tanya arrives first and takes $\frac{1}{4}$ of the shirts. Later, Matt arrives and takes $\frac{1}{4}$. During lunch, Rich stops by and picks up $\frac{1}{4}$. Finally, just before the final bell, Nicky takes $\frac{1}{4}$ of the shirts.

The next morning, you are surprised when Matt, Rich, and Nicky tell you that they don't have enough shirts. You can't figure it out – you know you ordered 256 shirts. Then you discover some shirts are still in the storeroom. Matt, Rich, and Nicky tell you they all followed your instructions.

What happened? How many shirts are still in the storeroom and how many do you need to give to Matt, Rich, and Nicky?

Problem D

Use divisibility rules to determine if the first number is divisible by the second number.

1. 1075; 5
2. 699; 3
3. 385; 6
4. 117; 3
5. 3242; 3
6. 2002; 6
7. 13,766; 3

Determining Your Results

DIRECTIONS FOR SCORING THE INVENTORY

This part is a little tricky. In order to get a score for each of the four learning styles, you will need to transfer the points from the inventory you just completed onto the scoring grid below. To do this, you will write the score you gave to each choice in the box next to the corresponding letter.

For example, look at your four responses to Question 1 on page 3 of the inventory. What number did you give Choice **A**? On the grid below, write that number in the white box next to **A** in Row 1. What number did you give Choices **B**, **C**, and **D** for Question 1? Write those numbers in the white boxes next to **B**, **C**, and **D** in Row 1. Then, do the same for Questions 2 - 22: Transfer your points from the inventory onto the grid by writing them in the white boxes next to the corresponding letters. But notice that the letters on the grid rotate. Not all the letters in Column 1 are **A**'s, not all the letters in Column 2 are **B**'s, and so on. **Be extra careful when transferring your points from the inventory onto the grid**, so that your score will be accurate. When you have transferred all your scores, compute the totals for each column.

Question Number	Mastery Choices	Understanding Choices	Self-Expressive Choices	Interpersonal Choices
1	A	B	C	D
2	D	A	B	C
3	C	D	A	B
4	B	C	D	A
5	A	B	C	D
6	D	A	B	C
7	C	D	A	B
8	B	C	D	A
9	A	B	C	D
10	D	A	B	C
11	C	D	A	B
12	B	C	D	A
13	A	B	C	D
14	D	A	B	C
15	C	D	A	B
16	B	C	D	A
17	A	B	C	D
18	D	A	B	C
19	C	D	A	B
20	B	C	D	A
21	A	B	C	D
22	D	A	B	C
Totals				

What Does All This Mean?

When it comes to learning math, there are really four distinct learning styles. These four math learning styles are described below. After you have read all four descriptions, write your scores from the previous page in the appropriate style box. Do you agree with your scores?

Mastery Math Students

Want to... learn practical information and procedures

Like math problems that... are like problems they have solved before and that use set procedures to produce a single solution

Approach problem solving... in a step-by-step manner

May experience difficulty when... math becomes too abstract or when faced with open-ended problems

Learn best when... instruction is focused on modeling new skills, practicing, and feedback and coaching sessions

Interpersonal Math Students

Want to... learn math through dialog, collaboration, and cooperative learning

Like math problems that... focus on real-world applications and on how math helps people

Approach problem solving... as an open discussion among a community of problem solvers

May experience difficulty when... instruction focuses on independent seat work or when what they are learning seems to lack real-world application

Learn best when... their teacher pays attention to their successes and struggles in math

Maria is a *Mastery Math Student*
(see page 2).

My *Mastery* Score:

My *Interpersonal* Score:

Giovanni is an *Interpersonal Math Student*
(see page 2).

Tanisha is an *Understanding Math Student*
(see page 2).

My *Understanding* Score:

My *Self-Expressive* Score:

Al is a *Self-Expressive Math Student*
(see page 2).

Understanding Math Students

Want to... understand why the math they learn works

Like math problems that... ask them to explain, prove, or take a position

Approach problem solving... by looking for patterns and identifying hidden questions

May experience difficulty when... there is a focus on the social environment of the classroom (e.g., on collaboration and cooperative problem solving)

Learn best when... they are challenged to think and explain their thinking

Self-Expressive Math Students

Want to... use their imagination to explore mathematical ideas

Like math problems that... are non-routine, project-like in nature, and that allow them to think "outside the box"

Approach problem solving... by visualizing the problem, generating possible solutions, and exploring among the alternatives

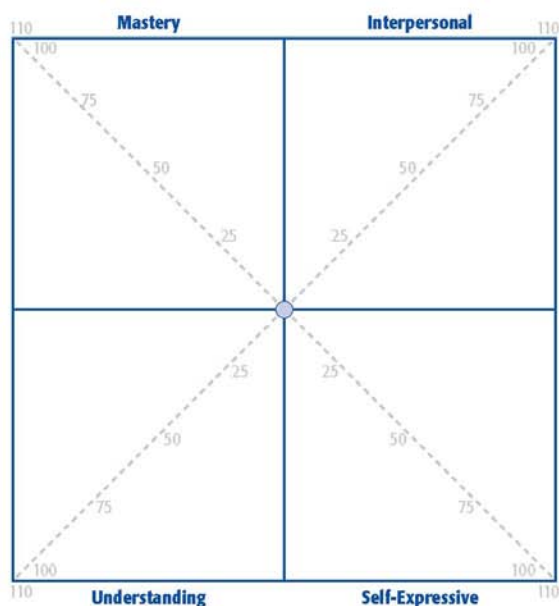
May experience difficulty when... math instruction is focused on drill and practice and rote problem solving

Learn best when... they are invited to use their imagination and engage in creative problem solving

What Does My Math Learning Style Profile Look Like?

Different kinds of problems and different kinds of classrooms call for different kinds of thinking. All students rely on all four learning styles to help them learn mathematics. However, we all tend to develop strengths so that one or two styles may be much easier for us to use than the others. The deepest and best understanding of how you learn mathematics will come when you build a Math Learning Style Profile, which shows your preferences for all four learning styles.

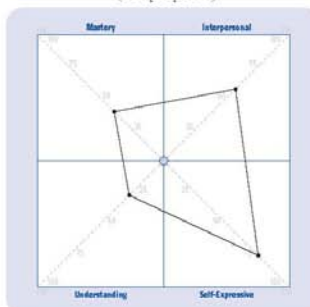
Building a Math Learning Style Profile is easy. To build yours, take your point totals for each style from the bottom of page 7 and chart them on the profile graph below. For each style, mark the score along the diagonal line in the appropriate style box. For example, if you had a total of 63 points for your Mastery score, you would make a mark along the diagonal line roughly halfway between the 50-mark and the 75-mark in the Mastery box. Repeat this process for each of the four styles. Once you have made your four marks, connect all four dots with straight lines to create a four-sided polygon. This figure represents your math learning profile and shows you, at a glance, which styles are your strongest and which need extra attention.



Transfer your scores from page 7 to the boxes below:

- My **Mastery** Score
- My **Interpersonal** Score
- My **Understanding** Score
- My **Self-Expressive** Score

(Sample profile)



Understanding Your Comfort Level

- 90** – **110** : A very strong preference; almost total comfort when using this style
- 65** – **89** : Comfortable when using this style
- 40** – **64** : Moderately comfortable when using this style
- 20** – **39** : Little comfort when using this style
- 0** – **19** : A very weak preference; uncomfortable when using this style

Reflecting on My Math Learning Style Profile

Now that you have built your own personal Math Learning Style Profile, it's time to think about your results and to reflect on how your new knowledge about yourself can affect your learning in math.

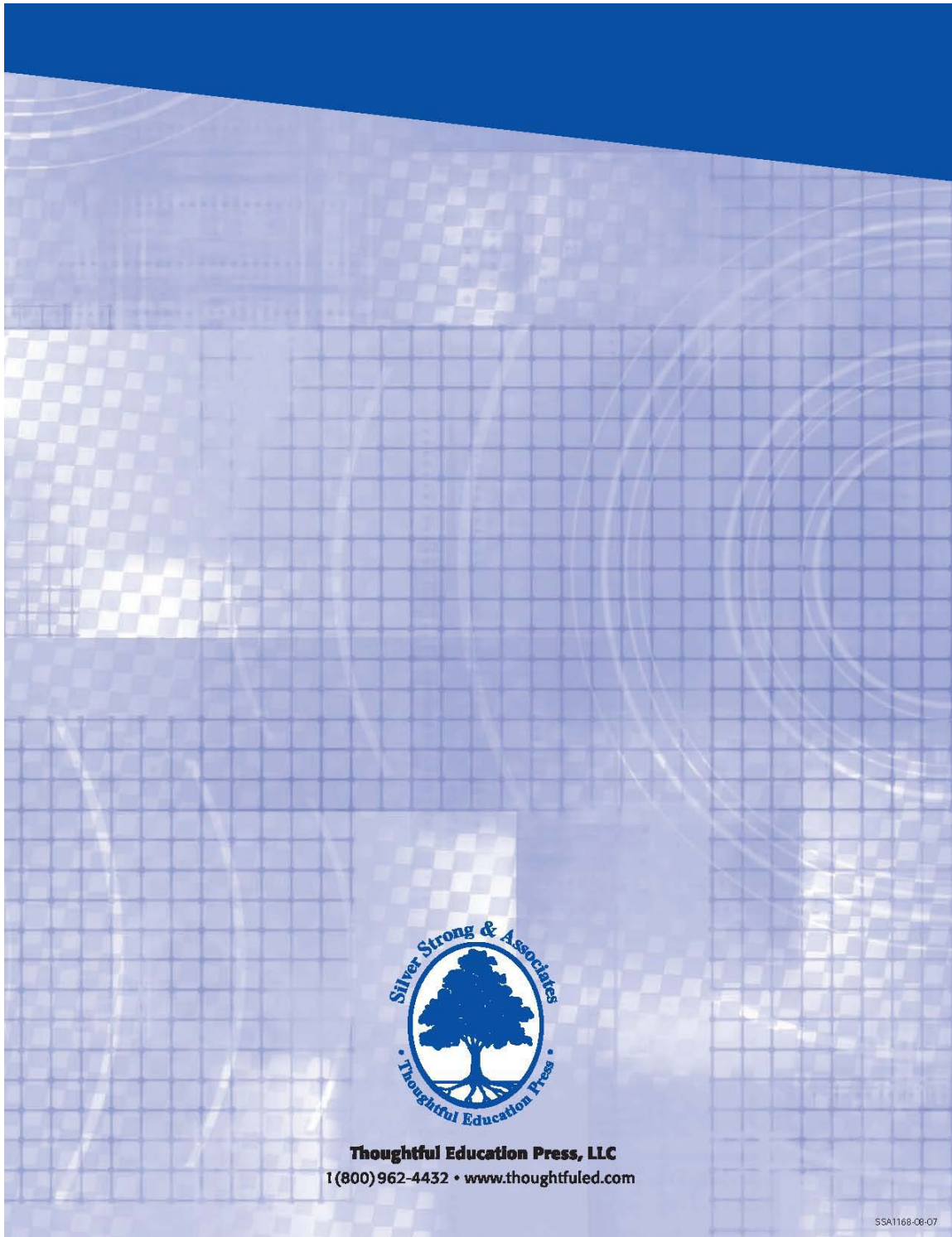
How is your Math Learning Style Profile reflected in your work as a math student?

Were there any significant differences between your impression of yourself as a learner and your actual results from the *Math Learning Style Inventory*?

If so, can you account for these differences?

How can your awareness of your Math Learning Style Profile be an asset to you?

All learning styles can and should be developed so that we become more complete learners. What style(s) would you like to develop and why? How will you do this?

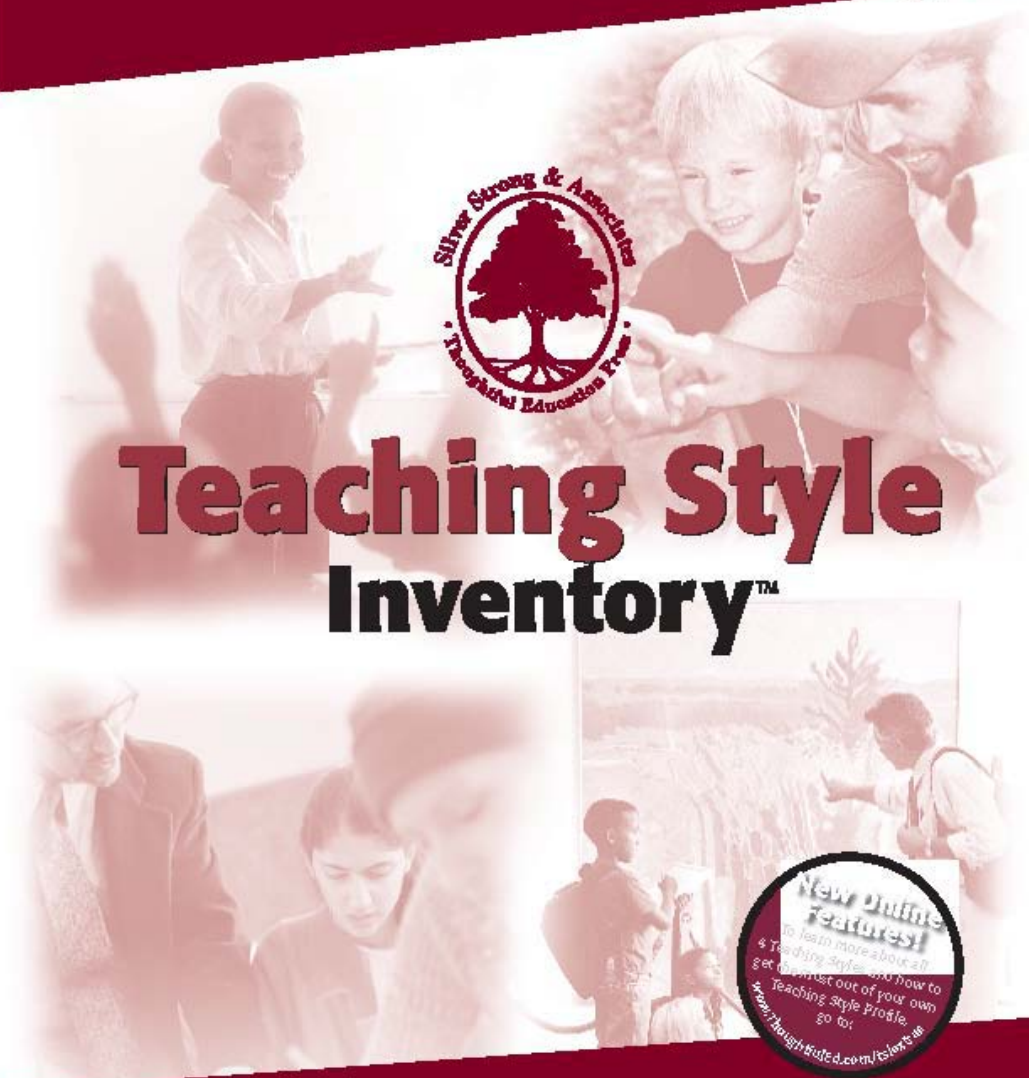


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Assess Your Own Teaching Style and Learn How to Reach All of Your Students!



Teaching Style Inventory™



Developed by Harvey F. Silver, J. Robert Hanson, and Richard W. Strong

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Choosing Teaching Preferences

Directions: In each of the following fourteen (A-N) sets of behaviors, rank the four responses as follows:

- Give the response that **best** describes your teaching preferences **5 points**
 Give the response that describes your teaching preferences **second best** **3 points**
 Give the response that describes your teaching preferences **third best** **1 point**
 Give the response that **least** describes your teaching preferences **0 points**

Be sure to assign a different weighted number (5, 3, 1, or 0) to each of the four responses in sets A-N. Do not make ties. Rank the responses according to those which best describe you and how you approach teaching. If a set of responses is hard to rank at first reading, go to the next set. Complete the missing set after you've finished all the other items. Note that a rank of 0 does not mean a response does not apply to you—it only means that response is your least preferred. Please answer every item and keep in mind that there are no right or wrong answers.

The aim of this inventory is to increase your self-awareness through conscious reflection on your decision-making processes both in and beyond the classroom, **not** to evaluate your teaching ability or to assign labels.

I. Planning

A. *I am most comfortable when my plans are based on...*

1. _____ key concepts and major themes
2. _____ established curriculum guides and test outlines
3. _____ the emotional and social needs of my students
4. _____ open-ended essential questions and project work

B. *My plans frequently include...*

5. _____ specific and well-defined tasks
6. _____ a wide variety of materials, activities, and projects with opportunities for students to make choices
7. _____ important issues to be analyzed and addressed
8. _____ activities intended to enhance self-understanding, social interaction, and group learning

II. Implementing

C. *When applying my plans to the classroom, I work hard to...*

9. _____ follow my plans in an orderly and prescribed manner
10. _____ focus classroom interaction on essential questions and deep understanding
11. _____ connect my activities to my students' life experiences
12. _____ coach and stimulate my students to think divergently and be creative

III. Setting

D. *The classroom atmosphere in which I am most comfortable emphasizes...*

13. _____ interaction, collaboration, cooperation, and conversation
14. _____ variety, stimulation, creative activity, and project work
15. _____ intellectual challenge, serious inquiry, and debate
16. _____ organization, clear tasks, and purposeful activity to achieve mastery

E. *I prefer my physical setting to be...*

17. _____ a friendly, comfortable place that provides opportunities for students to converse and work together
18. _____ an inspiring and engaging place that is colorful and has lots of interesting artifacts
19. _____ an orderly, well-structured environment where the teacher is the primary focus
20. _____ an intellectually stimulating room that has numerous books and resources for students to conduct independent study and extend their knowledge

IV. Curriculum Objectives

F. *In general, the major focus of the curriculum should be on...*

21. _____ mastering skills and acquiring specific information
22. _____ developing a healthy self-concept and social skills
23. _____ interpreting and applying ideas and theories
24. _____ developing creative potential in all academic areas

V. Operations

- G. *The tasks I assign my students tend to focus on...*
25. _____ workbooks, worksheets, recitation of information, practice exercises, and direct instruction
 26. _____ essays, research projects, readings, investigations, debates, and discussion of big ideas
 27. _____ small group discussions, personal sharing, role playing, simulations, group projects, team games, and other cooperative learning activities
 28. _____ creative problem solving, long-range projects, divergent expression, use of metaphor and artistic elements to express ideas
- H. *The work my students are required to do emphasizes...*
29. _____ acquiring specific knowledge and skills
 30. _____ understanding and explaining big ideas
 31. _____ self-expression and synthesizing ideas
 32. _____ cooperation and personal reflection

VI. Roles

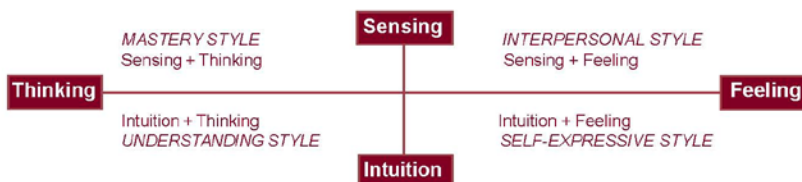
- I. *As a teacher, I tend to play the role of...*
33. _____ creativity stimulator and partner in imagination
 34. _____ intellectual challenger and content expert
 35. _____ information provider and assigner of tasks
 36. _____ nurturer and group facilitator
- J. *Strategies I frequently use emphasize...*
37. _____ non-traditional problem solving, metaphorical expression, creative writing, and imaginative or inventive work
 38. _____ debate, experiment, investigation, and inquiry
 39. _____ practice games, seatwork, short lectures, frequent exercises, and hands-on demonstrations
 40. _____ circle talks, students working as partners, and group projects that emphasize helping ourselves and others
- K. *I enjoy it most when my students play the role of...*
41. _____ questioners and researchers
 42. _____ group members and community contributors
 43. _____ innovators and creative problem solvers
 44. _____ hard workers and pragmatists
- L. *Qualities I most look for in my students include...*
45. _____ logical analysis, pleasure in thought, and a tolerance for abstraction or ambiguity
 46. _____ patience with others and a willingness to share feelings and work
 47. _____ ingenuity, a sense of what's possible, and aesthetics
 48. _____ a sense of order, patience with clearly-defined tasks, and a willingness to work hard and take pride in achievement

VII. Assessment

- M. *In assessing students' learning, I tend to rely heavily on...*
49. _____ short answer exercises that ask students to remember what they have learned in class
 50. _____ essays, projects, and problems that require explanations, evidence, and proof
 51. _____ personal qualities such as attention to detail, ability to concentrate, and cooperation
 52. _____ projects and tasks requiring creative expression, imagination, and the extension of learning to new contexts
- N. *In reviewing students' work, I tend to reward...*
53. _____ accuracy and precision
 54. _____ ideas that are soundly reasoned and interesting in formulation
 55. _____ the amount of individual effort and student progress
 56. _____ ingenuity, creativity, craftsmanship, the unusual, and the unique

Understanding Decision-Making as Teaching Behavior

In each of the fourteen sets that you just ranked, the four responses correspond to four different teaching styles. The teaching styles are based on the different ways people prefer to use their perception (sensing vs. intuition) and their judgment (thinking vs. feeling). The preference for sensing or intuition is independent of the preference for thinking or feeling. As a result, four distinct combinations occur:



SUBJECTIVE RANKING

Before scoring your *Teaching Style Inventory*, rank order the styles based upon your own immediate perceptions of your dominant teaching style. Please carefully read the style descriptions that follow and then determine which description is most characteristic, second-most characteristic, third-most, and least characteristic. Remember that everyone operates in all four styles, but that we tend to favor one or two styles over the others.

The Four Teaching Styles

Mastery Style Teachers (Sensing + Thinking) focus on clear outcomes (skills learned, projects completed). They maintain highly-structured, well-organized classroom environments. Work is purposeful, emphasizing the acquisition of skills and information. Plans are clear and concise. Discipline is firm but fair. Teachers serve as the primary information source and give detailed directions for student learning.
(Preference _____)

Interpersonal Style Teachers (Sensing + Feeling) emphasize the personal and social aspects of learning, often by exploring students' personal life experiences and building feelings of positive self-worth. The teacher shares personal feelings and experiences with students and attempts to forge personal connections between real life and the content students are learning. The teacher believes that school should be fun and often introduces learning through activities that involve the students actively and physically or that allow them to work cooperatively. Plans often change to meet the mood of the class or the feelings of the teacher.
(Preference _____)

Understanding Style Teachers (Intuition + Thinking) place primary importance on students' intellectual development. The teacher provides time and intellectual challenges to encourage students to develop skills in critical thinking, problem solving, logic, research techniques, and independent study. Curriculum planning emphasizes concepts and is frequently centered around a series of questions or themes. Assessment is often based on open-ended questions, debates, essays, or position papers.
(Preference _____)

Self-Expressive Style Teachers (Intuition + Feeling) encourage students to explore their creative abilities. Insights and imagination are highly valued. Discussions revolve around generating possibilities and finding new and interesting connections. The classroom environment is often full of creative clutter, while curriculum focuses on creative thinking, moral development, values, and flexible, imaginative approaches to learning. Curiosity, unique and interesting approaches to problem solving, and artistic expression are always welcome.
(Preference _____)

Subjective Ranking Preferences

1. Most characteristic: _____
2. Second-most characteristic: _____
3. Third-most characteristic: _____
4. Least characteristic: _____

Scoring Your TSI

To determine your results, transfer your rank numbers from your answer sheet (pages 2 and 3) to the scoring sheet below. Compute your score by adding the rank numbers down each column.

If you'd like to see how your overall style compares with your style in individual dimensions like planning, implementing, setting, curriculum objectives, etc., you can total your rank numbers separately for each Roman numeral.

	Mastery	Understanding	Self-Expressive	Interpersonal
I. Planning				
A	2 _____	1 _____	4 _____	3 _____
B	5 _____	7 _____	6 _____	8 _____
II. Implementing				
C	9 _____	10 _____	12 _____	11 _____
III. Setting				
D	16 _____	15 _____	14 _____	13 _____
E	19 _____	20 _____	18 _____	17 _____
IV. Curriculum Objectives				
F	21 _____	23 _____	24 _____	22 _____
V. Operations				
G	25 _____	26 _____	28 _____	27 _____
H	29 _____	30 _____	31 _____	32 _____
VI. Roles				
I	35 _____	34 _____	33 _____	36 _____
J	39 _____	38 _____	37 _____	40 _____
K	44 _____	41 _____	43 _____	42 _____
L	48 _____	45 _____	47 _____	46 _____
VII. Assessment				
M	49 _____	50 _____	52 _____	51 _____
N	53 _____	54 _____	56 _____	55 _____
TOTALS:	_____	_____	_____	_____

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Analyzing Your Teaching Preferences

No single style adequately represents the complexity of our teaching behavior. Particular teaching and learning challenges often cause us to “flex” or compensate by using other, often less-preferred, styles. It’s important, therefore, to identify not just your dominant style, but also your entire profile. It is the full profile that provides the truest picture of how you teach.

Your teaching style profile consists of four styles in a descending order of strength, from dominant to least preferred. To build your profile, complete the table below. First, write in the “Score” column your style scores from the bottom of page 5, listing them from highest to lowest. Next, identify the corresponding style for each of the four scores and the comfort level based on the *Comfort Level Scale* below. Finally, write in your subjective ranking for each style from page 4. How do your results compare with your initial subjective rankings?

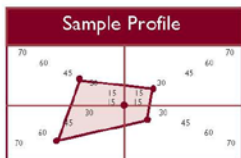
Order	Score	Style	Comfort Level (see scale below)	Subjective Ranking (page 4)
1. Dominant				
2. Secondary				
3. Tertiary				
4. Least Preferred				

Comfort Level Scale

57 - 70	Very comfortable in the style
43 - 56	Comfortable in the style
29 - 42	Moderate comfort in the style
15 - 28	Low comfort in the style
0 - 14	Very low comfort in the style

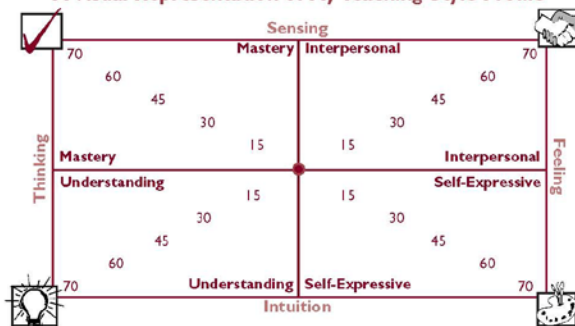
Visualizing Your Teaching Style Profile

The final step in profile-building is to create a visual representation, which will show you, at a glance, the relative strength of all four styles that make up your teaching style profile. To create a visual representation of your profile, take your point totals for each style and chart them on the profile graph below.



For example, if you received a score of 38 for the Mastery style, you would make a mark along the diagonal line roughly halfway between the 30-mark and the 45-mark in the Mastery box. Repeat this process for all four styles. Once you have made your four marks, connect all four dots with straight lines to create a four-sided polygon. (See *Sample Profile* at left for an example.)

A Visual Representation of My Teaching Style Profile



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Learning Behaviors and Activities by Style			
Mastery	Understanding	Self-Expressive	Interpersonal
TEACHERS MAY BE CHARACTERIZED AS:			
Trainers Information providers Instructional managers	Intellectual challengers Theoreticians Inquirers	Facilitators Stimulators Creators/originators	Nurturers Supporters Empathizers
LEARNERS MAY BE CHARACTERIZED AS:			
Realistic Practical Pragmatic	Logical Intellectual Knowledge-oriented	Curious Insightful Imaginative	Sympathetic Friendly Interpersonal
CURRICULUM OBJECTIVES EMPHASIZE:			
Knowledge Skills	Concept development Critical thinking	Creative expression Moral development	Positive self-concept Socialization
SETTINGS (Learning Environments) EMPHASIZE:			
Purposeful work Organization/ competition	Discovery Inquiry/independence	Originality Flexibility/imagination	Personal warmth Interaction/ collaboration
OPERATIONS (Thinking and Feeling Processes) INCLUDE:			
Observing Describing Memorizing Translating Categorizing	Classifying Applying Comparing/contrasting Analyzing Evaluating	Hypothesizing Synthesizing Metaphorical expression Divergent thinking Creating	Describing feelings Empathizing Responding Valuing
TEACHING STRATEGIES INCLUDE:			
Command Read and Retell Graduated Difficulty Direct Instruction Interactive Lecture	Concept Attainment Inquiry Multiple Document Learning Reading for Meaning Compare and Contrast Mystery	Metaphorical Expression Inductive Learning Pattern Maker/ Extrapolation Mind's Eye Etch-A-Sketch	Reciprocal Learning Decision Making Jigsaw Team Games Tournament Community Circle
STUDENT ACTIVITIES INCLUDE:			
Workbooks Drill and repetition Demonstrations Dioramas Competitions	Independent study Essays Logic problems Debates Hypothesizing	Creative art activities Imagining Boundary breaking Dramatics Open-ended discussions	Group projects "Show and Tell" Team games Directed art activities Personal sharing
ASSESSMENT TASKS CALL FOR:			
Making charts/maps Developing sequences/ timelines Repairing/debugging Reporting Constructing Defining/describing	Comparing/contrasting Making a case Conducting an inquiry Explaining Analyzing Classifying Debating Interpreting	Speculating—What if? Hypothesizing Creating metaphors Inventing/designing Using artistic media to express ideas	Performing commu- nity service Decision making Relating Reflecting Empathizing Keeping a journal

Dear Educator: Please help us lead the way in respecting and protecting intellectual property rights. Photocopying this publication is a violation of professional ethics and United States copyright law.

*Mathematics Beliefs Survey Questionnaire**Created by Linda Fusco for her doctoral dissertation at UNL (January, 2009)*

The purpose of this survey is to identify your beliefs about mathematics and understand how mathematics is learned.

Please write your PIN number in the space below:

PIN Number _____.

Opening Question

- (1) In the space provided please give an explanation as to why you decided to become a secondary mathematics teacher:** _____

Mathematics Education K-12

- (2) When did you become interested in studying mathematics? Check One**
- Elementary School
 - Middle School
 - High School
 - College
 - Other _____ Please Specify
- (3) What was the most advanced level of coursework you studied in high school?**
Check one
- Algebra II/Trigonometry
 - Pre Calculus
 - AP Statistics
 - AP Calculus AB
 - AP Calculus BC
 - Other (Please Specify)
- (4) Check off all of the science courses that you completed in High School and indicate the course level.**
- Earth Science (Honors, General)
 - Biology (Honors, General)
 - Chemistry (Honors, General)
 - Physics (Honors, General)
 - AP Physics B
 - AP Physics C
 - AP Biology
 - AP Chemistry
 - AP Environmental Science
 - Science Research
 - Other Please Specify _____
- (5) Check off all courses you completed in high school that used applied mathematics.**
- Engineering
 - Graphic Design

- AP Computer Science
- Computer Programming
- Music
- AP Psychology
- AP Economics
- Business
- Other Please Specify _____

(6) Use the list below and check off the high school honor societies into which you were inducted.

- National Honor Society
- Mathematics Honor Society
- Science Honor Society
- Other _____

(7) Please check off the range into which your high school grade point average fell.

- 2.1-2.5
- 2.6 – 3.0
- 3.1 – 3.5
- 3.6 – 4.0
- Other Please Specify _____

College Mathematics Education

(8) Please check off all of the mathematics courses that you have studied while attending your college or university.

- Calculus I
- Calculus II
- Calculus III
- Calculus IV
- Advanced Calculus
- Linear Algebra
- Abstract Algebra
- College Geometry
- Statistics
- Topology
- Logic
- Set Theory
- Non- Euclidean Geometry
- Number Theory
- Computer Science
- Others Please Specify _____

(9) Please check off all of the science courses you have completed while attending your college or university.

- Physics (algebra based, calculus based)
- Biology
- Chemistry

- Geology
- Meteorology
- Astronomy
- Oceanography
- Engineering
- Others Please Specify

(10) Please check the range into which your mathematics courses grade point average falls.

- below 2.0
- 2.1 – 2.5
- 2.6 – 3.0
- 3.1 – 3.5
- 3.6 – 4.0

(11) Please check the range into which your total grade point average falls.

- below 2.0
- 2.1 – 2.5
- 2.6 – 3.0
- 3.1 – 3.5
- 3.6 – 4.0

(12) Do you plan to continue your mathematics studies in graduate school?

- No Yes Not sure

Beliefs Systems

(13) Assign a number to each statement below to indicate your philosophy of mathematics. Use (1) to indicate your strongest view to (3) to represent your weakest view:

- Mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end.
- Mathematics is a static but unified body of knowledge, discovered, not created.
- Mathematics is a dynamic, continually expanding field of human creation and invention, a cultural product.

(14) Order from most important (1) to least important (3) your conception of the type and range of roles you envision yourself as a mathematics teacher. I see myself as an:

- Instructor placing the main emphasis on mathematics skills mastery with correct performance.
- Explainer emphasizing conceptual understanding with unified knowledge of mathematics.
- Facilitator emphasizing confident problem posing and solving.

(15) As a mathematics teacher I plan to use curricular materials in the following order Use (1) for first and 3 for last.

- () A strict following of a text or scheme
- () Modification of the textbook approach, enriched with additional problems and activities.
- () A teacher or school construction of the mathematics curriculum.

For each statement below please key in number that best describes your opinion on how students learn mathematics best.

(1) Strongly Agree (2) Agree (3) Slightly Agree (4) Slightly Disagree (5) Disagree (6) Strongly Disagree

Students learn mathematics best when instruction focuses on.....

- 16) mastering set procedures.
- 17) dialogue, collaboration, and working in teams.
- 18) helping students understand why the math they learn works.
- 19) exploring mathematical ideas using the imagination

The best math students approach problems.....

- 20) by visualizing the problem, generating possible solutions, and exploring among the alternatives.
- 21) in a step-by-step manner.
- 22) as an open discussion among a community of problem solvers.
- 23) by looking for patterns and identifying hidden questions.

The best way to assess students' mathematical understanding is with.....

- 24) problems that are similar to problems students have already solved and that require students to use a procedure to obtain a solution.
- 25) problems that focus on real-world applications and how math helps people.
- 26) non-routine problems that are project-like in nature.
- 27) problems that require students to analyze and explain mathematical data.

The most effective teachers of mathematics....

- 28) engage students in creative thinking and problem solving.
- 29) model new skills and allow ample time for practice.
- 30) pay close attention to students' successes and struggles in math.
- 31) challenge students to think "on their feet" and explain their ideas.

A good mathematics classroom is like.....

- 32) a book club, where students discuss their learning with their teacher and classmates.
- 33) a laboratory, where students experiment with ideas and try out new procedures.
- 34) a courtroom, where students have to explain and defend their ideas.
- 35) a sports practice, where students fine tune their skills before they count.

(36) Please list how old you will be at the completion of your student teaching assignment _____ years.

(37) Please indicate your gender.
Male _____ or Female _____

Myers Briggs Type Indicator

PERSONAL STYLE INVENTORY

R. Craig and David W. Champagne

Just as every person has differently shaped feet and toes from every other person, so we all have differently "shaped" personalities. Just as no person's foot shape is "right" or "wrong," so no person's personality shape is right or wrong. The purpose of this inventory is to give you a picture of the shape of your preferences, but that shape, while different from the shapes of other person's personalities, has nothing to do with mental health or mental problems.

The following items are arranged in pairs (a and b), and each member of the pair represents a preference you may or may not hold. Rate your preference for each item by giving it a score of 0 to 5 (0 meaning you really feel negative about it or strongly about the other member of the pair). The scores for a and b MUST ADD UP TO 5 (0 AND 5, 1 AND 4, 2 AND 3, ETC.). Do not use fractions such as 2-1/2. I prefer:

- 1a. ___ making decisions after finding out what others think.
 1b. ___ making decisions without consulting others.
- 2a. ___ being called imaginative or intuitive.
 2b. ___ being called factual and accurate.
- 3a. ___ making decisions about people in organizations based on available data
 3b. ___ making decisions about people in organizations based on empathy, feelings, and understanding their needs and values.
- 4a. ___ allowing commitments to occur if others want to make them.
 4b. ___ pushing for definite commitments to ensure that they are made.
- 5a. ___ quiet, thoughtful time alone.
 5b. ___ active, energetic time with people.
- 6a. ___ using methods I know well that are effective to get the job done.
 6b. ___ trying to think of new methods of doing tasks when confronted with them.
- 7a. ___ drawing conclusions based on unemotional logic and careful step-by-step analysis.
 7b. ___ drawing conclusions based on what I feel and believe about life and people from past experience.
- 8a. ___ avoiding making deadlines.
 8b. ___ setting a schedule and sticking to it.

- 9a _____ talking awhile and then thinking to myself about the subject
 9b _____ talking freely for an extended period and thinking to myself at a later time.
- 10a. _____ thinking about possibilities.
 10b _____ dealing with actualities.
- 11a _____ being thought of as a thinking person.
 11b _____ being thought of as a feeling person.
- 12a _____ considering every possible angle for a long time before and after making a decision.
 12b _____ getting the information I need, considering it for a while, and then making a fairly quick, firm decision
- 13a _____ inner thoughts and feelings others cannot see.
 13b _____ activities and occurrences in which others join.
- 14a _____ the abstract or theoretical.
 14b. _____ the concrete or real.
- 15a _____ helping others explore their feelings.
 15b _____ helping others make logical decisions.
- 16a. _____ change and keeping options open.
 16b _____ predictability and knowing in advance.
- 17a _____ communicating little of my inner thinking and feelings.
 17b _____ communicating freely my inner thinking and feelings.
- 18a _____ possible views of the whole.
 18b _____ the factual details available.
- 19a _____ using common sense and conviction to make decisions.
 19b _____ using data, analysis, and reason to make decisions.
- 20a _____ planning ahead based on projections.
 20b _____ planning as necessities arise, just before carrying out the plans.
- 21a _____ meeting new people.
 21b _____ being alone or with one person I know well.
- 22a _____ ideas.
 22b _____ facts.
- 23a _____ convictions.
 23b _____ verifiable conclusions.
- 24a _____ keeping appointments and notes about commitments in notebooks or appointment books as much *as* possible.

24b _____ using appointment books and notebooks as minimally as possible
(although I may use them).

25a _____ discussing a new, unconsidered issue at length in a group.

25b _____ puzzling out tissues in my mind, then sharing the results with another
person.

26a _____ carrying out carefully laid, detailed plans with precision.

26b _____ designing plans and structures without necessarily carrying them out

27a _____ logical people.

27b _____ feeling people.

28a _____ being free to do things on the spur of the moment

28b _____ knowing well in advance what I am expected to do.

29a _____ being the center of attention.

29b _____ being reserved.

30a _____ imagining the nonexistent.

30b. _____ examining details of the actual.

31a _____ experiencing emotional situations, discussions, movies

31b _____ using my ability to analyze situations.

32a _____ starting meeting at a prearranged time.

32b _____ starting meetings when all are comfortable

Appendix B

Interview Questions

1. Pre-student Teaching Interview Questions
2. Post-student Teaching Interview Questions

Pre Student Teaching Interview Protocol

Date:

Location:

Interviewer:

Interviewee Pseudonym:

Position of Interviewee:

Introduction

Thank you for taking the time to speak with me today. I am sincerely grateful for your willingness to share and express your thoughts. I will be asking you several questions and recording your responses verbatim. After the transcription of your thoughts and feelings, I will ask for your review of what I interpreted. It is important for the transcription to be verbatim so that I do not paraphrase something you've said with an incorrect interpretation.

What I am interested in finding out in this study is your views on teaching mathematics mentor after completing your student teaching assignment. You've had a chance to review the questions I am going to ask you. Please express your thoughts and feelings as freely as you like. I really want to know your perspective concerning your mentoring experience. I may ask you some additional questions that you have not reviewed as we go along in order to clarify for me what you mean. Do you consent to have our interview to be tape recorded? Are you ready to start?

Interview questions

1. *What lead to your decision to become a secondary mathematics teacher?*

Probe: When did you first become interested in studying mathematics?

2. *How would you describe the characteristics of an excellent mathematics teacher?*

Probe: Did you have a mathematics teacher that exhibited the characteristics of an excellent mathematics teacher?

3. *Describe your favorite mathematics course in high school.*

Probe: What made this course especially interesting?

4. *Explain how mathematics has helped you in other coursework in high school.*

Probe: Explain how you see mathematics relevant to your life.

5. Describe the methods you use to learn mathematics.

Probe: Explain other ways to learn mathematics.

6. Define mathematics.

Probe: Describe your philosophy of mathematics.

7. Explain why you have or have not taken mathematics courses beyond what has been required for your certification as a mathematics teacher?

Probe: Explain why or why not you will continue to study mathematics i.e. pursue a masters or doctorate in mathematics.

8. Explain how do you envision yourself in the role of a mathematics teacher?

Probe: What is the most important aspect of your role as teacher?

9. Do you believe that all students can learn mathematics? Explain your position.

Probe: How would you motivate students who are unresponsive to your instruction?

10. How would you describe the school environment?

Probe: Are all school environments the same?

11. Is there anything you would like to address in this interview concerning teaching practice, mathematics, the school environment, and your predicted success in the classroom?

Conclusion

Thank you for participating in this project and contributing to the ongoing research of teacher mentoring experiences. Your identity will be kept confidential.



Post Student Teaching Interview Protocol

Date:

Location:

Interviewer:

Interviewee Pseudonym:

Position of Interviewee:

Introduction

Thank you for taking the time to speak with me today. I am sincerely grateful for your willingness to share and express your thoughts. I will be asking you several questions and recording your responses verbatim. After the transcription of your thoughts and feelings, I will ask for your review of what I interpreted. It is important for the transcription to be verbatim so that I do not paraphrase something you've said with an incorrect interpretation.

What I am interested in finding out in this study is your view on teaching mathematics prior to your student teaching assignment. You've had a chance to review the questions I am going to ask you. Please express your thoughts and feelings as freely as you like. I really want to know your perspective concerning your mentoring experience. I may ask you some additional questions that you have not reviewed as we go along in order to clarify for me what you mean. Do you consent to have our interview to be tape recorded? Are you ready to start?

Interview questions

1. *Describe your student teaching experience?*

Probe: Explain which level, middle or high, of secondary mathematics teaching you enjoyed the most.

2. *Describe the social environment of the schools where you student taught.* (School and Community Involvement)

Probe: Explain in what ways your colleagues were supportive?

3. *What areas of teaching practice did you like and dislike?*

Probe: How did you plan your lessons? (Content Pedagogy, Planning, Diverse Learners)

4. *What resources did you use to plan your lessons?* (Communication and Technology)

Probe: Were the school resources provided satisfactory or did you have to supplement your textbook?

5. *How do you perceive your relationship with your students?* (Student development)

Probe: How comfortable did you feel managing your classroom? (Multiple Instructional Strategies)

6. *Explain if your student teaching experiences met with your expectations.* (Motivation and Management)

Probe: Give an example of an event that you did not anticipate?

7. *Explain the professional relationship between you and your cooperating teacher.*

Probe: Describe how you were alike and different from a professional point of view. (Reflective Practice and Professional Development)

8. *Explain how you identified the instructional need of your students.* (Assessment)

Probe: In what ways were you able to assess your students' mathematic ability?

9. *Based on your student teaching experience what would you do differently in your own classroom?*

Probe: How will your role as a teacher differ from your cooperating teachers' role?

10. *How was your pre-service experience useful to your first opportunity to practice teaching?*

Probe: Explain how your knowledge of mathematics assisted your ability to be answer student questions.

11. *Is there anything you would like to address in this interview concerning your student teaching practice, mathematics, the school environment, and your success in the classroom?*

Conclusion

Thank you for participating in this project and contributing to the ongoing research of teacher mentoring experiences. Your identity will be kept confidential.

Appendix C

IRB Approvals

1. SUNY Potsdam
2. SUNY New Paltz
3. SUNY Oswego
4. SUNY Cortland
5. SUNY Oneonta
6. SUNY Fredonia
7. SUNY Stony Brook
8. SUNY Buffalo
9. SUNY Geneseo
10. University of Nebraska-Lincoln



THE STATE UNIVERSITY OF NEW YORK

Potsdam

April 2, 2009

Ms. Linda Kasal Fusco
104 Parkview Drive
Bronxville, NY 10708

Dear Ms. Fusco:

I am pleased to grant approval for you to collect quantitative and qualitative data from undergraduate pre-service secondary education mathematics students attending SUNY Potsdam for your doctoral dissertation "A Mixed Methods Study of How the Process of Transition into Practice Impacts the Autonomy of Pre-Service Mathematics Teachers," contingent upon approval of the project by SUNY Potsdam's Institutional Review Board. I understand that you will collect data over the course of the next 12 months.

I wish you best of luck with your project.

Sincerely,

Margaret E. Madden, Ph.D.
Provost and Vice President of Academic Affairs

C: Dr. Maureen McCarthy, Chair, SUNY Potsdam IRB

Division of Academic Affairs • Phone: (315) 267-2108 • Fax: (315) 267-2115
44 Pierrepont Avenue • Potsdam, New York 13676-2294 • www.potsdam.edu

STATE UNIVERSITY OF NEW YORK
NEW PALTZ
INSTITUTIONAL REVIEW BOARD
Proposal Review Notice

Principal Investigator(s): Linda Fusco
Mailing Address: 104 Parkview Dr.
Bronxville, NY 10708
Project Title: A Mixed Methods Study of How the Transition into Practice Impacts the
Autonomy of Pre-Service Secondary Mathematics Teachers
Protocol #: 2009-701
Date: November 23, 2009

Committee Action:

XXX APPROVED _____ EXPEDITED _____ EXEMPT CATEGORY NO.

XXX Approved for conduct of research during period of November 23, 2009 to November 22, 2010
start date end date

***If a non-exempt project extends beyond twelve months, the Application for Continued Approval/Final Report - Appendix G form must be submitted to the IRB for review and approval two months prior to end date of the project period.**

A copy of your approved consent form has been enclosed, if applicable. Use the stamped copy in your consent process and provide a copy to each of your subjects. No changes may be made to the stamped copy without IRB approval.

Changes in approved research must be reported promptly and are not initiated without IRB approval except when necessary to eliminate apparent immediate hazards to the subject. SUNY New Paltz and the IRB must report investigator non-compliance to institutional officials, the Federal Office for Human Research Protections and other agencies as required.

Research investigators are responsible for reporting promptly to the IRB any injuries to human subjects, any adverse effects and events experienced by human subjects, and/or any unanticipated problems involving risks to human research subjects or others in any covered research. Serious or continuing non-compliance with Federal, institutional, or IRB requirements, is grounds for suspension or termination of IRB approval.

***When your study has been completed, you must file a final report with the IRB in care of the Office of Sponsored Programs. Use the form mentioned above, Application for Continued Approval/Final Report.**

Forward 2 copies of any requested revisions to Office of Sponsored Programs, HAB 805.

November 23, 2009
Dr. Maryalife Citera, Chair, Institutional Review Board Date

Attachments: Stamped consent form

rev. 9/01

For IRB use only: 1 HAWK DRIVE ■ NEW PALTZ, NEW YORK ■ 12561-2443
Documentation of training has been submitted:

**Oswego State University
Human Subjects Expedited Review Form**

TO: Ms. Linda Fusco

FROM: Barry At. Friedman, Ph.D., Co-Chair, Human Subjects Committee

RE: Research proposal: A MIXED METHODS STUDY OF HOW THE TRANSITION
(AND) PRACTICE IMPACTS THE AUTONOMY OF PRE-SEVEN SECONDARY MATH
TEACHERS.

Your above titled research project has been received for expedited review and:

has been approved needs further revision (see reasons below)

Please follow these steps:

- (1) You keep this top page ("Expedited Review Form") for your records.
- (2) Prior to conducting the research, complete the attached "Acceptance of Review by Principle Investigator" and return it to:



Dr. Barry A. Friedman
247 Rich Hall
College of Business
Oswego State University, Oswego, NY 13126

Thank you

Signature: _____

Print Name

Date: 4/6/09

Further comments:

**SUNY Cortland (FWA00009541)
Individual Investigator Agreement**

Individual Investigator's Name:	<u>Linda Fusco</u>
Investigator's Home Institution:	<u>University of Nebraska at Lincoln</u>
Specify Research Covered by this Agreement:	<u>A Mixed Methods Study of How the Transition Into Practice Impacts the Autonomy of Pre-Service Secondary Mathematics Teachers</u>

For this agreement, the Institutional Review Board (IRB)/Independent Ethics Committee (IEC) refers to the Investigator's home institution and SUNY Cortland.

- (1) The above-named Individual Investigator has reviewed: 1) *The Belmont Report. Ethical Principles and Guidelines for the Protection of Human Subjects of Research* (or other internationally recognized equivalent; see section B.1. of the Terms of the Federalwide Assurance (FWA) for International (Non-U.S.) Institutions); 2) the U.S. Department of Health and Human Services (HHS) regulations for the protection of human subjects at 45 CFR part 46 (or other procedural standards; see section B.3. of the Terms of the FWA for International (Non-U.S.) Institutions); 3) the FWA and applicable Terms of the FWA for the institution referenced above; and 4) the relevant institutional policies and procedures for the protection of human subjects.
- (2) The Investigator understands and hereby accepts the responsibility to comply with the standards and requirements stipulated in the above documents and to protect the rights and welfare of human subjects involved in research conducted under this Agreement.
- (3) The Investigator will comply with all other applicable federal, international, state, and local laws, regulations, and policies that may provide additional protection for human subjects participating in research conducted under this agreement.
- (4) The Investigator will abide by all determinations of the IRB/IEC designated under the above FWA and will accept the final authority and decisions of the IRB/IEC, including but not limited to directives to terminate participation in designated research activities.
- (5) The Investigator will complete any educational training required by their home institution and/or the IRB/IEC prior to initiating research covered under this Agreement. This training must meet the minimal requirements, as specified by OHRP. If the home institution does not offer OHRP compliant training, the Investigator is required to complete SUNY Cortland IRB training.
- (6) The Investigator will report promptly to the IRB/IEC any proposed changes in the research conducted under this Agreement. The investigator will not initiate changes in the research without prior IRB/IEC review and approval, except where necessary to eliminate apparent immediate hazards to subjects.
- (7) The Investigator will report immediately to the IRB/IEC any unanticipated problems involving risks to subjects or others in research covered under this Agreement.
- (8) The Investigator, when responsible for enrolling subjects, will obtain, document, and maintain records of informed consent for each such subject or each subject's legally authorized representative as required under HHS regulations at 45 CFR part 46 (or any other international or national procedural standards selected on the FWA for the institution referenced above) and stipulated by the IRB/IEC.

- (9) The Investigator acknowledges and agrees to cooperate in the IRB/IEC's responsibility for initial and continuing review, record keeping, reporting, and certification for the research referenced above. The Investigator will provide all information requested by the IRB/IEC in a timely fashion.
- (10) The Investigator will not enroll subjects in research under this Agreement prior to its review and approval by the IRB/IEC.
- (11) Emergency medical care may be delivered without IRB/IEC review and approval to the extent permitted under applicable federal regulations and state law.
- (12) This Agreement does not preclude the Investigator from taking part in research not covered by this Agreement.
- (13) The Investigator acknowledges that he/she is primarily responsible for safeguarding the rights and welfare of each research subject, and that the subject's rights and welfare must take precedence over the goals and requirements of the research.

Investigator
Signature: _____Date: 3/24/09

Name: Fusco Linda K Degree(s): BS, MST
(Last) (First) (Middle Initial)

Office Address: 104 Parkview Dr Office phone: 914 738 0059

Bronxville NY 10708
(City) (State) (Zip Code)

email: Fuscol1@optonline.netFax: 914 738 8132

This research has been reviewed and approved by institutional officials at SUNY Cortland and the SUNY Cortland IRB.

IRB Administrator
Signature: _____Date: 3-30-09

Name: Eaton Leslie G.
(Last) (First) (Middle Initial)

Office Address: State University of New York College at Cortland Office phone: (607) 753-2079
Institutional Review Board
P.O. Box 2000

IORG0094382 | 3
IRB0004790

<u>Cortland</u>	<u>NY</u>	<u>13045</u>
(City)	(State)	(Zip Code)

email: irb@cortland.edu

Fax: (607) 753-5738

INSTITUTIONAL REVIEW BOARD (IRB)

Chair: Craig Bielert, Professor of Psychology

Members:

Lisa Curch, Assistant Professor of Sociology

Joanne Curran, Associate Dean of Education

Steven Gilbert, Professor of Psychology

Sallie Han, Assistant Professor of Anthropology

Patricia Knuth, Assistant Executive Director, The ARC Otsego

Kim Muller, Director, Sponsored Programs Office (ex officio)

Date: 18 March 2009

To: Linda Fusco

IRB Project Number: 2009-22

This communication is to acknowledge receipt of the IRB Review Form for your project entitled *A Mixed Methods Study of How the Transition into Practice Impacts the Autonomy of Pre-Service Secondary Math Teachers*. Please carefully note the following actions:

- Your IRB Review Form has been received and was submitted to the IRB on 18 March 2009. You will be updated on its status through the review process.
- The IRB completed review of your project on . Your project does not fall under human subjects' protection statutes and does not require IRB approval for you to proceed.
- The IRB reviewed your project on . Prior to the IRB determining approval, the following Principal Investigators on your project must complete the CITI (Collaborative IRB Training Initiative) program for protection of human subjects in research and submit certification to the IRB in order for them to complete their review (or must provide proof of current certification through another human subjects in research protection program). Please access the CITI web-based program at www.citiprogram.org. If you have questions, contact the Director of Grants Development at mullerkk@oneonta.edu.
- Principal Investigator:
Principal Investigator:
Principal Investigator:
Principal Investigator:
- The IRB reviewed your project on . Prior to the IRB determining approval, the following Faculty Supervisor(s) must complete the CITI (Collaborative IRB Training Initiative) program for protection of human subjects in research (or must provide proof of current certification through another human subjects in research protection program). Please access the CITI web-based program at www.citiprogram.org. If you have questions, contact the Director of Grants Development at mullerkk@oneonta.edu.
- Faculty Supervisor:
Faculty Supervisor:
- The IRB reviewed your project on . Your proposal requires revisions. Please note the attached comments.
- The IRB completed review of your proposal on 18 March 2009 and all Principal Investigators (and Faculty Supervisors if applicable) on your project have completed the CITI program. You are authorized by the IRB to proceed with your research project.

If you have any questions, please contact the Grants Development Office (Kim Muller, x2479, mullerkk@oneonta.edu).

Ms. Fusco –

Thank you for your revised application for your proposed research titled *A Mixed Methods Study of How the Transition into Practice Impacts the Autonomy of Pre-Service Secondary Mathematics Teachers*. Your revisions have answered the concerns of the Committee. This e-mail is your approval and your research may proceed as described.

As a reminder, you must comply with Part D of the Campus Policies on Human Subjects requiring notification at the time data collection begins and when it is done. You may accomplish this with a simple e-mail to me. Additionally, the modified documents on SUNY Fredonia letterhead must be sent to my office to be placed in the HSRC file.

Thank you for keeping the high standards relating to research and the protection of human subjects on the Fredonia campus. Best wishes on your research.

Maggie Bryan-Peterson

Human Subjects Administrator

Office of Sponsored Programs

E230a Thompson Hall

SUNY Fredonia

Stony Brook University would not be engaged in your research, provided no one from SBU will provide you with identifiable information about SBU students, or be involved in your research in any way, including obtaining informed consent from subjects.

IRB oversight would NOT be required.

Betsy Baron
IRB Administrator
Office of Research Compliance
W5530 Frank Melville, Jr. Memorial Library
Stony Brook University
Stony Brook, NY 11794-3368
PH: 631-632-9036
FX: 631-632-9839
email: bbaron@notes.cc.sunysb.edu

fuscol1---03/26/2009 02:46:06 PM---Betsey,

From: fuscol1@optonline.net
To: elizabeth.baron@stonybrook.edu
Cc: jweigand@math.sunysb.edu
Date: 03/26/2009 02:46 PM
Subject: IRB Information for Linda Fusco

----- Original Message -----

From "Marks, Christian" <marks@buffalo.edu>
Date Mon, 02 Nov 2009 09:26:54 -0500
To "'fuscol1@optonline.net'" <fuscol1@optonline.net>
Subject Fusco RE: Email Draft for Recruiting SUNY Buffalo Students to Participate in Linda Fusco's Doctoral Study

[Linda,](#)

I am authorized as the designee of the SBSIRB Chair to provide determinations as to whether or not a project constitutes human subjects research and if a project engages UB or its affiliates in human subjects research.

Based on the information provided below, the project does appear to be human subjects research but does not engage UB in human subjects research. This is because UB personnel will not be acting as representatives of the study but merely providing students with the opportunity to participate. Also, UB will not be providing you any identifiable private information.

As such UB is not engaged in human subjects research and no UB IRB approval is needed for your participation as described below.

You should save a copy of this e-mail as a record that you did your due diligence in checking with the IRB on this matter.

Christian Marks, Ph.D., CIP
SBSIRB Administrator
515 Capen Hall
University at Buffalo
Buffalo, NY 14260-1611
(716) 645-6474
marks@buffalo.edu

Note: The Researcher had to submit IRB approvals through a professor, Melissa Sutherland to gain IRB approval from SUNY Geneseo.

From: Melissa Sutherland
Date: Friday, April 24, 2009 11:05 am
Subject: Fwd: IRB Proposal Approved!
To: Linda Fusco

> We are officially approved!
> "See" you on Tuesday. Your Fed Ex has not yet arrived. I'm not
> sure
> what happens if they try to deliver on a weekend.
> Melissa
>
> >Envelope-to: sutherm@geneseo.edu
> >Date: Fri, 24 Apr 2009 10:18:39 -0400
> >To: sutherm@geneseo.edu, zook@geneseo.edu, frisiras@geneseo.edu
> >Subject: IRB Proposal Approved!
> >From: irb@geneseo.edu
> >
> >Dear Melissa,
> >
> >Proposal #200809049 was approved!
> >
> >Expiration: 4-24-2010
> >
> >Login: <http://irb.geneseo.edu/index.php?pg=login>
> >
> >[This message was generated automatically]
Melissa Sutherland
> Associate Professor
> SUNY Geneseo, Dept of Math., South 324B
> office (585) 245-5494, fax (585) 245-5128
> sutherm@geneseo.edu



March 4, 2009

Linda Fusco
Department of Educational Administration
104 Parkview Dr Bronxville, NY 10708

Sheldon Stick
Department of Educational Administration
123 TEAC UNL 68588-0360

IRB Number: 2009039608 EX
Project ID: 9608
Project Title: A Mixed Methods Study of How the Transition Into Practice Impacts the
Autonomy of Pre-Service Secondary Mathematics Teachers

Dear Linda:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as exempt.

You are authorized to implement this study as of the Date of Final Approval: 03/04/2009. This approval is Valid Until: 03/03/2010.

1. The approved informed consent forms have been uploaded to NUgrant (IRB Consent Form Strand #1-Approved.pdf and IRB Consent Form Strand #2-Approved.pdf files). Please use these forms to distribute to participants. If you need to make changes to the informed consent forms, please submit the revised forms to the IRB for review and approval prior to using them.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;

- Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board. For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Mario Scalora, Ph.D.
Chair for the IRB





May 4, 2009

Linda Fusco
Department of Educational Administration
104 Parkview Dr Bronxville, NY 10708

Sheldon Stick
Department of Educational Administration
123 TEAC UNL 68588-0360

IRB Number: 2009039608 EX
Project ID: 9608
Project Title: A Mixed Methods Study of How the Transition Into Practice Impacts the
Autonomy of Pre-Service Secondary Mathematics Teachers

Dear Linda:

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB.

1. It has been approved to change the time frame listed on the Recruitment letter and informed consent form for Strand #1.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Mario Scalora, Ph.D.
Chair for the IRB



Appendix D

Recruitment Letters

1. Recruitment Letter Phase I
2. Informed Consent Form Phase I
3. Recruitment Letter Phase II
4. Informed Consent Form Phase II
5. Recruitment Letter for Fredonia
6. Amended Recruitment Letter for Phase I (through January 2010)
7. Amended Informed Consent Form for Phase I (through January 2010)



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

Quantitative Strand Recruitment Letter

February 2009

Dear (Students Name)

Your status as a(n) [name of post secondary institution] mathematics secondary education major ready to begin student teaching in the upcoming semester, has placed you in the standing to take part in a very important research study. Your participation will contribute to the research underlying a published study on the beliefs of pre service mathematics teachers regarding their conception of mathematics and their understanding of how mathematics should be taught. Information gleaned from this study will be important to understanding how pre-service education majors transition into the teaching profession. The time frame for this study is April, 2009 through June, 2009.

Please review the attached consent form. When your consent form has been received you will be sent an email that will include a web-based Mathematics Beliefs survey and the TTI TriMetrix talent questionnaire information and a PIN number. For your convenience and confidentiality, the survey and questionnaire are available on the Web. You will also receive in the mail three documents: Myers Briggs Type Indicator, Mathematics Learning Style Inventory, and the Teaching Style Inventory. Please complete the documents and return them in the stamped addressed envelope provided. It would be greatly appreciated if you could return the completed documents within the week after receipt.

If you have any questions, feel free to contact me at (914) 738 0059 (home) or (914) 380- 2130 (cell) or email me at fuscol1@optonline.net

Thank you in advance for your cooperation.

Sincerely,

Linda Fusco

Doctoral Candidate at the University of Nebraska-Lincoln



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

INFORMED CONSENT FORM

IRB# 2009039608 EX

Identification of Project:

A MIXED METHODS STUDY OF HOW THE TRANSITION INTO PRACTICE IMPACTS THE AUTONOMY OF PRE-SERVICE SECONDARY MATHEMATICS TEACHERS

Purpose of the Research:

This is a research project (a mixed methods study) designed to explore the impact of the student teaching experience on pre-service secondary mathematics teachers' autonomy. Autonomy is defined as "the ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence" (Cooney & Shealy, 1997, p. 88). The purpose of this study will be to collect, analyze, and mix both quantitative and qualitative data to explore the phenomenon of pre-service secondary mathematics teachers' autonomy, pre and post their student teaching experience in New York State. The goal of the quantitative phase (Strand #1) will be to use numeric (survey and profile) data to determine the extent to which pre-service secondary mathematics teachers' autonomy is dependent on certain factors (beliefs, social context, reflection on the practice of teaching). As a primary participant in Strand #1 (quantitative) of the study your involvement will be substantial. You must be 19 years of age or older to participate. You are invited to participate in this study because you are a student in a teaching methods course.

The time frame for participation in this research will be April 2009 through June, 2009.

Procedures:

Participation in the Strand # 1 will require approximately 2 1/2 hours of your time and is not considered part of your course assignment. You will be asked to complete a Web-based Mathematics Beliefs survey (30 minutes), Myers Briggs Type Indicator profile (20 Minutes), Math Learning Styles Inventory (30 Minutes), Teacher Learning Style Inventory (30) and the TTI TriMetrix talent questionnaire (40 minutes). The Web-based Mathematics Beliefs survey and the TTI TriMetrix talent questionnaire will be completed on-line. You will be sent the link and a PIN number to access the on-line survey and a link to access the TTI TriMetrix questionnaire once you have returned the signed informed consent form. The Math Learning Styles Profile, Teacher Learning Style Inventory, and Myers Briggs Type Indicator profile are paper-based and will be sent to you by mail with a stamped return envelope. The aforementioned profile, inventories, survey, and questionnaire will need to be completed prior to the commencement of your student teaching assignment. You may then be selected as a participant for the qualitative (Strand # 2) of the study.

Risks and/or Discomforts:

There are no known risks or discomforts associated with this research.

Benefits:

You may find the study interesting and the feedback from the study may shed light on your teaching skills. While you may not personally benefit from your participation in this research, your participation may provide valuable information to the academic community about the experiences of pre-service teachers' perceptions and beliefs about how mathematics is taught.

Page 1 of 3

Confidentiality:

The information obtained during this study will be kept strictly confidential to the extent permitted by law. Confidentiality will be maintained throughout the study through the use of number IDs. In addition, all data collected and materials related to the research will be kept by the researcher in a locked metal file cabinet in the investigator's office and will only be seen by the investigator during the study and for three years after the study is complete. The information obtained in this study may be published in educational journals or presented at education conferences but the data will be reported as aggregated data.

Compensation:

There will be no compensation for participating in this research. The participants will receive the results of the survey, profile, and questionnaire instruments and can discuss their individual results with the investigator after the study has been completed.

Opportunity to Ask Questions:**Questions**

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may call the investigator, Linda Kasal Fusco, at any time, at her residence phone, (914) 738-0059 or cell phone (914) 380-2130. Please contact the investigator if you want to voice concerns or complaints about the research.

Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 for the following reasons:

- you wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- to voice concerns or complaints about the research
- to provide input concerning the research process in the event the study staff could not be reached,

Freedom to Withdraw:**Withdrawal Without Prejudice**

Participation in this study is voluntary. You are free to withdraw your consent and to discontinue participation in this study at any time without harming the relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Significant New Findings

Any significant new findings that develop during the course of the study that may affect your willingness to continue the research will be provided to you by the researcher.

Consent, Right to Receive a Copy:

You are voluntarily making a decision whether or not to participate in this research study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

Signature of Participant:

Signature of Research Participant

Date

Name and Phone number of investigator(s)

Linda Kasal Fusco, MST, Principle Investigator
Sheldon Stick, PhD Secondary Investigator

(914) 738 -0059
(402) 472 0973 Office



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

Qualitative Strand Recruitment Letter

Dear Pre-Service Secondary Mathematics Teacher:

I am writing to invite you to participate in the second phase (qualitative data collection) of a doctoral research study I am conducting. Your name was purposefully selected from the participants in the first strand (quantitative data collection) of the study that was administered in April, 2009. You will be one of 8 participants selected to continue in this study. I am interested in finding your views and perspectives about your intended practice as a secondary mathematics teacher.

Because your perception of your student teaching experience will be the focus of this study, your involvement in this study will not interfere with your student teaching responsibilities. I will be asking you to partake in two 1-hour interviews; submit selected journal entries, if required by your institution; provide a set of lesson plans you developed for student teaching; and, if feasible, video record one lesson you will teach. One interview will be conducted prior to your student teaching assignment and the second after your student teaching has been completed.

Please review the attached consent form. Upon your written consent and prior to conducting any interview with you, I will provide you with an outline of questions we want to ask in order to give you time to think about your responses. Throughout these interviews you might also be asked some clarifying questions to elicit additional details and examples from your responses. I will take all precautions to ensure your anonymity. You would have the option to withdraw from the study at any time should you choose to do so. I am totally appreciative for your participation in my study and in assisting me with my professional endeavors. The data from this research will be used in my doctoral dissertation. You should, however, be aware that I might choose to publish the findings of this study at a later date. Again, I will take precautions to ensure your anonymity, using a pseudonym.

You may find the results from participating in this study beneficial to your teaching practice. Please contact me at any time if I can provide any additional information. I look forward to hearing from you by June 1, 2009.

If you have any questions, feel free to contact me at (914) 738 0059 (home) or (914) 380- 2130 (cell) or email me at [fuscol1@optonline.net](mailto:fusco1@optonline.net)

Sincerely,

Linda Fusco

Doctoral Candidate University of Nebraska - Lincoln



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

INFORMED CONSENT FORM

IRB# 2009039608 EX

Identification of Project:

A MIXED METHODS STUDY OF HOW THE TRANSITION INTO PRACTICE IMPACTS THE AUTONOMY OF PRE-SERVICE SECONDARY MATHEMATICS TEACHERS

Purpose of the Research:

This is a research project (a mixed methods study) designed to explore the impact of the student teaching experience on pre-service secondary mathematics teachers' autonomy. Autonomy is defined as "the ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence" (Cooney & Shealy, 1997, p. 88). The purpose of this study will be to collect, analyze, and mix both quantitative and qualitative data to explore the phenomenon of pre-service secondary mathematics teachers' autonomy, pre and post their student teaching experience in New York State. The quantitative phase (Strand #1), the collection of numeric (survey and profile) data to determine the extent to which pre-service secondary mathematics teachers' autonomy is dependent on certain factors (beliefs, social context, reflection on the practice of teaching), has been completed. The goal of the qualitative phase (Strand #2) of the study will be to use individual interviews and artifacts to provide an in-depth understanding of the complex phenomenon of teacher autonomy as the study participants make a transition into student teaching in secondary mathematics in New York State. As participant in Strand #2 (qualitative) of the study your involvement will be substantial. You must be 19 years of age or older to participate. You are invited to participate in Strand #2 of this study because you have been purposefully selected from the participants in Strand #1 of the study and you are scheduled for student teaching in the Fall 2009.

The time frame for participation in this research will be August 2009 through January, 2009.

Procedures:

As a participant in Strand #2, the qualitative portion of the study, you will be asked to partake in two audio-recorded interviews each lasting 1 hour. One interview will pertain to your perception of the teaching practice prior to student teaching; the second interview will pertain to your perception of your student teaching experience. The interviews will be conducted via telephone and a convenient location of your choice. You will be asked to provide the researcher with selected lesson plans you developed for your student teaching experience; a video of you teaching a lesson (if available); and a sample of your student teaching experiences recorded as journal entries (if required by your institution). The qualitative data and artifacts will be collected prior to, or after, your student teaching experience so as not to impact your time or work as a student teacher.

Risks and/or Discomforts:

There are no known risks or discomforts associated with this research.

Benefits:

You may find the study interesting and the feedback from the study may shed light on your teaching skills. While you may not personally benefit from your participation in this research, your participation may provide valuable information to the academic community about the experiences of pre-service teachers' first practical teaching experiences.

Pages 1 of 3

Confidentiality:

The information obtained during Strand #2 will be kept strictly confidential to the extent permitted by law. Confidentiality will be maintained throughout the study through the use of pseudonyms. In addition, all data collected and materials related to the research will be kept by the researcher in a locked metal file cabinet in the investigator's office and will only be seen by the investigator during the study and for three years after the study is complete. The information obtained in this study may be published in educational journals or presented at education conferences but the data will be reported as aggregated data. The audiotapes will be erased after transcription.

Compensation:

There will be no compensation for participating in this research. The participants will receive the results of the survey, profile, and questionnaire instruments and can discuss their individual results with the investigator after the study has been completed.

Opportunity to Ask Questions:**Questions**

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may call the investigator, Linda Kasal Fusco, at any time, at her residence phone, (914) 738-0059 or cell phone (914) 380-2130. Please contact the investigator if you want to voice concerns or complaints about the research.

Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 for the following reasons:

- you wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- to voice concerns or complaints about the research
- to provide input concerning the research process in the event the study staff could not be reached,

Freedom to Withdraw:**Withdrawal Without Prejudice**

Participation in this study is voluntary. You are free to withdraw your consent and to discontinue participation in this study at any time without harming the relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Significant New Findings

Any significant new findings that develop during the course of the study that may affect your willingness to continue the research will be provided to you by the researcher.

Consent, Right to Receive a Copy:

You are voluntarily making a decision whether or not to participate in this research study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

_____ Check if you agree to be audio taped during the interview.

Signature of Participant:

Signature of Research Participant

Date

Name and Phone number of investigator(s)

Linda Kasal Fusco, MST, Principle Investigator
Sheldon Stick, PhD Secondary Investigator

(914) 738 -0059
(402) 472 0973 Office



Dear SUNY Fredonia Student,

The SUNY Fredonia Human Subjects Review Committee has granted the approval to me, Linda Fusco, a doctoral candidate at the University of Nebraska (UNL), to recruit students as participants in my study, *A Mixed Methods Study of How the Transition into Practice Impacts the Autonomy of Pre-Service Teacher Secondary Mathematics Teachers*. The SUNY Fredonia Human Subjects Committee has asked that a letter be attached to the UNL Informed Consent Form providing you with additional contact information.

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may withdraw from the study at any time without penalty. You may call me, Linda Fusco the investigator, at any time at my residence phone, (914) 738-0059 or cell phone (914) 380-2130, if you want to voice your complaints about the research or you may call the University of Nebraska-Lincoln Institutional Review Board at the phone number listed in the UNL Informed Consent Form.

If you would like to contact someone other than the Linda Fusco or UNL IRB with concerns about the research, please direct your questions to:

Dr. Maggie Bryan- Peterson, CRA, Human Subjects Administrator, Office of Sponsored Programs, E230a, Thompson Hall, (716) 673-3528.

Or

Dr. Keary Howard, Coordinator of the Adolescence Mathematics Program, 208, Fenton Hall, (716) 673-3873.

Sincerely,

Linda Fusco



Dear SUNY Fredonia Student,

My name is Linda Fusco. I am a doctoral candidate at The University of Nebraska, at Lincoln. I am seeking participants in my doctoral study titled A Mixed Methods Study of How the Transition into Practice Impacts the Autonomy of Pre-Service Mathematics Teachers. I have been given permission by SUNY Fredonia to recruit participants for my study by The Human Subject Committee.

I have waited until my retirement to complete my doctorate, as the culmination of my 36 ½ years as a teacher of mathematics and science in the New York State public school system. I began my education journey as a graduate of SUNY Plattsburgh in 1970 earning a B.S. in Mathematics. In 1973 I received my MST in Mathematics from Fordham University. During the past three decades. I have practiced and experienced mathematical reform, both as a teacher and as a supervisor of mathematics teachers.

This letter is attached to the recruitment letter approved by the University of Nebraska, at Lincoln (UNL) Internal Review Board (IRB). Since the research is being conducted through UNL, the informed consent form and participant information form is on UNL letterhead.

Dr. Keary Howard will act as the SUNY Fredonia contact person for the study participants. Please take time to read the attached forms and feel free to contact me with any questions.

I am looking forward to including you in my study.

Sincerely,

Linda Fusco, 104 Parkview Dr., Bronxville, NY 10708

914 738 0059 Home, 914 380 2130 cell, fuscol1@optonline.net



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

November, 2009

Dear SUNY Buffalo Student,

Your status as a SUNY mathematics secondary education major ready to begin student teaching in the upcoming semester has placed you in the standing to take part in a very important research study. Your participation will contribute to the research underlying a published study on the beliefs of pre service mathematics teachers regarding their conception of mathematics and their understanding of how mathematics should be taught. Information gleaned from this study will be important to understanding how pre-service education majors transition into the teaching profession. The time frame for this study is December, 2009 through January, 2010.

Please review the attached consent form. When your consent form has been received you will be sent an email that will include a web- based Mathematics Beliefs survey and the TTI TriMetrix talent questionnaire information and a PIN number. For your convenience and confidentiality, the survey and questionnaire are available on the Web. You will also receive in the mail three documents: Myers Briggs Type Indicator, Mathematics Learning Style Inventory, and the Teaching Style Inventory. Please complete the documents and return them in the stamped addressed envelope provided. It would be greatly appreciated if you could return the completed documents within the week after receipt.

If you have any questions, feel free to contact me at (914) 738 0059 (home) or (914) 380- 2130 (cell) or email me at [fuscol1@optonline.net](mailto:fusco1@optonline.net)

Thank you in advance for your cooperation.

Sincerely,

Linda Fusco
Doctoral Candidate at the University of Nebraska-Lincoln
104 Parkview Drive
Bronxville, NY 10708



COLLEGE OF EDUCATION AND HUMAN SCIENCES
Department of Educational Administration

INFORMED CONSENT FORM

IRB# 2009039608 EX

Identification of Project:

A MIXED METHODS STUDY OF HOW THE TRANSITION INTO PRACTICE IMPACTS THE AUTONOMY OF PRE-SERVICE SECONDARY MATHEMATICS TEACHERS

Purpose of the Research:

This is a research project (a mixed methods study) designed to explore the impact of the student teaching experience on pre-service secondary mathematics teachers' autonomy. Autonomy is defined as "the ability of teachers to see themselves as authorities, in that they can evaluate materials and practices in terms of their own beliefs and practices, and be flexible in modifying their beliefs when faced with disconfirming evidence" (Cooney & Shealy, 1997, p. 88). The purpose of this study will be to collect, analyze, and mix both quantitative and qualitative data to explore the phenomenon of pre-service secondary mathematics teachers' autonomy, pre and post their student teaching experience in New York State. The goal of the quantitative phase (Strand #1) will be to use numeric (survey and profile) data to determine the extent to which pre-service secondary mathematics teachers' autonomy is dependent on certain factors (beliefs, social context, reflection on the practice of teaching). As a primary participant in Strand #1 (quantitative) of the study your involvement will be substantial. You must be 19 years of age or older to participate. You are invited to participate in this study because you are a student in a teaching methods course.

The time frame for participation in this research will be December, 2009 through January, 2010.

Procedures:

Participation in the Strand # 1 will require approximately 2 1/2 hours of your time and is not considered part of your course assignment. You will be asked to complete a Web-based Mathematics Beliefs survey (30 minutes), Myers Briggs Type Indicator profile (20 Minutes), Math Learning Styles Inventory (30 Minutes), Teacher Learning Style Inventory (30) and the TTI TriMetrix talent questionnaire (40 minutes). The Web-based Mathematics Beliefs survey and the TTI TriMetrix talent questionnaire will be completed on-line. You will be sent the link and a PIN number to access the on-line survey and a link to access the TTI TriMetrix questionnaire once you have returned the signed informed consent form. The Math Learning Styles Profile, Teacher Learning Style Inventory, and Myers Briggs Type Indicator profile are paper-based and will be sent to you by mail with a stamped return envelope. The aforementioned profile, inventories, survey, and questionnaire will need to be completed prior to the commencement of your student teaching assignment. You may then be selected as a participant for the qualitative (Strand # 2) of the study.

Risks and/or Discomforts:

There are no known risks or discomforts associated with this research.

Benefits:

You may find the study interesting and the feedback from the study may shed light on your teaching skills. While you may not personally benefit from your participation in this research, your participation may provide valuable information to the academic community about the experiences of pre-service teachers' perceptions and beliefs about how mathematics is taught.

Page 1 of 3

Confidentiality:

The information obtained during this study will be kept strictly confidential to the extent permitted by law. Confidentiality will be maintained throughout the study through the use of number IDs. In addition, all data collected and materials related to the research will be kept by the researcher in a locked metal file cabinet in the investigator's office and will only be seen by the investigator during the study and for three years after the study is complete. The information obtained in this study may be published in educational journals or presented at education conferences but the data will be reported as aggregated data.

Compensation:

There will be no compensation for participating in this research. The participants will receive the results of the survey, profile, and questionnaire instruments and can discuss their individual results with the investigator after the study has been completed.

Opportunity to Ask Questions:**Questions**

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. You may call the investigator, Linda Kasal Fusco, at any time, at her residence phone, (914) 738-0059 or cell phone (914) 380-2130. Please contact the investigator if you want to voice concerns or complaints about the research.

Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 for the following reasons:

- you wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- to voice concerns or complaints about the research
- to provide input concerning the research process in the event the study staff could not be reached,

Freedom to Withdraw:**Withdrawal Without Prejudice**

Participation in this study is voluntary. You are free to withdraw your consent and to discontinue participation in this study at any time without harming the relationship with the researchers or the University of Nebraska-Lincoln, or in any other way receive a penalty or loss of benefits to which you are otherwise entitled.

Significant New Findings

Any significant new findings that develop during the course of the study that may affect your willingness to continue the research will be provided to you by the researcher.

Consent, Right to Receive a Copy:

You are voluntarily making a decision whether or not to participate in this research study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

Signature of Participant:

Signature of Research Participant

Date

Name and Phone number of investigator(s)

Linda Kasal Fusco, MST, Principle Investigator
Sheldon Stick, PhD Secondary Investigator

(914) 738 -0059
(402) 472 0973 Office

Appendix E

Matthew J. Perini

Matthew J. Perini

Matthew J. Perini serves as Director of Publishing for Silver Strong & Associates and Thoughtful Education Press. Over the past 10-years, Matthew has authored books, curriculum guides, articles, and research studies covering a wide range of educational topics, including learning styles, multiple intelligences, reading instruction, and effective teaching practices.

Along with Richard Strong and Harvey Silver, Matthew has collaborated on a number of recent bestsellers in education, including *So Each May Learn: Integrating Learning Styles and Multiple Intelligences*, *Teaching What Matters Most: Standards and Strategies for Raising Student Achievement*, and *The Strategic Teacher: Selecting the Right Research-Based Strategy for Every Lesson*, all published by ASCD; *Reading for Academic Success, Grades 7-12* and *Reading for Academic Success, Grades 2-6* for Corwin Press; and Thoughtful Education Press's *Tools for Promoting Active, In-Depth Learning*, which won a Teachers' Choice Award in 2004.

Matthew has extensive experience in designing and validating inventories for assessing student learning profiles. He served on the design teams that developed and piloted the *Math Learning Style Inventory for Secondary Students*, the *Multiple Intelligences Indicator for Adults*, *The Learning Style Inventory for Elementary Students*, and *The Learning Style/Multiple Intelligences Checklist*.

Appendix F

Cross Case Analysis Tables

1. Table A—Pre-student Teaching Themes, Sub Themes and Categories across Cases
2. Table B—Post-student Teaching Themes, Sub Themes and Categories across Cases

Table A
Pre-student Teaching Themes, Sub Themes and Categories across Cases

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<i>Rationale for Decision to Teach Secondary Mathematics</i>	<ul style="list-style-type: none"> - Job market 	<ul style="list-style-type: none"> - Positive experience teaching others 	<ul style="list-style-type: none"> - Positive experience teaching others - Role model 	<ul style="list-style-type: none"> - Role model 	<ul style="list-style-type: none"> - Job market 	<ul style="list-style-type: none"> - Positive experience teaching others - Job market 	<ul style="list-style-type: none"> - Positive experience teaching others - Role model
Personal connection to real world experience	<ul style="list-style-type: none"> - Connected to real world experience (computer science) 	<ul style="list-style-type: none"> - Connected to real world experience (Market research) 	<ul style="list-style-type: none"> - Connected to real world experience (Dance) 	<ul style="list-style-type: none"> - Connected to real world experience (Sports) 	<ul style="list-style-type: none"> - Connected to real world experience (Philosophy) 	<ul style="list-style-type: none"> - Connected to real world experience (Tutoring at risk students, armed forces) 	<ul style="list-style-type: none"> - Connected to real world experience (Coaching)
Preferred grade level	<ul style="list-style-type: none"> - Middle School 		<ul style="list-style-type: none"> - High School 	<ul style="list-style-type: none"> - Middle School 	<ul style="list-style-type: none"> - High School 	<ul style="list-style-type: none"> - Middle School 	<ul style="list-style-type: none"> - High School
<i>Attributes of Teaching the Role of Teaching</i>	<ul style="list-style-type: none"> - Relates math to students interests - Provides emotionally safe, respectful classroom climate - Demonstrates real life application of math 	<ul style="list-style-type: none"> - Relates math to students interests - Provides an emotionally safe, respectful classroom climate 	<ul style="list-style-type: none"> - Provides an emotionally safe, respectful classroom climate - Inspire and challenge all students - Makes learning fun and creative 	<ul style="list-style-type: none"> - Relates math to students interests - Provides an emotionally safe, respectful classroom climate - Inspire and challenge all students 	<ul style="list-style-type: none"> - Relates math to students interests - Respects learning differences 	<ul style="list-style-type: none"> - Relates math to students interests - Provides an emotionally safe, respectful classroom climate - Demonstrates real life application of math. 	<ul style="list-style-type: none"> - Relates math to student interests - Provides an emotionally safe, respectful classroom climate - Demonstrates real life application of math

Table A continues

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
Good Teaching (cont'd)	<ul style="list-style-type: none"> - Inspire and challenge all students - Respects learning differences - Makes learning fun and creative 						
<i>Attributes Reflective of the Participant's Dominant MLS</i>	<ul style="list-style-type: none"> - Identified organized and methodical (Mastery) 	<ul style="list-style-type: none"> - Identified to explain why (Under-Understanding) 	<ul style="list-style-type: none"> - Identified brings new ideas into instruction (Self Expressive) 	<ul style="list-style-type: none"> - Identified knows content (Mastery) 	<ul style="list-style-type: none"> - Identified understanding of math concepts (Under-Understanding) 	<ul style="list-style-type: none"> - Identified visual representation of problems (Self Expressive) 	<ul style="list-style-type: none"> - Identified and provided collaborative opportunities to discuss math (Interpersonal)
Poor teaching	<ul style="list-style-type: none"> - Lecture, worksheets with no application of math concepts - Teaching to the test/cramming content - Insensitive to student interests and differences 	<ul style="list-style-type: none"> - Lecture, worksheets with no application of math concepts 	<ul style="list-style-type: none"> - Lecture, worksheets, test with no application of math concepts - Teaching to the test /cramming content - Insensitive to student interest and differences 	<ul style="list-style-type: none"> - Teaching the test/cramming content 	<ul style="list-style-type: none"> - Insensitive to student interests and differences 	<ul style="list-style-type: none"> - Lecture and worksheets with no application of math concepts - Insensitive to student interests and differences 	<ul style="list-style-type: none"> - Insensitive to student interests and differences

Table A continues

<i>Themes Sub-Themes</i>	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<i>Math Beliefs</i> How Math was Learned by the Participants	<ul style="list-style-type: none"> - Computation of model problems - Memorize definitions, theorems, proofs - Agreed that Mastery was her dominant MLS style 	<ul style="list-style-type: none"> - Computation of model problems - Visualize problems - Creating own examples - Agreed that Understanding was her MLS dominant style 	<ul style="list-style-type: none"> - Computation of model problems - Visualize problems - Collaboration and reciprocal coaching - Agreed that Self-expressive was her MLS dominant 	<ul style="list-style-type: none"> - Computation of model problems - Collaboration and reciprocal coaching - Agreed that Mastery was his MLS dominant style 	<ul style="list-style-type: none"> - Computation of model problems - Memorize definitions, theorems, proofs - Creating own examples - Agreed that Understanding was his MLS dominant style 	<ul style="list-style-type: none"> - Visualize problems - Agreed that Self-expressive was his MLS dominant style 	<ul style="list-style-type: none"> - Computation of model problems - Collaboration and reciprocal coaching - Agreed that Interpersonal was his MLS dominant style
How Math was Learned by Others	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives 	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives - Engaging in solving real world applications 	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives - Engaging in solving real world applications 	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives - Interests 	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives - Interests 	<ul style="list-style-type: none"> - Discussing mathematics in a group - Interests 	<ul style="list-style-type: none"> - Hands on – projects, portfolios manipulatives - Discussing mathematics in a group - Interests
Favorite Math Course Attribute	<ul style="list-style-type: none"> - Calculus- relative to life - Computer Programming deciphering step by step solutions 	<ul style="list-style-type: none"> - College Geometry- Abstract discovery learning 	<ul style="list-style-type: none"> - Pre Calculus- Learning new math concept 	<ul style="list-style-type: none"> - HS Algebra- like step by step solving a puzzle- 	<ul style="list-style-type: none"> - History of Math- Demonstrates how math is connected to society 	<ul style="list-style-type: none"> - Trigonometry- can visualize it all on paper. 	<ul style="list-style-type: none"> - AP Calculus- was taught collaboratively

Table A continues

<i>Themes Sub-Themes</i>	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
Favorite Math Course Attribute (cont'd)					<ul style="list-style-type: none"> - Symbolic Logic-created a world of abstracts 		
Application of Mathematics to Life	<ul style="list-style-type: none"> - Science and engineering 	<ul style="list-style-type: none"> - Science and engineering 	<ul style="list-style-type: none"> - Science and engineering - Problem solving in everyday life 	<ul style="list-style-type: none"> - Science and engineering - Problem solving in everyday life 	<ul style="list-style-type: none"> - Problem solving in everyday life - Improves critical thinking 	<ul style="list-style-type: none"> - Science and engineering - Improves critical thinking 	<ul style="list-style-type: none"> - Science and engineering - Improves critical thinking
Defining of Mathematics	<ul style="list-style-type: none"> - Most difficult interview question - System of numbers, logic and spatial relationships used in everyday life 	<ul style="list-style-type: none"> - Most difficult interview question - System of numbers, logic and spatial relationships used in everyday life 	<ul style="list-style-type: none"> - Most difficult interview question - Set of rules that gets a person to think abstractly about our world. 	<ul style="list-style-type: none"> - Most difficult interview question - System of numbers, logic and spatial relationships used in everyday life 	<ul style="list-style-type: none"> - Set of rules that gets a person to think abstractly about our world 	<ul style="list-style-type: none"> - Science and engineering - Improves critical thinking 	<ul style="list-style-type: none"> - Most difficult interview question - System of numbers, logic and spatial relationships used in everyday life
Philosophy of mathematics	<ul style="list-style-type: none"> - Math is connected to life. 	<ul style="list-style-type: none"> - Math is connected to life. 	<ul style="list-style-type: none"> - Math is connected to life. 	<ul style="list-style-type: none"> - Could not articulate philosophy 	<ul style="list-style-type: none"> - Math is connected to life. 	<ul style="list-style-type: none"> - Could not articulate philosophy 	<ul style="list-style-type: none"> - Math is connected to life.
<i>Perception of School Culture</i>	<ul style="list-style-type: none"> - Students learn at different rates and learning level 	<ul style="list-style-type: none"> - Not all students like to learn math 	<ul style="list-style-type: none"> - All students can learn at different rates and learning level 	<ul style="list-style-type: none"> - All students can learn math 	<ul style="list-style-type: none"> - Not all students like to learn math 	<ul style="list-style-type: none"> - All students can learn math 	<ul style="list-style-type: none"> - All students can learn math at different rates and learning levels.

Table A continues

<i>Themes Sub-Themes</i>	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
School Learning Environment	<ul style="list-style-type: none"> - Not conducive to students - Impacted by socio-economics - Needs to be collaborative - Needs to have admin support - Parents are part of the culture 	<ul style="list-style-type: none"> - Not conducive to students - Impacted by socio-economics - Needs to be collaborative - Not clear on how admin fits into the culture - Parents are part of the culture 	<ul style="list-style-type: none"> - Not conducive to students - Needs to be safe for students - Needs to have admin support 	<ul style="list-style-type: none"> - Needs to be safe for students - Needs to be collaborative 	<ul style="list-style-type: none"> - Not conducive to learning - Needs to be collaborative - Not clear on how admin fits into the culture - District cultures are different - Parents are part of the culture 	<ul style="list-style-type: none"> - Needs to be safe for students - Needs to have admin support 	<ul style="list-style-type: none"> - Impacted by socio-economics - Not clear on how admin fits into the culture - District cultures are different - Parents are part of the culture
<i>Preparation for Student Teaching</i>		<ul style="list-style-type: none"> - Prepared for content in Grad school 			<ul style="list-style-type: none"> - Prepared in college/grad school 	<ul style="list-style-type: none"> - Prepared for college/grad courses 	<ul style="list-style-type: none"> - Prepared by college or grad school
Methodology	<ul style="list-style-type: none"> - Introduced to a variety of instructional methods but not modeled - Some training in technology 	<ul style="list-style-type: none"> - Introduced to a variety of instructional methods but not modeled 	<ul style="list-style-type: none"> - Introduced to a variety of instructional methods but not modeled 	<ul style="list-style-type: none"> - Some training in technology 	<ul style="list-style-type: none"> - Introduced to a variety of instructional methods but not modeled 		<ul style="list-style-type: none"> - Introduced to a variety of instructional methods but not modeled

Table A continues

<i>Themes Sub-Themes</i>	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
Observed Teaching Practice	<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school 		<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school - No prep on resources 	<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school - No prep on resources 	<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school 	<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school 	<ul style="list-style-type: none"> - Taught and/or observed in middle school or high school
Student Teaching Expectations and Concerns	<ul style="list-style-type: none"> - Build confidence in varied instructional methods - Poor preparation on teaching practice 	<ul style="list-style-type: none"> - Build confidence in varied instructional methods 	<ul style="list-style-type: none"> - Build confidence in varied instructional methods - Time management of lessons 		<ul style="list-style-type: none"> - Time management of lessons 	<ul style="list-style-type: none"> - Poor preparation on teaching practice 	<ul style="list-style-type: none"> - Poor preparation for teaching practice

Table B
Post-student Teaching: Themes, Sub-themes and Categories across Cases

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<i>Perception of Student Teaching Experience</i> Overall	<ul style="list-style-type: none"> - Disappointing - Good relationship with students - Destroyed teaching confidence - Liked working with students 	<ul style="list-style-type: none"> - Disappointing - Unnatural - Good relationship with students - Destroyed teaching confidence - Liked working with students - Disliked paper work 	<ul style="list-style-type: none"> - Good - Good relationship with students - Preferred HS placement 	<ul style="list-style-type: none"> - Good - Good relationship with students - Liked working with the students - Preferred HS placement - Disliked paperwork 	<ul style="list-style-type: none"> - Disappointing - Unnatural - Good relationship with students - Destroyed teaching confidence 	<ul style="list-style-type: none"> - Good - Good relationship with students - Preferred HS placement 	<ul style="list-style-type: none"> - Good - Good relationship with students - Liked working with students - Disliked paperwork
Culture of the Placements	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS) - Isolated, unfriendly faculty (HS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (HS) - Isolated, unfriendly faculty(MS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS/HS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS/HS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS) - Isolated, unfriendly faculty (HS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS/HS) 	<ul style="list-style-type: none"> - Conductive to student learning, supportive (MS)
Opportunity to Teach	<ul style="list-style-type: none"> - With presence of Coop teacher (MS/HS) 	<ul style="list-style-type: none"> - With the presence of Coop teacher (MS/HS) 	<ul style="list-style-type: none"> - With the presence of Coop Teacher (MS/HS) 	<ul style="list-style-type: none"> - With the presence of Coop Teacher (MS/HS) 	<ul style="list-style-type: none"> - With presence of Coop Teacher (MS/HS) 	<ul style="list-style-type: none"> - With the presence of Coop Teacher (MS/HS) 	<ul style="list-style-type: none"> - With the presence of Coop Teacher (MS/HS)

Table B continues

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
Opportunity to Teach (cont'd)	<ul style="list-style-type: none"> - Eased into the program (MS) - Was not able to observe Coop Teacher (HS) - Observed other teachers 	<ul style="list-style-type: none"> - Started off with teaching full schedule day 1 (MS) - Eased into the program (HS) - Was not able to observe Coop Teacher (MS) 	<ul style="list-style-type: none"> - Eased into the program (MS/HS) - Observed other teachers 	<ul style="list-style-type: none"> - Eased into the program (MS/HS) 	<ul style="list-style-type: none"> - Started off with teaching full schedule day 1 (HS) - Eased into the program (MS) - Was not able to observe Coop Teacher (HS) 	<ul style="list-style-type: none"> - Started off with teaching full schedule day 1 (HS) - Eased into the program (MS) 	<ul style="list-style-type: none"> - Started off teaching with full schedule day 1 (MS/HS) - Was not able to observe Coop Teacher (MS/HS) - Observed other teachers
Opportunity to Plan Instruction	<ul style="list-style-type: none"> - Formal lesson plan not required - Referred to Coop teacher's lesson/ packets (MS) - Curriculum shared but not explained by Coop Teacher (MS) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Referred to Coop Teacher's Lessons/packets (MS/HS) - Curriculum shared but not explained by Coop Teacher (HS) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Freedom to plan lessons (MS/HS) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Referred to Coop Teacher's Lessons/packets (MS/HS) - Curriculum shared but not explained by Coop Teacher (HS) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Referred to Coop Teacher's Lessons/packets (MS/HS) - curriculum shared but not explained by Coop Teacher (HS/M) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Freedom in to design instruction - Curriculum shared but not explained by Coop Teacher (HS/MS) 	<ul style="list-style-type: none"> - Formal lesson plan not required - Referred to Coop Teacher's Lessons/packets (MS) - Freedom to design instruction (HS) - Curriculum shared not explained by Coop Teacher (HS/HS)
IEPs/NYSED mathematics standards (stds)	<ul style="list-style-type: none"> - Stds not part of lesson (MS/HS) 	<ul style="list-style-type: none"> - Stds not part of the lesson (HS) 	<ul style="list-style-type: none"> - IEPs/NYS student scores made available (MS/HS) 	<ul style="list-style-type: none"> - Stds not part of lesson (MS/HS) 	<ul style="list-style-type: none"> - Stds not part of lesson (MS/HS) 	<ul style="list-style-type: none"> - Stds not part of the lesson (MS/HS) 	<ul style="list-style-type: none"> - Stds not part of lesson (HS)

Table B continues

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
IEPS/NYSED mathematics standards (stds) (cont'd)	- No student data shared	- No student data shared				- IEPS/NYS student scores made available (MS/HS)	- IEPS/NYS student scores made available (MS/HS)
<i>Coop Teachers' Attributes</i>							
Perceived Relationship	- Good professional relationship (MS) - No professional relationship (MS) - MS first time Coop had ST clarify expectations - MS did not clarify expectations - Berated by coop teacher (HS)	- Good professional relationship (HS) - No professional relationship (MS) - MS did not clarify expectations - Berated by coop teacher (MS)	- Good professional relationship (MS/HS)	- Good professional relationship (MS/HS) - MS first time Coop had ST clarify expectations	- Good professional relationship (MS) - No professional relationship (MS) - Berated by coop teacher(HS)	- Good professional relationship (MS/HS)	- Good professional relationship (MS/HS) - MS open to doing group work - MS supportive
Perceived Cooperating Teacher Teaching Style	- Lecture – Procedural (MS) - Engaged students (MS) - HS not traditional	- Engaged students (HS) - HS not traditional - Compassionate toward students (HS)	- Engaged students (MS/HS) - compassionate toward students (HS/MS)	- Lecture Procedural (MS/HS)	- Lecture Procedural (HS/MS)	- Lecture Procedural (MS)	- Lecture Procedural (HS/MS) - Engaged the students (MS/HS) - Compassionate toward students (MS)

Table B continues

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<i>Impact on Participant's Instructional Decision s</i> Instructional Practices Implemented	<ul style="list-style-type: none"> - Lecture - Cooperative learning game 	<ul style="list-style-type: none"> - Lecture 	<ul style="list-style-type: none"> - Lecture - Cooperative learning game - Constructivist lesson - Exit slips 	<ul style="list-style-type: none"> - Lecture - Cooperative learning game - Hands – on manipulatives - Guided notes (HS) 	<ul style="list-style-type: none"> - Lecture - Technology - Exit slips 	<ul style="list-style-type: none"> - Lecture - Cooperative learning game - Technology 	<ul style="list-style-type: none"> - Lecture - Cooperative learning game - Constructivist lesson - Hands-on manipulatives - Technology - Guided notes (MS/HS)
Instructional Strategies Impeded	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Modifying lessons for students at risk - Homework - Instruction for the block - Hands – on manipulatives 	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Modifying lessons for students at risk - Homework - Instruction for the block - Teaching for understanding 	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Modifying lessons for students at risk - Homework - Hands – on manipulatives 	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Instruction for the block 	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Modifying lessons for students at risk - Homework - Teaching for understanding 	<ul style="list-style-type: none"> - Differentiated instruction not attempted 	<ul style="list-style-type: none"> - Differentiated instruction not attempted - Modifying lessons for students at risk

Table B continues

<i>Themes Sub-Themes</i>	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<i>Perceived Impact on Future Teaching Practice</i> Instructional Practice	<ul style="list-style-type: none"> - Challenge to design instruction for 80 minutes 	<ul style="list-style-type: none"> - Challenge to design instruction for 80 minutes - Curriculum was fragmented and teachers teach to the test 	<ul style="list-style-type: none"> - Challenge to use varied methodologies with at-risk students 	<ul style="list-style-type: none"> - Challenge to design instruction for 80 minutes 	<ul style="list-style-type: none"> - Curriculum was fragmented and teachers teach to the test 	<ul style="list-style-type: none"> - Challenge to design instruction for 80 minutes - Curriculum was fragmented and teachers teach to the test 	<ul style="list-style-type: none"> - Challenge to use varied methodologies with at-risk students
Format for Lesson	<ul style="list-style-type: none"> - Maintain a traditional classroom routine - Not adapting coop teachers style (HS) 	<ul style="list-style-type: none"> - Not lecture - Not adapting coop teachers style (HS/MS) 		<ul style="list-style-type: none"> - Maintain a traditional classroom routine 	<ul style="list-style-type: none"> - Not lecture - Not adapting coop teachers style (HS/MS) - Incorporate more technology 		<ul style="list-style-type: none"> - Not lecture - Not adapting coop teachers style (HS/MS) - Incorporate more technology
Developing Future Lessons	<ul style="list-style-type: none"> - Provide varied assessments - Provide more challenging problems for students at-risk 	<ul style="list-style-type: none"> - Provide a more structured curriculum applied to student interests 	<ul style="list-style-type: none"> - Provide varied assessment - provide more challenging problems for students at-risk 	<ul style="list-style-type: none"> - Integrate textbooks 	<ul style="list-style-type: none"> - Integrate textbooks - Provide varied assessment - provide more challenging problems for students at-risk 	<ul style="list-style-type: none"> - Integrate textbooks - provide a more structured curriculum applied to student interests 	

Table B continues

Themes Sub-Themes	Mary	Ursula	Selma	Mark	Upton	Seth	Ingmar
<p><i>Summary</i></p> <p>Suggestions for Preparation of Pre-service Teachers for Student Teaching</p>	<ul style="list-style-type: none"> - Needs to focus more on pedagogy - Best practice instruction not modeled - More instructional methods for teaching students at risk - Need to learn secondary curriculum and resource - Be confidence building 	<ul style="list-style-type: none"> - Needs to focus more on pedagogy - Best practice instruction not modeled - More instructional methods for teaching students at risk - Need to learn secondary math curriculum and resource - Design student teaching experience so that pedagogical ideas can be implemented - Be confidence building 	<ul style="list-style-type: none"> - More instructional methods for teaching students at risk - Need to learn secondary curriculum and resource 		<ul style="list-style-type: none"> - Best practice instruction not modeled - More instructional methods for teaching students at risk - Design student teaching experience so that pedagogical ideas can be implemented - Be confidence building 	<ul style="list-style-type: none"> - Needs to focus more on pedagogy - Best practice instruction not modeled 	<ul style="list-style-type: none"> - More instructional methods for teaching students at risk