10-7-2008

Effects of an Advanced Mathematics Education Graduate Program on Teacher Practice

Mickey Newman Washburn, Jr.

ACCEPTANCE

This dissertation, EFFECTS OF AN ADVANCED MATHEMATICS EDUCATION GRADUATE PROGRAM ON TEACHER PRACTICE, by MICKEY NEWMAN WASHBURN, JR., was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

_____
Christine D. Thomas, Ph. D.
Committee Chair

_____
Karen A. Schultz, Ph. D.
Committee Member

_____
Steven W. Harmon, Ph. D.
Committee Member

_____
Pier Junor Clarke, Ph. D.
Committee Member

_____
Douglas A. Wagner, Ph. D.
Committee Member

_____
Date

_____
Christine D. Thomas, Ph. D.
Co-Chair, Department of Middle-Secondary Education and Instructional Technology

_____
R. W. Kamphaus, Ph. D.
Dean and Distinguished Research Professor
College of Education

AUTHOR'S STATEMENT

By presenting this dissertation as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this dissertation may be granted by the professor under whose direction it was written, by the College of Education's director of graduate studies and research, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without my written permission.

_____

Mickey Newman Washburn, Jr.

NOTICE TO BORROWERS

All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of the dissertation is:

Mickey Newman Washburn, Jr.
395 Ivy Mill Court
Roswell, GA 30076

The director of this dissertation is:

Dr. Christine Thomas
Department of Middle-Secondary Education and Instructional Technology
College of Education
Georgia State University
Atlanta, GA 30303-3083

VITA

Mickey Newman Washburn, Jr.

ADDRESS: 395 Ivy Mill Court
Roswell, GA 30076

EDUCATION:

Ph. D.	2008	Georgia State University Teaching and Learning
M. Ed.	2000	Georgia State University Mathematics Education
B. S.	1978	University of Alabama Business Administration with Major in Accounting

PROFESSIONAL EXPERIENCE:

2007-Present	Mathematics Teacher Peachtree Ridge High School Suwanee, GA
2003-Present	National Board for Professional Teaching Standards Certification in Adolescent/Young Adult Mathematics.
2000-2007	Mathematics Teacher Parkview High School Lilburn, GA
2002-2006	Graduate Research/Teaching Assistant Georgia State University Atlanta, GA
1998-2000	Mathematics Teacher Dunwoody High School Dunwoody, GA

PRESENTATIONS AND PUBLICATIONS

Schultz, K. A. & Washburn, M. N. (2004). A Prototypic Advanced Mathematics Education Program That Connects Communities of Practitioners and Researchers. A Poster Presentation to the 2004 North American Chapter of International Association of Psychology of Mathematics Education. Toronto.

Schultz, K. A. & Washburn, M. N. (2003). A Talk on National Board Certification and the Role of Higher Education. Presented to the 2003 Georgia Mathematics Conference. Rock Eagle, GA.

Washburn, M. N. (2003). National Board Certification, What Can I Do To Help? A talk presented to Gwinnett Leadership Conference, Athens, GA.

Washburn, M. N. (2003). *Geometry in Real Life*. Reflections, 49(2), p. 14-15.

Washburn, M. N. (2002). Geometry in Real Life. A talk presented to the 2002 Georgia Mathematics Conference. Rock Eagle, GA.

PROFESSIONAL SOCIETIES:

2002-Present National Council of Teachers of Mathematics

2002-Present American Educational Research Association

2002-2006 Georgia Council of Teachers of Mathematics

1998-Present Professional Association of Georgia Educators

ABSTRACT

EFFECTS OF AN ADVANCED MATHEMATICS EDUCATION
GRADUATE PROGRAM ON TEACHER PRACTICE
by
Mickey Newman Washburn, Jr.

Public concern over the mathematical incompetence of students and adults is longstanding and justified. The No Child Left Behind act has affected the nation's teachers, their school systems, and their communities. The act required all classrooms have a "highly-qualified teacher" by June, 2006 (United States Department of Education, 2002). Thus, the purpose of this evaluative case study was to understand if the unique National Board Certification (NBC) focused Educational Specialist (EdS) program was effective in creating change in teacher practice of six high school mathematics teachers in a suburban Georgia county. The learning outcomes of the program and perceptions of self-efficacy were evaluated and used as guidelines for the effectiveness of the program.

The study was grounded in theories of metacognition, social constructivism, and self-efficacy. Metacognition provided the basis for "thinking about thinking" (McApline, Weston, et al, 1999) but reflection expanded the thought process to thinking about thinking or actions. Reflections were an integral for each of the constructs of the EdS program and this dissertation.

Data for the study included written teacher reflections, action research projects, and mentoring manuals; in addition to interviews three years after the program. Data were coded and analyzed through a process of constant comparison using the NVivo 7 software. The findings at each stage of analysis, which were halfway through the program, end of the program, and three years after the program, indicate the five constructs metacognition, social constructivism, self-efficacy, community of learners, and action research were common across data sets. Four of the five constructs became more prevalent at each stage of analysis with only action research peaking prior to the third stage. The patterns developed during the study indicated long-term change in teacher practice and these constructs solidified as part of their teaching philosophy.

EFFECTS OF AN ADVANCED MATHEMATICS EDUCATION GRADUATE PROGRAM ON TEACHER PRACTICE

By

Mickey N. Washburn, Jr.

A Dissertation

Presented in Partial Fulfillment of Requirements for the
Degree of
Doctor of Philosophy
in
Teaching and Learning
in
the Department of Middle-Secondary Education and Instructional Technology
in
the College of Education
Georgia State University

Atlanta, GA
2008

ACKNOWLEDGMENTS

My ability to persevere through the last six years was made possible by my faith in Jesus Christ and the strength that he has given throughout my life.

I owe several people a debt of gratitude. First, I thank Dr. Karen Schultz for her unending patience and support from the very first semester until the present. She has always shown support for my positions and helped me direct and understand the implications of my class work, instruction, and research. I thank Dr. Doug Wagner for continually supporting my work at Georgia State and at Parkview High School and helping me to become the teacher that I am today. Also, I would like to thank Dr. Christine Thomas for supporting me from the very beginning of my doctoral program and for her forcing me to think about research well before it's time. My thanks extend to Dr. Pier Junor Clarke and Dr. Steve Harmon's willingness to participate in this final step.

My thanks to those who gave me their work and time for my research. Without their willingness to do this, I would never have been able to complete my dissertation. Their insights and perceptions led me to make conclusions and recommendations and were setting examples for those around them.

I owe my mother, Mary, a great debt for enduring support in everything I have attempted and who continuously encouraged me to finish.

The final thank you is most important. To my wife, Penny, and children, Nick, Melanie, and Ben, I love you and thank you. Without their love, support, understanding, and occasional push I would never have finished this project. Penny has supported me in everything I have attempted even before we were married. I do not know what I would do without her.

TABLE OF CONTENTS

List of Tables vi

List of Figures vii

Abbreviations viii

Chapter

1 INTRODUCTION 1

Statement of Problem 4

Educational Specialist Degree 6

Purpose of Study 9

Questions 10

Theoretical Framework 11

Brief Overview of Study 17

Significance of Study 19

Summary 19

2 LITERATURE REVIEW 21

Teacher Knowledge 22

Mathematical Content Knowledge 24

Pedagogical Content Knowledge 27

Methods for Improving Teacher Practice 31

Professional Development Programs 32

Graduate Degree Programs 37

Teacher Improvement and Student Achievement 47

Summary 55

3 METHODOLOGY 59

Evaluative Case Study 60

Participants 61

Unit of Analysis 63

Case Study Overview 63

Case Study Protocol 63

Case Study Questions 64

Data Collection Procedures 64

Interview Questions 66

Study Database 67

Chain of Evidence 67

Validity and Reliability 67

Construct Validity 68

Internal Validity 68

External Validity 68

Reliability 69

Data Analysis 69

Researcher Preconceptions 71

Summary 72

4 RESULTS AND DISCUSSION 74

First Data Analysis 79

Metacognition 82

Social Constructivism 102

Community of Learners 112

Self-Efficacy 118

Action Research 125

Second Data Analysis 129

Summary of Change in Teacher Practice 137

5 CONCLUSIONS AND RECOMMENDATIONS 141

Conclusions 143

Limitations 150

Recommendations 150

References 152

Appendix A 162

Appendix B 205

Appendix C 207

Appendix D 239

Appendix E 261

LIST OF TABLES

Table		Page
1	*Participants in EdS program*	62
2	*Construct references versus data sets*	130

Figures

Figure 1.	Nelson and Narens (1990) model of a metacognitive system.	11
Figure 2.	Social constructivist theory (modified).	12
Figure 3.	Self-efficacy (Bandura, 1989; Pajares, 1996).	13
Figure 4.	Action research (Glickman, Gordon, & Ross-Gordon, 2004).	14
Figure 5.	Modified overlapping theoretical frameworks of EdS program.	16
Figure 6.	Reflective teaching model (Hart, Najee-ullah, & Schultz, 2006)	44
Figure 7.	Overlapping conceptual models for program (adapted).	57
Figure 8.	Diagram of data analysis.	76
Figure 9.	Metacognitive references versus data sets	131
Figure 10.	Social constructivist references versus data sets	132
Figure 11.	Community of learners' references versus data sets	133
Figure 12.	Self-efficacy references versus data sets	134
Figure 13.	Action research references versus data sets	135

Abbreviations

NCTM	National Council of Teachers of Mathematics
NBPTS	National Board of Professional Teaching Standards
NAEP	National Assessment of Educational Progress
TIMSS	Third International Mathematics and Science Study
EdS	Educational Specialist Degree
GSU	Georgia State University
NCATE	National Council for Accreditation of Teacher Educators
SES	Socio-Economic Status

Chapter 1

INTRODUCTION

> Public concern about how well U.S. schoolchildren are learning mathematics is abundant and growing. The globalization of markets, the spread of information technologies, and the premium being paid for workforce skills all emphasize the mounting need for proficiency in mathematics. Media reports of inadequate teaching, poorly designed curricula, and low test scores fuel fears that young people are deficient in the mathematical skills demanded by society. (National Research Council, 2001, p. xiii)

Seven years ago, these were the sobering words of Jeremy Kilpatrick taken from his preface to *Adding It Up*, the culminating report of the 16-member Mathematics Learning Study Committee, which reviewed relevant research on pre-kindergarten through grade eight mathematics learning. While the National Research Council's Mathematics Learning Study Committee was concluding its report, the No Child Left Behind Act of 2001 was crafted (becoming law January 8, 2002) and another group of experts was commissioned by the U.S. Department of Education's Office of Educational Research and Improvement to propose an agenda and guidelines for research and development aimed to improve mathematics education. In 2003, this 18-member RAND Mathematics Study Panel, chaired by Deborah Ball, published its report with the following in the opening summary statement.

> The mathematics performance of students and adults in the United States has never been regarded as wholly satisfactory. However, current goals and expectations for mathematics proficiency, as reflected in recent federal legislation such as the No Child Left Behind Act and numerous state policy initiatives, present a new and formidable challenge: Although the educational system has always produced some mathematically proficient individuals, now *every* student

> must be mathematically competent. The ambitious goal of mathematical proficiency for all students is unprecedented, and it places enormous demands on the U.S. educational system. (Ball, 2003, p. xiii)

During the past 30 years, mathematics proficiency of kindergarten through 12th grade students has been drawn into question through studies such as the Third International Mathematics and Science Study (TIMSS) and the National Assessment of Educational Progress (NAEP). These studies have compared results between students in the United States and those in over 40 other industrialized nations. Insight into how teacher actions affect mathematical proficiency students was studied through teacher questionnaires and videotapes of actual classroom teaching. Teacher preparation colleges, universities, school systems, and professional and private organizations have been addressing these results and have established standards and assessments to monitor progress. Based on these test results, progress in mathematical proficiency was indicated in elementary and middle school students, while high school students continue to struggle with mathematical competency.

Researching the inextricable link between teacher practice and student achievement has a long history (Hill, Rowan, & Ball, 2005; Monk, 1994; Vandevoort, Amrein-Beardsley, & Berliner, 2004; Wenglinsky, 2002). Two approaches to these investigations stand out. First was a process product approach which looks at the relationship between teacher behaviors and student achievement (Hill et al., 2005; Lappan, 2000). These studies compared actual teacher behaviors in the classroom with student achievement. These behaviors were measured by teacher questionnaires and correlated with student standardized test results. Content area and teaching methods were not taken into consideration. The second was an education production approach which

compared resources expended by teachers, school systems, and families correlated to student achievement. Data from teachers were teaching degrees, certification levels, number of years teaching, and number of advanced content courses taken and from school systems were number of students in a class, money spent on buildings, books, calculators, and computers. Data also included the socio-economic status (SES) in order to compare the resource expenditures to student achievement on standardized tests. Both the process product and education product studies found that the quantity of resources expended affected the level of student achievement. The first educational production study was the Coleman report or *Equality of Educational Opportunity*. These comparative research approaches revealed significant differences in student achievement based on teacher behaviors and the resources of the teacher, school system, and family, this research did not satisfactorily address how teachers affect student achievement.

Hill et al. (2005) argued for examining the effects of mathematics instructional methods on student performance and to "parse more precisely different theoretically and empirically grounded distinctions in content knowledge for teaching and investigate their relationships, separately and in combination, to student achievement" (p. 401). Pedagogical content knowledge "goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching" (Shulman, 1986, p. 9). Hiebert, Gallimore, and Stigler (2002) had already brought attention to the concept of teachers' craft knowledge, generated through everyday activities and the reflection on those activities. They suggested that in addition to mathematical content knowledge, teachers' responsiveness to knowledge of the student and cultural context also plays a role in student achievement.

This suggested line of inquiry confirms the RAND Mathematics Study Panel's selection of the first two research focus areas for long-term research and development. The first was on developing teachers' mathematical knowledge in ways that were directly useful for teaching and the second was on teaching and learning skills used in mathematical thinking and problem solving (Ball, 2003).

Statement of the Problem

Improving student achievement in mathematics has been one of the driving forces of the professional education community over the past 30 years. Most recently the US Department of Education's No Child Left Behind (NCLB) act defined what a highly qualified teacher is. A highly qualified teachers has an undergraduate major in their teaching field, passed a state approved competency test, completed a national certification program, or met other approved guidelines (US Department of Education, 2006). These highly qualified teachers were to have filled every classroom in the nation by the end of the 2005-2006 school-year. While NCLB allows several options to become a NCLB highly qualified teacher, the National Council of Teachers of Mathematics (NCTM) took a stronger position by stating that mathematics teachers should not only have attained a degree in mathematics to secure content knowledge, they must also be proficient in pedagogical content knowledge enabling them to teach in a highly qualified manner. The NCTM (2005) position statement on what a highly qualified teacher states:

> NCTM expects that high school teachers will have completed mathematics coursework equivalent to that required for a major in mathematics. Middle school teachers should have acquired the depth and proficiency in mathematics equivalent to at least an undergraduate minor in mathematics. Elementary teachers, resource teachers, and all others charged with providing instruction in mathematics should have completed the equivalent of at least three college-level mathematics courses that emphasize the mathematical structures essential to the elementary grades (including number and operations, algebra, geometry, data

> analysis, and probability). Furthermore, all teachers need to know how mathematics is used in interpreting the statements, solutions, and questions of students, using such responses to build future understandings.
>
> All teachers must understand how students learn mathematics. They must know how to plan, conduct, and assess the effectiveness of mathematics lessons and know how and when to make teaching decisions (e.g., listening, modeling, questioning). Highly qualified teachers of mathematics not only understand – but also invest in – the particular culture of their students and school. They are adept at knowing how to actively engage students of diverse backgrounds and strengths in significant and challenging mathematical tasks that help them understand concepts, learn skills, and solve problems. A highly qualified mathematics teacher at any level recognizes the need for, and commits to, lifelong professional learning involving mathematics and its instruction. Overall, the mathematical knowledge, informed actions, positive attitudes, and high expectations of highly qualified mathematics teachers lead to mathematics learning, confidence, and the development of a positive attitude toward mathematics on the part of students. (n.p.)

Ball's (2003) suggested areas of research in mathematics education support the NCTM's position statement. While this position statement supports NCLB, it did not rely on the achievement of a degree or successfully passing a test, but encourages the improvement of teachers in their daily activities.

All teachers must be NCLB highly qualified, not just beginning teachers. Teacher shortages drove many school districts to hire teachers who were not highly qualified and cannot continue in the classroom if they did not attain highly qualified status by meeting at least one of the options in the NCLB act. These shortages generally occur in areas where schools were already under performing and in low SES communities (Darling-Hammond, 2003).

While experienced teachers meeting the NCLB qualifications for highly qualified may not satisfy the NCTM; for student mathematical proficiency to improve, both new and experienced teachers must strengthen their teaching practice. Continuing professional development was a priority to improve teaching practice and through these

ongoing programs, teachers were better prepared to meet the NCTM qualifications (Borko, 2004; NCTM, 2000; Ponte, Ax, Beijaard, & Wubbels, 2004; Renyi, 1996).

Teachers participate in many different forms of professional development including school based staff development, professional organization based, or through higher education programs. Graduate degrees such as the unique Educational Specialist (EdS) that was the unit of study for this study, provided mathematics teachers opportunities to develop through long-term interaction with peers and teacher educators and through specially designed programs that raise teachers' knowledge and practice to a higher level. This long-term contact was essential to implementing change in a teacher's practice.

The vast majority of teachers greeting their students at the beginning of each year were experienced, returning teachers. Although initial teacher preparation programs perpetually raise the bar for new teachers, the burden of improving mathematics proficiency was on the experienced, returning teachers.

Investigating ways to improve teachers' use of mathematical knowledge and the skills they need for mathematical thinking and problem solving was the focus of this study. A cohort of high school teachers in neighboring schools already holding a masters degree found each other while looking for an advanced graduate program that would delivery what they thought would enhance their practice and build leadership skills while meeting requirements for National Board Certification.

Educational Specialist

The teacher cohort selected the EdS advanced graduate program at GSU. These teachers self-determined that they would like to improve their practice for the benefit of

their students and their self-efficacy. This terminal degree "advances educators in their instructional and leadership skills beyond the master's level of competence" (Georgia State University, 2002, p. 184). This program was an applied degree designed to extend skills of experienced teachers and develop applications of these skills into various educational settings. The objectives of the EdS programs were:

1. To develop advanced theoretical and practical knowledge in the areas of human growth and development, foundations of education, curriculum development, classroom practice, and educational measurement.
2. To develop and apply knowledge of theory and research in the areas of supervision and school organization to the development and assessment of staff in-service and supervision.
3. To develop and apply knowledge of research methodology to the assessment of curriculum content and organization and classroom practice.
4. To assist the student in preparation for the National Board for Professional Teaching Standards assessment. (p. 184)

This program, normally provided on-campus with the resources and students of the various colleges would not produce the community of learners in which the cohort was interested.

At the time of the cohort formed, GSU happened to be at the beginning stages of NCATE preparation which included incorporating the NBPTS advanced core propositions and standards in the EdS program. I proposed a plan to the mathematics education coordinator to use a modified EdS program offered off-campus to this cohort, and prepare the teachers to achieve their National Board Certification at the same time as their EdS degree. The EdS program began Fall of 2002 and ended Spring of 2004. During the first year, seven of the nine teachers submitted materials to the NBPTS for certification. One student had previously certified and one chose not to submit his materials. This program was unique in the combination of theory, conceptual models, and experiences that were normally offered and the introduction of the NBPTS

certification program as an additional conceptual model which advanced the core propositions and standards that NCATE encouraged.

The program encompassed four education courses and six mathematics education courses (syllabi in Appendix A). The first four courses were designed to assist teachers in preparation for the NBPTS assessments. These courses constructed knowledge applicable to these assessments by using the Reflective Teaching Model (RTM) (Hart, Najee-ullah, & Schultz, 2004), and the Mathematical Task Analysis (MTA) (Henningsen & Stein, 2002; Stein, Smith, Henningsen, & Silver, 2000). As each course was completed, the students developed new knowledge through the analyses and reflection of their teaching and learned to write about their experiences through description, analysis and reflection as described in the NBPTS certification guidelines (NBPTS, 2005).

Curriculum development, action research, and leadership development constituted the remaining six courses. These courses provided opportunities for the teachers to critically investigate the curriculum they were currently teaching, develop opinions about improvement, and assist in development of methods in which they might become stronger leaders in their departments, schools, and district. While each of these courses provided insight into advancement of teaching and leadership skills, they also provided the students the opportunity to reflect and assess their personal positions and opinions of their teaching, school, curriculum, and their affect on student achievement.

Each course was developed under the guidelines of the National Council for Accreditation of Teacher Education (NCATE) which uses the NBPTS core propositions and standards for their foundation. These propositions, listed in the following, were key to teacher education.

Proposition 1. Teachers are committed to students and learning.
Proposition 2. Teachers know the subjects they teach and how to teach those subjects to students.
Proposition 3. Teachers are responsible for managing and monitoring student learning.
Proposition 4. Teachers think systematically about their practice and learn from experience.
Proposition 5. Teachers are members of learning communities. (NBPTS, 1989, n.p.)

Propositions 1 and 3 described the way teachers must know the psychology and learning theories appropriate for their students while Proposition 2 described the content knowledge and pedagogical content knowledge that each teacher must possess. Proposition 4 described the methods that teachers reflect on their teaching and learns from their experiences which were essentially a form of action research (Glickman et al., 2004; Gratton, 2003; Lubienski, 2000; Obrien, 1998 ; Ponte et al., 2004) to increase student achievement. And Proposition 5 described teachers working together to better themselves to increase their effectiveness. Each of these propositions was foundational to the EdS program and provided the basis for the design of all other activities and experiences in the program.

Purpose of Study

The purpose of this study was to investigate the effect of the uniquely designed EdS program to develop "teacher's mathematical knowledge in ways that are directly useful for teaching" (Ball, 2003, p. xv) and "teaching and learning skills associated with mathematical thinking and problems solving" (p. xv). The research identified which activities and experiences based on program objectives effected change in teacher practice and how these changes affected teacher pedagogical content knowledge and student achievement (Hill et al., 2005).

A second interest was to contribute research in graduate education as a method to improve teacher practice to the body of knowledge. Most research in improving teacher practice was in the context of initial mathematics teacher preparation or in-service staff development but little done in the advanced graduate degree level (Tzur, 2001). The present study considered how teaching and learning might be affected through an EdS degree in mathematics education.

Questions

Ball (2003) encouraged future research to address ways mathematical knowledge might be used in teaching and teaching and learning skills as they apply to mathematical thinking and problem solving. The EdS program objectives were grounded in the standards and propositions of NCATE, NBPTS, and the NCTM which provided frameworks, conceptual models, and methodologies to guide the learning outcomes that the teachers wanted to experience. This research studied how the experiences and activities based on program learning objectives affected teaching and how they continue affecting the teachers' practice. The questions were:

1. How did the teacher learning outcomes affect participants' practice during the program?
2. How are the changes in the teacher practices related to their learning outcomes evident one year later? Two years later?
3. What form of continuing improvement is still used? Why and how is this form continuing to affect teachers' practice?
4. The participants attained NBPTS certification during the program. What level of teaching is demonstrated today and does it meet the NBPTS or the NCTM position on highly-qualified teaching? What evidence supports this level of teaching? What program learning outcomes are present in this evidence?

These questions assisted in determining if the EdS program improved the teacher's practice or not and if they continued to change after the life of the program. This study provided data and suggestions to teacher educators on the effects of this unique EdS

cohort program on these nine secondary mathematics teachers. Conclusions reached might suggest further areas of study and methods to improve effectiveness of future programs.

Theoretical Framework

Metacognition and the social constructivist learning theories framed this study. These theories helped explain how teachers learn to teach mathematics as well as how they executed that teaching. The theory of self-efficacy made it possible to evaluate how teachers felt about their teaching and their students' achievement. Self-efficacy allowed this research to focus through the eyes of the teachers and on what they deem was the value of the program. These theories provided a critical lens to view the data and draw conclusions at the end of the study.

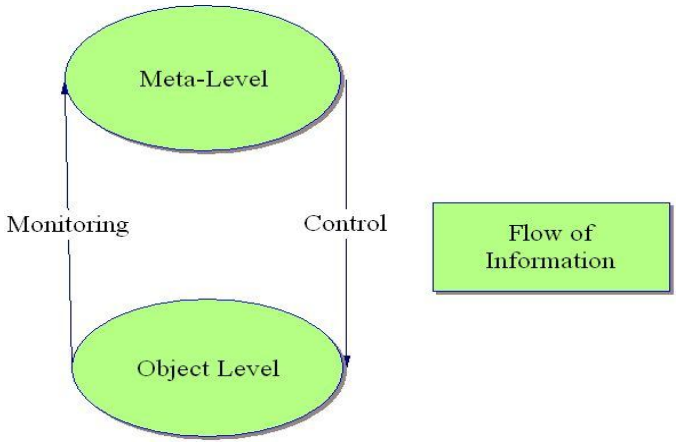

Figure 1. Nelson and Narens (1990) model of a metacognitive system.

Metacognition was cognition about cognition (Flavell, 2004). Baird (1994) described it as knowledge about learning, and awareness of and control over personal learning practices which impacts teacher education. In Wilson and Clarke's (2002) work,

metacognition was an “awareness individuals have of their own thinking; their evaluation of that thinking; and their regulation of that thinking” (p. 4) which builds a model of the theory. Metacognition and reflection were similar in most respects. Nelson and Narens (1990) proposed the model in Figure 1 above to understand the control and monitoring function of the meta-level. Metacognition was the “thinking about thinking” or the “learning about learning,” while reflection was not as limited. Reflection was evaluative thought about anything from the lesson taught to the route taken to work or school today. Reflection occurred during evaluation of a process, object, or thoughts.

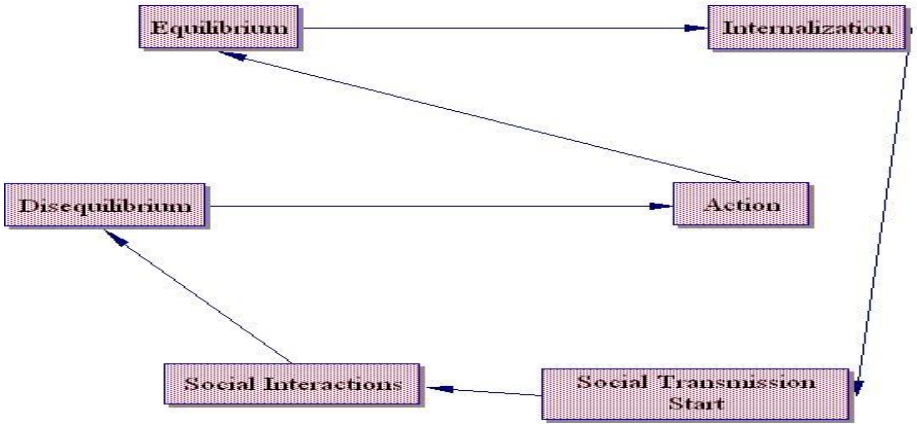

Figure 2. Social constructivist theory (modified).

Constructivism was the theory that the mind is active in the construction of knowledge (Schwandt, 2001). In Figure 2, a modification of the cyclical nature of social constructivism was presented. Constructivism has two polarizing views. The first view was radical constructivism in which all knowledge was believed to be constructed by the person with no environmental or social effects. Social constructivism constructs knowledge through the social interactions with other people or the environment. Tzur

(2001) developed a conceptual framework from the works of Dewey, Piaget, and Schöen where reflection was central to social constructivism:

> I am aware that the term social constructivism was not used at the time of Dewey and Piaget. However, I consider their work as social constructivist for two reasons: (a) the centrality of social interactions to the very process of reflection and (b) the rejection of a positivistic view of the mind and epistemological emphasis on the role of human experience in the formation of knowledge. (p. 261)

This statement built a convergence of social constructivism and reflection or metacognition, explaining how the theories were inextricably connected. These connected theories constructed the theoretical framework for the EdS program's learning outcomes however they did not provide a complete picture for this study. Understanding the teachers' disposition was necessary to draw conclusions from their experiences during the program and since. The theory of self-efficacy guided this study in understanding secondary mathematics teacher dispositions and was presented in Figure 3.

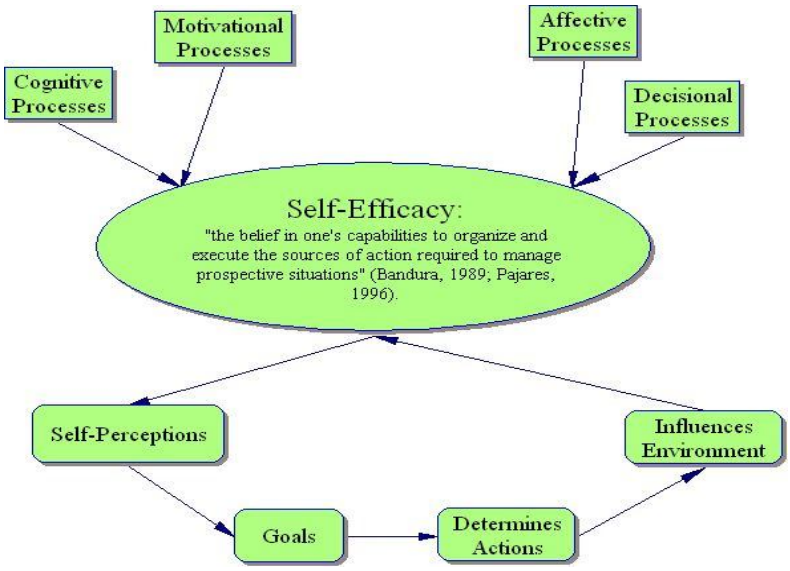

Figure 3. Self-efficacy (Bandura, 1989; Pajares, 1996).

Self-efficacy was "the belief in one's capabilities to organize and execute the sources of action required to manage prospective situations" (Bandura, 1989; Pajares,

1996). Self-efficacy beliefs regulate human functioning through cognitive, motivational, affective, and decisional processes (Bandura & Locke, 2003). Knowledge, skill, and prior attainments were often poor predictors of subsequent attainments because the beliefs that individuals hold about their abilities and about the outcome of their efforts powerfully influence the ways in which they behave (Pajares, 1996). The motivation process was driven by self-perceptions of people's capability, which determines their goals and control over their actions and their influence on the environment. Humans were proactive and self-regulating (Pajares, 2002).

In the EdS program's final semester, the participants used Bandura's theory (1989) of self-efficacy to guide an action research plan to manage future situations while mentoring teachers. Action research provided a methodology to investigate and solve a problem.

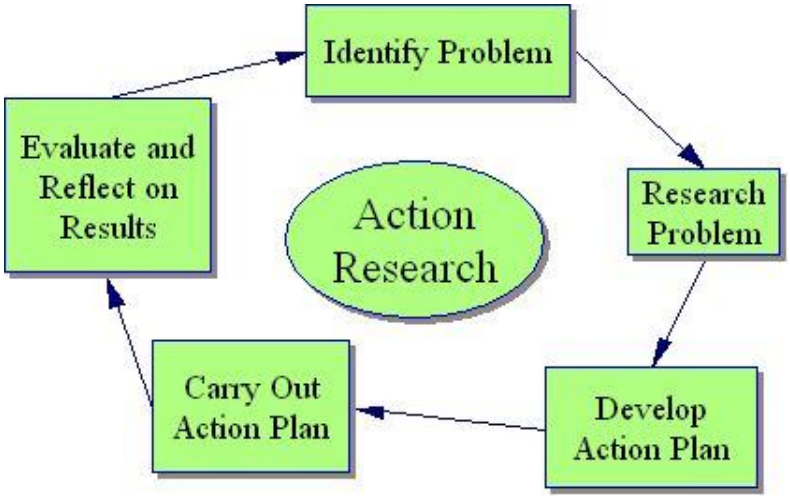

Figure 4. Action research (Glickman, Gordon, & Ross-Gordon, 2004).

Glickman, Gordon, and Ross-Gordon (2004) prepared the cyclical model of action research seen above. Once the teacher understood the problem someone they were

mentoring had, they would cooperatively research the problem, develop action plans to solve the problem, initiate the plan and then evaluate the results of the action plan. After evaluation of the results, a cooperative reflection of success and what future actions, if any, were needed. This final assignment brought together all theories and conceptual frameworks of the program through a leadership project to mentor others in the future.

This study endeavored to determine how the learning objective based activities and experiences of the EdS program affected teacher practice and how these changes affected student achievement. Primary affects investigated will be the methods of using mathematical knowledge in teaching and teaching and learning skills in mathematical thinking and problems solving. Each theory provided essential but overlapping concepts which enabled a theory based analysis of data. Teachers' reflective practices mediated between knowledge and action to construct new knowledge and create the changes. While metacognition was best described for this study as knowledge about learning and an awareness and control over our personal learning practices (Baird, 1994), this theory constructed the concept of people being responsible and managing their own learning practices. This concept also based learning on their current knowledge and experiences. As learning and experiences occurred through the social environment, the person's current base of knowledge was altered by accepting the new information and scaffolding, tying past and present experiences into a connected base of knowledge (Carlson, 1999; Cobb & Yackel, 1996; Nyikos & Hashimoto, 1997). This building or constructing of new knowledge from our learning experiences in the world was the social constructivist learning theory. Again, people were in charge of their learning through acceptance or rejection of new information and experiences with which they could construct

knowledge. Finally, self-efficacy mediated between knowledge and action. This process of self-referent thought continued the same concept of metacognition and social constructivism by placing the individual in the center of the learning process. As the individuals learned new information or had a new experience, they reflected and either accepted or rejected this information or experience. If accepted, they constructed a new level of knowledge, scaffold on top of the present knowledge

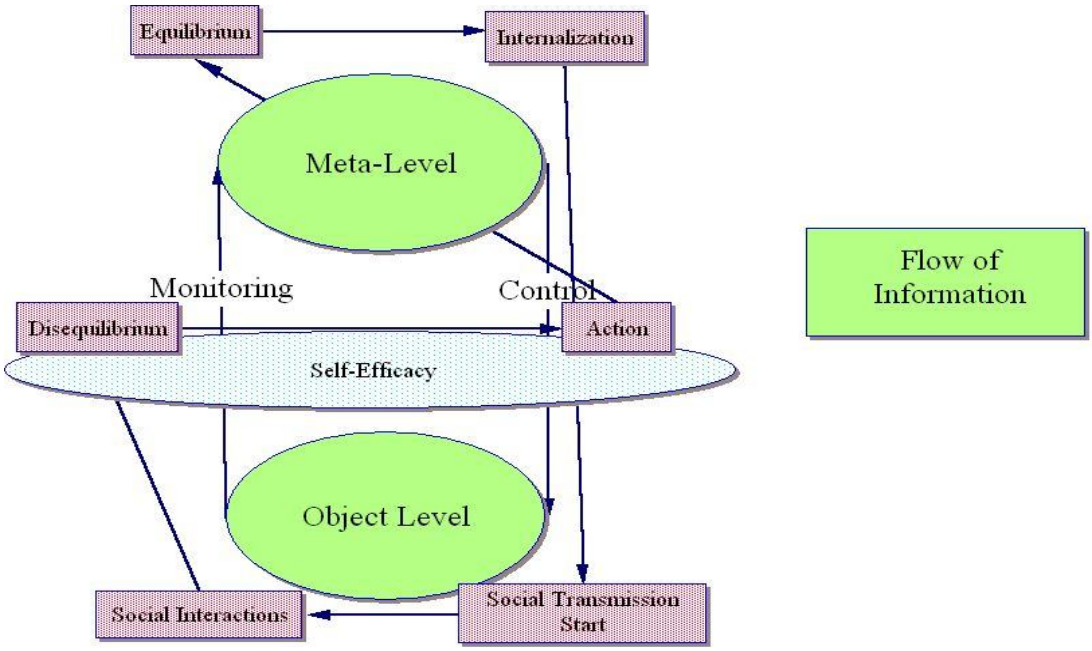

Figure 5. Modified overlapping theoretical frameworks of EdS program.

base. The individual then used this new knowledge base to guide actions. The EdS program provided a long-term development experience for the teachers which were theoretically based on accepted theories of learning and development in mathematics. Figure 5 above presents a graphical representation of the overlapping theories of the EdS program. These theories constructed additions to knowledge and methods of monitoring

and control over personal actions and learning. If these theories and methods instigated change in teaching then they were successful.

Brief Overview of Study

This research was a case study with the unit of analysis as the EdS degree. A case study approach was appropriate when evaluation must be performed and an understanding of the dynamics was needed due to a lack of indicators of programmatic success. In the case study, thick, rich descriptions were developed which provided a common language approach to evaluation (Merriam, 1998).

This single case study had six embedded units [the participants] that were the data sources. Instrumentation was from documentation, archival sources and interviews. Documentary evidence takes many forms and relevant to almost all case studies. Archival data were in existence prior to the beginning of this study and like documentation were relevant to case studies especially in corroborating other data. The participants of this study were the secondary mathematics teachers who participated in the EdS degree program that focused on the NBPTS certification. These teachers had between five and 23 years experience in the classroom at the beginning of the program. Three men and six women, ranged in age from 28 to 56 were to be included. Two women were Black and the remainder Caucasian. All participants had previously completed a Masters degree, with four in mathematics and five in mathematics education.

Each participant completed the EdS degree program and taught full-time. In addition, seven of the nine completed the National Board Certification (NBC) during this process. One had previously completed her certification and one chose not to submit materials for certification.

The case study questions as discussed in a previous section guided the study and provided a basis from which to expand. Data collection requests were made after Institutional Review Board approval and consent forms had been completed. Each participant was sent a request for specific archival data and was asked to review these sources prior to the interview. An interview was scheduled at their convenience and choice of location. The interview was semi-structured based on the case study questions but varied based on emergent themes in each interview. A chain of evidence and a study database was developed to assist in analysis and future study (Creswell, 2003a; Merriam, 1998; Yin, 2003). During collection and analysis of data, constant comparison and contrast were used to indicate convergence. Validity was increased by member checking where participants read a draft copy of the results.

The archival data included peer observation descriptions, written reflections, and journal entries which were recorded at various points in time. This strengthened the validity of the conclusions through triangulation (Creswell, 2003a; Merriam, 1998; Yin, 2003). The interviews, which made up new data, investigated current attitudes, dispositions, and practices as an extension of the archival data. Generation of triangulation occurred from use of multiple theories which were metacognition, social constructivism and self-efficacy. Views of the data from each theoretical perspective provided a convergence of conclusions. Analysis of the data included pattern matching between the embedded units, which was a form of cross case analysis and time series analysis for changes across time and explanation building (Creswell, 2003a; Yin, 2003). This analysis looked for causal links, explored rival explanations, and traced changes in patterns over time.

Significance of Study

With the ongoing efforts to improve student achievement in the United States, this study provided additional research into the effects of continuing professional development through advanced graduate degrees and how these programs affected in-service teachers. While the study investigated teaching and learning in the mathematics classroom, the theories may have application to other content areas. In addition, there has been little research done on advanced graduate degrees affects on teaching and learning of in-service teachers and therefore provided ample areas for future research. This study was intended to provide research in the areas of teaching and learning, effects of advanced graduate degrees, and effects of conceptual models in teaching and learning of mathematics in secondary schools.

Summary

Improvement of the mathematical proficiency of students was of primary concern and the organizations that have identified methods to accomplish this were diverse and many times confrontational. Student success in mathematics was affected by numerous inputs, including socioeconomic status, the school system, the teachers, the family and their self-efficacy; this study focused on one part of this cultural equation, which was the teacher. Even though teachers had met all the requirements to be highly qualified, the NCTM believes that teachers must not only reach this level, but must continue highly qualified teaching. This highly qualified teaching through improvement in teacher practice was the focus of the advanced graduate degree program and its learning objectives. The study was an evaluative case study of the program and centered on the

learning objectives and the outcomes the teacher/participants experienced and if those outcomes were still affecting teacher practice today, almost thirty months later.

Chapter 2

LITERATURE REVIEW

This topic of this study was to investigate methods to develop "teacher's mathematical knowledge in ways that are directly useful for teaching" (Ball, 2003, p. xv) and "teaching and learning skills associated with mathematical thinking and problems solving" (p. xv). The research identified which activities and experiences of the EdS program objectives effected change in teacher practice and how these changes affected teacher pedagogical content knowledge and student achievement (Hill et al., 2005). Federal and state legislation, professional organizations and every school district in the nation has attempted to improve teacher practice for many years. Improving all teachers was the ultimate goal; however, experienced teachers make up the majority of the teacher workforce with 83% of the 2,870,000 teachers remaining in the same school (NCES, 2005). Of the 17% or 580,000 teachers who were new hires in 1999-2000, the last year with published data, only 4% or about 136,000 were brand new teachers. In other words, in the 1999-2000 school year, 83% of teachers stayed at the same school, 13% changed schools or were returning to the classroom, and 4% were new teachers. Figures for 2006 were estimated to be more than 150,000 new teachers (Hussar, 1999).

Since the new teacher population was relatively small, creation of a substantial improvement in student success falls on improving already practicing teachers. The basic method to improve experienced teachers was through professional development.

Experienced teachers have two primary choices to improving their practice. First was through staff development which is organized, initiated, and mandated through schools, districts or professional organizations. The second was through graduate degrees voluntarily sought. The self-motivated, experienced teachers applying for an EdS degree were the focus of this study.

This review of literature followed the premise that improving the ways mathematical knowledge was used in teaching and improving the skills of teaching and learning for problem solving and mathematical thinking advanced secondary mathematics teachers and improved student mathematics achievement (Ball, 2003; Koency & Swanson, 2000; Stigler & Hiebert, 1999). I analyzed and synthesized past research on what teachers need to know, successful methods to develop these domains of knowledge, and how these domains affect student achievement. My foci of the review built a basis for this study in terms of both effectiveness with student achievement and lack of other research in advanced graduate programs of mathematics education. The review was limited to literature primarily concerning secondary mathematics education; however other literature when appropriate was included. I divided this review into three areas, teacher knowledge, methods for improving teacher knowledge, and teacher improvement and student achievement.

Teacher Knowledge

Teachers facilitate student construction of mathematics proficiency in terms of knowledge, disposition, and attitude. In order for teachers to accomplish this task, they must have acquired the necessary knowledge and skill to accomplish the task. There were three domains of knowledge that were necessary. First was mathematical content

knowledge, second was pedagogical knowledge, and third was pedagogical content knowledge (Cooney, 1999; Harel, 1994; Harel & Lim, 2004; Hiebert, Gallimore, & Stigler, 2002; Hill, Schilling, & Ball, 2004). Lappan (2000) divided this knowledge into 12 domains, but they could easily be grouped into the same three.

This study did not focus on pedagogical knowledge in its broad sense, but the pedagogical knowledge that was required to teach secondary mathematics. A clear, concise understanding of general pedagogical knowledge helped the understanding of pedagogical content knowledge. NCTM (2000) says that teachers should know how students learn and be familiar with tools, materials, and techniques to use in their teaching and how to organize and manage the classroom. The NBPTS developed standards for multiple content areas and as these standards were aligned, several common elements emerged (Darling-Hammond, Wise, & Klein, 1995). These elements led to the establishment five core propositions which represent their position on pedagogical knowledge across all content areas which are:

1. Teachers are committed to students and learning,
2. Teachers know the subjects they teach and how to teach those subjects to students,
3. Teachers are responsible for managing and monitoring student learning,
4. Teachers think systematically about their practice and learn from experience,
5. Teachers are members of learning communities (NBPTS, 1989).

Each proposition identified specific responsibilities of the highly qualified teacher and was succinct. These propositions encompassed a large quantity of teacher knowledge and skill but were not subject matter or student level dependent. While pedagogical knowledge was necessary for all teachers, the need for more specific knowledge and skills must be expected for every teacher. Mathematical content knowledge and

pedagogical content knowledge for mathematics education of students in secondary schools was of primary interest in this research. These types of knowledge were shown to be significant to effectiveness of secondary mathematics teachers in the following sections.

Mathematical Content Knowledge

Mathematical content knowledge provides the teacher with sufficient knowledge to understand the material they must teach along with its connections to other mathematical topics, ability to solve problems, and ways of critical thinking (Lappan, 2000). Teachers must have assimilated the knowledge they require to understand and connect the various strands of mathematics and connect it to other fields and eventually to the real world (NCTM, 2000). This knowledge came from many different places, but primarily through the university classroom setting. In the NCTM (2005) position statement, the standard set for secondary mathematics teachers was to have achieved the equivalent of an undergraduate degree in mathematics. At this level, the teacher would have taken over 19 mathematics classes (GSU, 2006). While content knowledge was specific to one subject, it must also be viewed in a broad context, producing connections between its various strands and to other subject areas.

NCTM believes that all high school mathematics teachers should have completed substantial mathematical content courses. In 1994, Monk's research used data from the Longitudinal Study of American Youth (LSAY) collected over a three year period from 1989-1991. He tied the LSAY data to teacher survey data including types and numbers of courses taken in their teacher preparation program, degree, and experience. Data were developed from 51 randomly selected localities across the nation with 60 tenth grade

students per local originally selected. In total there were 2,829 students in the data sample and surveys were completed by students, teachers, and parents. This research indicated the first five undergraduate mathematics courses make a significant difference in student test scores of approximately 1.2% while the remaining courses taken do not make a significant difference. His research did find that every mathematics education course taken by the pre-service teacher did increase student test scores by an equivalent 1.2%. Further, Monk found that teacher degrees, experience, and credit hours do not provide any impact on student success.

Over 100,000 students in grades four, seven, and ten where each was administered mathematical and psychological tests each fall and spring from 1962-1967 (Begle, 1979). In addition, data from teachers, schools, and communities were gathered and results showed no correlation between being a teacher with a mathematics major and student success. Disaggregated data found 15% of the subjects showed a negative correlation between the number of mathematics courses taken and student success and that 20% of the subjects exhibited a positive correlation between a mathematics major and student success.

Sixteen years later, a meta-analysis done by Darling-Hammond, Wise, and Klein (1995) found there was higher positive correlation between education courses than subject area courses to teacher performance. Their findings indicated the importance of knowledge of subject-specific pedagogy especially knowledge about students increases teacher effectiveness. Darling-Hammond et al. indicated that fully prepared teachers were more effective and their students learn more than teachers through many alternative methods and “greater preparation in child development, learning theory, curriculum

development, and teacher methods had a stronger influence on teacher effectiveness than does additional subject-matter preparation" (p. 27).

While these studies indicated no correlation between mathematical knowledge as measured by tests and courses taken to student success, the NAEP research in 1996 indicated that there was a positive correlation between eighth grade student achievement and teachers having majored in math. This indication was in contrast to the studies conducted by Begle and Monk. However, this study did not look at mathematics education courses and their effect on student success as Monk's study did. Fourth grade students whose teachers majored in mathematics education or education outperformed those whose teachers majored in other fields (National Research Council, 2001).

Several production function studies, as discussed in Chapter 1, have shown that there was a positive correlation between certification exams or subject-matter tests and student success (Hill et al., 2005). According to Hill et al. there were several problems in these studies including an inability to describe how this content knowledge related to student achievement and the limited ability to define and measure teacher knowledge as it relates to student achievement. "Measuring quality teachers through performance on tests of basic verbal or mathematics ability may overlook key elements in what produces quality teaching" (p. 375). This statement would seem to hold true for all content areas and grades. These results were limited to elementary schools; however they did find a positive correlation between teacher's mathematical knowledge and student gains. There were not consistent gains across all years studied; however some years were significant while others were not. Hill et al's study measured mathematical knowledge for teaching

not just content knowledge and found that “this task-sensitive measure is positively related to student achievement” (p. 399).

These research reports showed that while mathematical content knowledge was necessary, the effect of a major in mathematics was small (Begle, 1979; Darling-Hammond et al., 1995; Monk, 1994). At the same time, the effects of educational courses that discuss instructional pedagogy were positive but not significant. The courses that combined these two areas into pedagogical content knowledge had the greatest impact on student success (Hill et al., 2005), and were termed mathematics education courses. The National Center for Research in Teacher Education (NCRTE) (1991) concluded that teachers need subject focus but simply requiring a major in the subject will be ineffective in improving teacher performance. Each of these studies found that knowledge of mathematics was important; they also conclude that education courses focused on mathematics had a larger impact on the teacher and therefore student achievement.

This study looked at the effects of an EdS program on a cohort of self-motivated teachers’ practice and student achievement. It was interesting to note that the program included no pure mathematics courses while it did include six mathematics education courses and four education courses.

Pedagogical Content Knowledge

This concept of pedagogical content knowledge was first presented by Shulman (1986) which he proposed “goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching” (p. 9)). Shulman suggested looking

at the teacher knowledge base in three domains, content knowledge, pedagogical content knowledge and curriculum knowledge.

Since this introduction of pedagogical content knowledge, a variety of research in multiple disciplines has shown its importance for teaching. Additional researchers have attempted to organize teacher knowledge in other ways but it seems that each has included pedagogical content knowledge either as one domain of knowledge or divided into parts. Grossman (1990) included four: subject-matter knowledge, general pedagogical knowledge, pedagogical content knowledge, and knowledge of context. Ball (1990) focused on two distinct areas: the ability of the teacher to execute an operation and the ability to effectively represent that operation to students.

A Model of Pedagogical Reasoning was developed by Shulman which described a cycle that teachers should complete for improving teaching (Intime, 1999). The cycle activities included comprehension, transformation, instruction, evaluation, reflection, and new comprehension. This model for pedagogical reasoning resembled the steps of the conceptual models used as learning objectives in the advanced graduate degree this study focused on and also resembled action research, also a part of the degree program. Shulman's model may have been an overarching framework for all the conceptual models and research methodology to fit within. Teachers learn best by studying, doing, and reflecting, by collaborating with others, and by looking closely at students work and sharing what they see. But this kind of learning cannot occur in college classrooms without practice in school classrooms nor can it be in school classrooms divorced from knowledge of interpreting practice that comes from college classrooms (Intime). This

ability to associate practice and knowledge allowed teachers to improve through this interwoven process of college classroom and school classrooms.

Attempts to measure pedagogical content knowledge of mathematics teachers led to the development of a survey instrument (Hill, Schilling, and Ball, 2004). The surveys were given to teachers attending the California Mathematical Professional Development Institutes and focused on elementary teachers. Results indicated that knowledge for teaching does span both content knowledge and pedagogical content knowledge (Hill et al.). All teachers attending, not just expert teachers were subjects and the teachers were not randomly selected. The results may be limited to generalization to typical elementary teachers. However, they also lend themselves to applications with secondary teachers.

Craft or practitioner knowledge was generated through teachers' everyday activities and the reflection on those activities (Hiebert, Gallimore, and Ball, 2004). This type of knowledge was specific to the setting in terms of content, level of students, socioeconomic and cultural position which is pedagogical content knowledge. Craft knowledge was very personal and not easily made public which led to the solitary professional life of a teacher. Allowing a collaborative process to take place, teacher knowledge was linked to practice through the problems it was motivated to solve and that each piece of new knowledge was connected to teaching and learning that actually occur. Hiebert et al believed that this craft knowledge was different from professional knowledge in that professional knowledge was developed through more scientific procedures and therefore generalizable while craft knowledge was based on the practice of teaching students in specific situations which was not easily generalizable. The work of Hiebert et al demonstrates that practitioner knowledge was more individual and not as

easily generalizable, this research attempted to show how professional knowledge affects teachers' craft knowledge and how this craft knowledge can help through case study to develop professional knowledge.

Student teachers were not comfortable integrating mathematics and science instruction due to insufficient coursework in teacher preparation programs (Frykholm and Glasson, 2005). As these student teachers "collaborated, shared ideas, and helped each other with fundamental concepts and procedures", their deficiencies in concept knowledge and their uncomfortable feelings were reduced. This study developed the concept that collaborations between student teachers increased their pedagogical content knowledge and made them more comfortable in teaching in the specific situations they faced. These collaborations may offer insight into methods to improve pedagogical content knowledge which was the center of the learning objectives of the EdS degree that was the focus of this study.

Pedagogical content knowledge may not help teachers to follow the standards in mathematics and teach based on reform ideals (Kinach, 2000). Teachers must first change from an "instrumental" to a "relational" understanding of teaching in mathematics which was the move from algorithmic to problem solving. After pre-service teachers embraced the reform methods of teaching, they were prepared to develop a reform pedagogical content knowledge. Kinach implied that changes in pedagogical content knowledge may also lead to changes in subject matter knowledge and understanding. These conclusions developed implications on how graduate students may be challenged to develop a relational or reform pedagogical content knowledge.

To summarize teacher knowledge, while the largest professional body, NCTM's, position was that all high school mathematics teachers should have the equivalent of an undergraduate degree in mathematics, there were opposing views. Much of the research does not indicate the degree leads to increased student achievement, but some content knowledge in mathematics was necessary. In fact, the research indicates that mathematics education courses which develop that content specific pedagogy, referred to as pedagogical content knowledge, have a larger impact on student achievement than mathematics courses. The more mathematics education courses taken, the larger the affect, while mathematics courses reach a point of diminishing returns (Begle, 1979; L. Darling-Hammond, D. J. Holtzman, S. J. Gatlin, & J. V. Heilig, 2005b; Darling-Hammond et al., 1995; Grossman, 1990; Harel, 1994; Harel & Lim, 2004; Hill et al., 2005; Koency & Swanson, 2000; Lappan, 2000; Monk, 1994; NCRTE, 1991; Stigler & Hiebert, 1999). This research indicated that the most effective method to increase student achievement was through increased mathematics education courses once a basic level of mathematics understanding had been achieved.

Methods of Improving Teacher Practice

The second focus of this literature review will be on successful methods for improving teacher practice. There were three basic methods of improving teacher practice. Improving teacher preparation was a method that affects a very small portion of the teacher population in the United States each year. It was expected that about 150,000 new teachers were hired in 2006 out of the almost 2,900,000 teachers. This small percent of novice teachers indicates that improving experienced teachers affect more students. Professional development provided two methods to improve experienced teachers which

were staff development and graduate degrees. NCLB of 2001 requires that all teachers have high quality professional development available (Borko, 2004; US Department of Education, 2006). This section of the review of literature looked at effects of staff development programs and graduate degree programs and their implications for improving teacher practice. This research focused on advanced graduate degree programs effecting teachers who have previously attained a masters degree, but the literature on professional development and all graduate degrees provided insight into and basis for this study.

Professional Development Programs

Subject-specific staff development was vital to the improvement of teacher practice (interview with Shulman, Sparks, 1992). While generic staff-development had been popular, it was incomplete because of its inability to develop pedagogy in terms of specific content. This subject-specific development was even more important since there was "much less broad transfer and geralizability from one domain to another" (Sparks, p. 1). In this interview, Shulman also described the use of case studies in teaching teachers. The use of cases leads to questions that generate action and reflection on teachers' own situations. The case study methodology for this research also led to reflection and action on the efficacy of the program.

Improvement in mathematics achievement occur due to changes in the quality of teaching but this change was difficult (Koency & Swanson, 2000). Changes occurred when teachers escape from the traditional style of teaching and it takes time to alter perceptions of mathematics teaching. Proposed teacher leaders were needed to "drive new approaches to teaching mathematics" (p. 11) but must be expert teachers supported

to become leaders. The key to the development of teacher leaders was collaboration which integrates pedagogical skills and content knowledge.

The Quantitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) study suggested that collaboration through professional learning communities was essential to teacher change and student learning (Borko, 2004). The second finding came from Borko's STAAR project to form professional learning communities which created discussions in the community meetings and lessons were planned, implemented, and videotaped. The videotapes were reviewed and discussed in subsequent community meetings. While analysis was not complete at the time of publication, participant comments indicated that "peer collaboration and mathematical conversations played crucial roles in their evolving understanding" (Koellner-Clark & Borko, 2004). These projects focused on middle school teachers, but their application to secondary schools was evident. The QUASAR project results were an integral part of the EdS program that was the focus of this research. While the STAAR project was not used as a basis for the advanced program, the same concepts of professional learning communities and videotaping of classroom activities were integral.

The Enhancing Mathematics in Elementary School (EMES) project was structured through a holistic constructivist framework and was sensitive to the objectives of increasing participants' knowledge of mathematical content in models of standards-based practice, familiarity with national and state teaching standards, awareness of issues in diversity and equity, enhanced problems-solving, critical thinking and mathematical communication skills, participant support in assimilation and application of new knowledge and support in collaboration and networking (Farmer, Gerretson, & Lassak,

2003). The project involved a group of elementary mathematics teachers, but research was conducted through three case studies of teachers who were participants in the whole project. The results from the case studies indicated "opportunities for discussion, journaling and reflective writing, centered on mathematical ideas and issues of pedagogy, allowed teachers to construct mathematical and professional meanings for themselves from the project activities" (p. 357). The final part of the project was for each teacher to plan implementation of their new knowledge from the project. This implementation was designed by the teacher to meet their own needs. The implications of the EMES project was that professional development should be longitudinal, collaborative, content and context specific, and individually oriented to allow each participant to develop personally. This project was conducted with elementary teachers of mathematics and therefore was limited in application to the secondary mathematics teachers involved in the advanced graduate degree that was the focus of this study but the implications from the research does strengthen the basis for cohorts that were content and context specific and were longitudinal and collaborative.

A survey of 800 teachers in 1996 by the National Educators Association Foundation developed why teachers attend professional development and what types of development they deem most productive (Renyi, 1996). Teachers attend professional development primarily to improve student achievement (73 percent) and improve teaching skills (55 percent). This research found for both experienced and beginning teachers that "sustained, in-depth teacher learning connects directly with student results" (n.p.).

A model of teachers' knowledge base suggested three critical knowledge components, content, student epistemology, and pedagogy (Harel & Lim, 2004). The subjects for the research were mathematics teachers in a public middle/high school serving low-income students with an intensive college preparatory education. This was a qualitative study over a two-year, on-site professional development project. One class was observed at least once per week and the teacher was then debriefed on the goals for and reflections of the lesson. Harel and Lim suggested that changes in teachers practice will not occur in short time frames and must focus on all three components for the professional development.

Teacher education should be a continuous, career-long process (National Research Council, 2001). One method the council identified was inquiry in the classroom. Classroom inquiry was designed as a long-term continuing growth experience which was a vital part of effective professional development. This process helps teachers to continue to grow in knowledge, conceptions and practice through inquiry in their own classroom (Borko, 2004). This inquiry was placed in the context of their classroom where teachers were familiar with the artifacts that were used and produced. This method provided continuous professional development of the teachers' practice and contextual teacher education through personal research in their classroom on their students. This methodology was often called action research which was an integral part of the EdS program and the capstone portfolio and paper required for completion.

The process of discourse as related in the NCTM standards was the interaction between teacher and students. Discourse and the reflection that can accompany discourse provided the framework for the study of fourteen secondary mathematics teachers in the

Discrete Mathematics Project (DMP) (Peressini & Knuth, 1998). These teachers participated in a two-week summer program, four five-hour follow-up discussions, classroom observations, and journaling. Data were then analyzed through a social linguistics lens. The discourse in some of the classrooms was dialogic but others remained univocal with the teacher as the locus of authority. Even after the intense professional development session during the summer, not all teachers were able to move to reform teaching. During this study, videotapes of classroom observations and then reflection on discourse occurring during the observation allowed time for the teachers and teacher educator to discuss results and develop plans for future lessons. This process of reflection on videotaped classroom observations was used during the EdS program in the form of the Reflective Teaching Model. Each of the conceptual models used in this degree program emphasized discourse and reflections to improve on classroom practice.

NCTM Research Council established recommendations for future professional development (Middleton et al., 2006). These recommendations were:

1. Although there should and needs to be "pure" mathematics education research in its traditional sense, the field as a whole needs to engage in more research that has the potential to directly inform practitioners' instructional practice and student learning.
2. Mathematics education research should seek out practitioners with whom they can engage in collaborative and meaningful research on questions of mutual interest.
3. Practitioners, including district-level and building administrators, and classroom teachers, should be more willing to overcome obstacles and open their districts, buildings, and classrooms to mathematics education researchers when the research project is collaborative in nature and clearly aimed at improving instruction and student learning.
4. Mathematics education researchers should be willing to work with the NCTM's Research Associate to produce research Analyses, Briefs, and Clips (n.p.).

These recommendations were important for teachers to improve their effectiveness through implementation of research-based practices. The subject of this study, the EdS program, attempted to use research-based practices to improve teachers. Three of the conceptual models used in the program were the Mathematical Task Analysis, the Reflective Teaching Model, and the NBPTS certification in secondary mathematics which were all research and theoretically based.

Graduate Degree Programs

Research into graduate degree programs in mathematics education was narrow in its focus and limited in its quantity, unlike research into professional development programs which has covered a broad context and a large quantity of research and material. While this study focused on an EdS degree, the literature on this sector of teacher education is lacking, therefore the literature review included articles that reach beyond mathematics and all levels of graduate programs. This review identified and explicated findings that may be applicable to the research and help to frame the subject.

A large group of South African teachers from five of the nine provinces who were in the process of taking courses to earn their Advanced Certification in Education (ACE) were studied (Adler & Davis, 2006). The teachers were involved in 16 mathematics-specific in-service qualification programs from 13 different institutions. Most programs included teachers from grades 7-12, however some split their programs to cover grades 7-9 or grades 10-12, and the number of courses was split evenly between mathematics and mathematics education. The average number of students in each of these cohorts was approximately 50. The research started with a survey of all formal assessment tasks and identified characteristics of “unpacking” of the knowledge in the

tasks. These evaluation tasks concentrated meaning and the criteria by which they were to be judged and revealed the mathematical knowledge and the mathematical and pedagogical competencies expected. This research was qualitative with the instrumentation being the teacher responses to the various tasks in each of the courses. While much of the teacher education research suggested that communities of practice were the best methods for learning mathematics and teaching, this research was based on large-scale formalized education due to political and practical reasons. One suggestion that this study developed was the negotiation of power between mathematics and mathematics education. If this negotiation was not successful for a shift to mathematics for teaching, then mathematicians will continue to determine the content teachers need to know through formal courses. "The sharp difference between the knowledge domains of mathematics and teaching could well be what lies at the heart of the struggle to merge these into a single (pedagogic) discourse like mathematics for teaching" (p. 293) This study provided insight into how programs of continuing formalized education created conflict between the content areas such as mathematics and the pedagogical content knowledge which was developed through methods of teaching courses. This research developed interesting suggestions on the difficulty of negotiation and of the context in which the program was held. These conclusions presented themselves in planning for the EdS program that was the focus of this research by building on the participants' mathematical knowledge with additional pedagogical content knowledge in the context of the school system where each was employed.

The NBPTS published a monograph of eight reports on master's degrees grounded in their standards and core propositions (2001). These reports prepared by

teacher educators/researchers at eight different institutions reflect the use of the NBPTS standards and how they believed the programs affected teachers. Each of these reports details how their particular institutions aligned their Master degree programs with the NBPTS standards as established by the NCATE for in-service teachers. Each program developed professional portfolio requirements based on the NBPTS five core propositions and incorporated the specific NBPTS standards for the content area of the teacher. While each university program produced results that these researchers found was significant, the positive results lead each to project continuation of the cohort programs focused on the NBPTS. Some cohorts instigated action research in the teachers' classrooms to build a methodology for the portfolio requirements for the degree and National Board Certification (NBC) completion. One cohort, developed at an off-campus site and aligned with NBPTS propositions and standards, produced results that were significantly better than a comparable on-campus cohort. The university proceeded to align the on-campus program with NBPTS. Other programs have produced "docucases" focused on NBC participants teaching and reflection through the use of video. These docucases were being used for both pre-service and in-service teacher education programs. These docucases, when perceived holistically, have produced reflection by students in these programs. In each of these reports, researchers wrote of what they felt were positive results of NBPTS aligned programs and their affects on teachers. Some indicated that even though they felt that the teachers were being positively affected, there should be additional research on how these teachers affected their students' achievement. Just as these universities accrediting body, NCATE, provided the spotlight on NBPTS proposition and standards so did the Ed S program of

this study. The NBC provided a conceptual framework through which the Ed S program focused its coursework during the first year of the cohort and then focused on Action Research as a method for continuing improvement of teacher practice during the second year. The programs in the monologue were of Master level degree or certificate level, the EdS program was an advanced terminal graduate degree with emphasis on teachers as leaders in their schools.

Interactions between graduate student Fellows and in-service teachers was identified as useful in improving Fellows' competencies (Mitchell et al., 2003). The National Science Foundation (NSF) report through cross-site case study analysis indicated that interactions between the graduate Fellows and the teachers to which they were assigned suggested positive results in communication and instructional skills improvement. Through these same interactions, students benefited through teachers acquiring content and pedagogical content knowledge. While this research does not directly impact this study, the affect was to provide continued encouragement for pre-service graduate students becoming teachers to interact with practicing teachers.

Some doctoral programs in science and mathematics education were being encouraged to develop university instructors who were capable of teaching content and the pedagogy that was principle to successfully teaching undergraduates and graduates to teach science and mathematics (Lennon, Rusk, Holden, & Pulos, 1999). These changes were encouraged through the reform effort in undergraduate mathematics and science education. This paper provided insight into how the reform movement in mathematics education was impacting university undergraduate instructors as well as K-12 teachers.

To create change in teachers, they must be convinced of the new methods advantages. Most professional development programs do not provide sufficient time and opportunities for them to be convinced (Leikin, 2005). "Education programmes therefore have a special role in supporting educational reform by developing teachers' knowledge and beliefs" (p. 236). The EdS program provided a two year period of interaction between the teacher educators, graduate instructors, teacher/participants, and the professional learning community that developed.

Developing a Master's degree program was a difficult and time consuming task, but to include becoming a teacher-leader as one of the program objectives was unique (Langbort, 2000). This program included four mathematics/mathematics education courses, four elementary education courses, a research course and a written thesis or field study. Included in the courses was developing an understanding of the major reform movement literature and leadership in mathematics education. These leadership skills were essential to increase elementary school teachers who were capable of leading their peers (Langbort). This report emphasized many of the same problems, opportunities, and considerations that the EdS program planners went through. This was especially true since one of the program objectives was to build leadership through mentoring, presentations, research, and collaboration.

The preferences of teachers who were interested in taking an Advanced Masters Degree were studied (Dawkins & Penick, 1999). The preferences were surveyed around the NBPTS core propositions, the Advanced Masters competencies, and sociocultural understandings of learning which built the "socio-cultural analysis by incorporating the complex relations among person, activity, and situation into a single entity, encouraging

the teacher to learn in the context of practice and reflection on practice" (p. 3). The preferences of these teachers was to suggest that instruction issues were the most pressing while philosophical and research issues were not important. Additionally, these teachers' preferences indicated the majority was planning to stay in the classroom and their priority was improving their practice. The EdS program was designed to improve practice through instruction in conceptual models and by following the NBPTS propositions.

To summarize the methods for improving teacher practice, they included teacher preparation, professional development, and graduate degree programs. These three methods each played a role in effecting students, but their impact was not equal. Teacher preparation only affects approximately five percent of the teacher workforce in any one year. Long-term change can be accomplished through teacher preparation; however this change will be moderated through the influence of the 95% of experienced teachers. Professional development affected the majority of these teachers and we encouraged change through implementing effective professional development. The components of professional development were the key to its effects.

Essential components consistently arise throughout these research studies and form a consistent picture of professional development in mathematics education. The first component was long-term and in-depth development (Borko, 2004; National Research Council, 2001; Farmer et al., 2003; Harel & Lim, 2004; Koelner-Clark & Borko, 2004; Koency & Swanson, 2000; Renyi, 1996; Sparks, 1992). Short professional development programs of a day, week, and even several months do not provide the sustained contact and implied accountability to change habits of traditional teaching

methods. These traditional teaching methods were the habits that have inhibited the reform movement in mathematics education.

The second component was content and content focused pedagogy, developing mathematical knowledge but also the methods of presenting mathematics effectively in the classroom (Borko; Cooney, 1999; National Research Council; Frykholm & Glasson, 2005; Harel & Lim; Hiebert et al., 2002; Koellner-Clark & Borko, 2004; Lappan, 2000; Monk, 1994; Shulman, 1986; Sparks). Significant research had suggested that mathematics knowledge without skills on how to present it to students did not translate into increased student achievement. Subject specific pedagogy was more important to the increase in student achievement (success) than pure mathematical knowledge.

The third component in professional development was to be collaborative in nature thus allowing teachers to construct knowledge through interaction with each other and focused on mathematical tasks (Borko; Farmer et al.; Koellner-Clark & Borko, 2004; Koency & Swanson). This process of interaction focused on mathematical tasks built the teachers' competencies by expanding their view of the task through the eyes of others. This became very effective through the use of lesson plans developed during collaboration and then the discussion of videotapes taken during the presentation of the lesson. This plan-teach-debrief cycle (Figure 6)proposed in the Reflective Teaching Model (RTM) was effective method for development of teachers (Hart et al., 2004).

Collaboration builds a community of learners also know as a professional learning community which enables the teacher to continue their growth long after the life of the professional development (Borko; Koellner-Clark & Borko, 2004). Professional learning

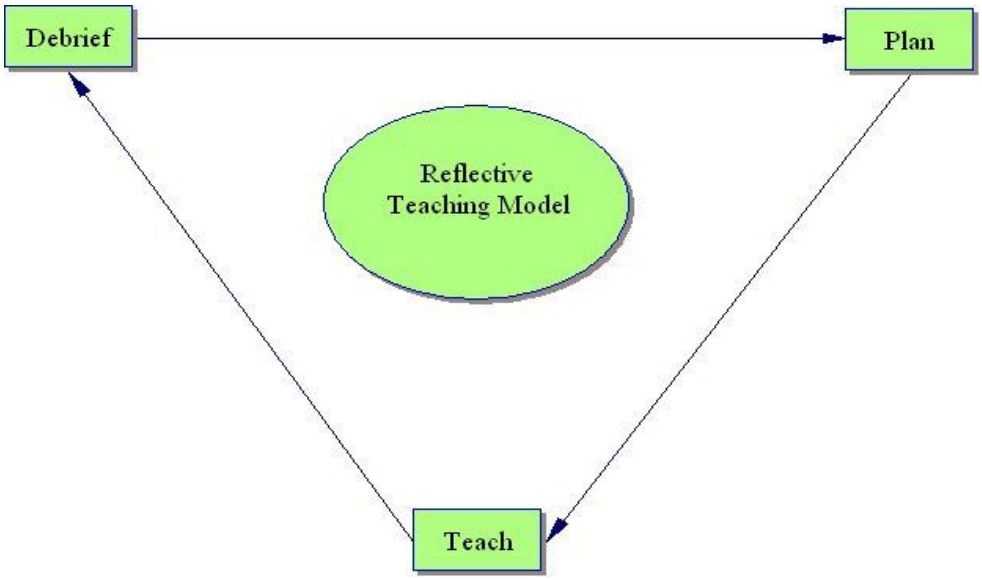

Figure 6. Reflective teaching model (Hart, Najee-ullah, & Schultz, 2006)

communities build formally during a professional development program or informally as teachers approach others for mutual support. These communities continued to increase teacher competency long after the program was complete.

Three additional components were individual orientation, inquiry in classroom and student focused (National Research Council; Farmer et al.; Harel & Lim; Renyi). While these components were not consistent in all of the studies, they were important enough to be included here. First, the individual orientation allowed teachers to focus on development of their professional capabilities in the context of their classroom. This individual orientation made the professional development more personal and the teachers were able to incorporate the learning objectives into their philosophy of teaching. Second was the inquiry in the classroom which prepares teachers to continue to improve their teaching practice long after the life of the development program. The final essential component was that everything was focused on improving student success.

Graduate programs recognized what was essential and included each of these professional development components. All graduate programs were long-term and in-depth by their very nature of requiring from 10 to 15 graduate level classes to be taken over several years. The normal program for a teacher was to take a number of courses in the content area or education courses that focused on the pedagogical content knowledge needed to improve student success (GSU, 2006). Many education courses required collaborative work through group projects and presentations, encouraging the building of a collaborative perspective for their individual classroom. The graduate program allowed students to choose courses within a framework that were of interest to them personally. Inquiry in the classroom was emphasized in several courses, including research courses and mathematics education courses while every course holds as a primary tenet that everything you learn was to enable the teacher to be more effective in improving student success. So graduate programs emphasized the same components that the research indicated professional development programs should.

Changes had come about due to significant pressures on graduate schools, such as changes in standards expected by the schools' accrediting body, professional organizations such as NCTM and NBPTS, and through the increased expectations of the nation for increasing student achievement. Each of these reasons had added to the movement to change teacher education and even the call for the abolishment of university based teacher education. The Adler and Davis (2006) study added one additional divisive issue to this contentious situation which was the negotiation between departments of mathematics and mathematics education. To say this was a troubled time in teacher education and especially mathematics education would be an understatement.

Universities accredited by NCATE accepted its position that the five core propositions from the NBPTS be the basis for graduate teacher education. Others have grounded their programs in the NBPTS core propositions and content standards and believed that the results from their programs showed significant improvements over previous teacher education programs. While these universities believed their programs were improving teacher practice through NBPTS propositions and standards, others were calling for scientific evidence as to the affects these programs have on teachers and their students' success.

The context of teacher education must be personal for the teacher to be affected and teacher-leaders were needed not just in a classroom but throughout the school. The final conclusion that was suggested from this literature was that professional development programs do not provide sufficient opportunities or time for teachers to become convinced that new methods of teaching were better than previous. They need support for an extended time to change their methods and build these new methods into their repertoire.

This literature did provide insight into the basis for construction of the EdS program that was the focus of this study. The EdS program was accredited by NCATE so the NBPTS core propositions played a significant part in the learning objectives of the program. Leadership, which was one of the goals of the EdS program, was central to schools success in helping to recruit, develop and retain teachers. The context of the program was relevant to the teachers/participants and through use of the Reflective Teaching Model, their classroom interactions were brought into discussions to help each teacher improve and model for others.

While the quantity of research in graduate teacher education programs was small, the literature that was available does support the EdS program and encourages the evaluation of its results for possible continuation. "Productive strategies for evaluating outcomes are becoming increasingly important for the improvement, and even the survival, of teacher education" (Darling-Hammond, 2006, p. 120).

Teacher Improvement and Student Achievement

The third focus of this literature review was the effect that teacher improvement has on student achievement. There was on-going research into improvement of teacher practice, knowledge, pedagogical knowledge and beliefs through professional development. The question of how this professional development affects student achievement needs more study (Huffman, Thomas, & Lawrenz, 2003). This research provides additional knowledge to the academic body concerning EdS programs affects on teacher practice and therefore student achievement.

Immersion, curriculum implementation, curriculum development, examining practice, and collaborative work were methods of professional development involved in a study of science and mathematics eighth grade teachers (Huffman et al., 2003). Two methods used in this study show positive affects on teachers' knowledge and practice; examining practice and curriculum implementation. These methods of professional development and their relationship to practice and student success were the focus of this study. There were 94 science and 104 mathematics eighth-grade teachers in rural, suburban and urban areas throughout a southern state included in the study. This state also has a poverty rate with over 50% of all students receiving free or reduced lunches. Instrumentation for the study included a survey questionnaire for teachers with questions

from established sources to provide validity and then pilot tested to insure reliability. Other instrumentation included state achievement test scores to measure student success and a second teacher survey on the type and duration of professional development. After separate regression analysis for science and mathematics teachers and student achievement, the study found that both curriculum development and examining practice were significant predictors of the use of standards based curriculum while the other methods of professional development were not significant predictors. The analysis involving student achievement found that only curriculum development related to student achievement, but the relationship was negative, while the other methods and all the methods for science teachers were not significant. The study suggests that teachers with lower average achievement scores engage in more long-term curriculum development than those teachers with higher achievement. This was a good indication that professional development was reaching teachers with the greatest need. It was important to note that examining practice and curriculum development were significant indicators of standards-based instruction in both science and mathematics.

During the EdS program, learning objectives included examining practice through three conceptual models and the development of curriculum for mathematics topics. These methods were significant indicators in Huffman, Thomas, and Lawrenz's (2003) study for standards-based instruction. The EdS's standards were from both the NCTM and NBPTS. While the EdS program also included collaborative work and immersion strategies, these did not show significance with standards-based instruction in Huffman, Thomas, and Lawrenz's study.

Professional development of a constructivist perspective was the focus of a study by Simon and Shifter (1993). This study focused on the affect of professional development from this perspective on students' attitudes, beliefs on learning, performance on standardized tests, and the activity in the classroom. While test performance moved away from a reform movement perspective, the political and practical sides required the inclusion of performance scores. Instrumentation included "surveys, standardized tests, and teachers' reports of student change" (Simon and Schuster, 1993, p. 332). The data were collected through three cycles of professional development and students in the teachers' classrooms were not the same each year. In secondary school students, there were 295 pre-program surveys and 303 post-program surveys indicated no significant change from one year to the next. The standardized test produced no significant differences from elementary or secondary students or the total group. The mathematical activity was measured qualitatively through teacher observations of changes in student behavior. The changes that were noted were cognitive changes, affective changes and social change. The teachers had given more attention to reform methods and moved the classroom focus from teacher to student. However this attention to reform methods and classroom focus did not create a clear indication of significant changes in secondary school students in the affective and did not produce results on standardized tests that indicate more or better mathematical comprehension. As with much research, the study developed more questions for further study than it did answer the original questions.

In looking at how teachers affect student achievement, Darling-Hammond, Holtzman, Gatlin, and Heilig (2005a) replicated the Hoover Institution's CREDO study,

again using the Houston Independent School District to assemble a similar data set in looking at how effective teachers were. The CREDO study used data from 1996 to 2000 in grades 3 through 8 but focused on grades 4 and 5 while the data set for Darling-Hammond et al's study included years 1995-2002 for grades 3 through 8. The original CREDO study investigated the effect of Teach for America (TFA) recruits on student achievement through a comparison of the TFA recruits and other teachers hired who were not traditionally certified. The Houston school district hired approximately 50% uncertified new teachers. The current Darling-Hammond study replicated the CREDO study but went further in analyzing the TFA recruits versus new teachers who were traditionally certified. This comparison provided insight into the need for teacher education. "Uncertified TFA teachers showed significant negative effects on student achievement in five of six estimates (and the sixth also has a negative coefficient). The same was true for uncertified teachers who were not members of Teach for America" (p. 18). This study provided evidence contrary to that used by the United States Secretary of Education (2002) when he emphasized that unnecessary traditional teacher education preparation was hindering the hiring of potentially qualified teachers. Consequently, this indication that traditional teacher education programs better prepare prospective teachers to affect student achievement, led to one of the hypothesis of this research that advanced graduate degree programs (such as the EdS) improve veteran teachers and make them more effective in improving student achievement (success) than other typical professional development programs.

In 1999, the NAEP data from 7,146 eighth graders was analyzed and included measures (number of different measures in parenthesis) of student performance (1) and

background (3), teacher quality (3) and professional development (10), and classroom practices (21) (Wenglinsky, 2002). This research used multiple models to analyze the data. In the first, no significant relationship exists between student test scores and those teacher characteristics studied with the exception of the college level coursework as measured by a major or minor in the field. The subsequent models confirmed that teacher classroom practices have the greatest effect which was significant at a .09 level. All teacher inputs effects combined were comparable to that of student SES. In addition Wenglinsky suggested that professional development strongly influences classroom practice and "the more professional development they (teachers) received regardless of topic, the more likely they are to engage in hands-on learning activities" (p. 22). The conclusion reached was that active teachers were the key and were defined as those who allowed lessons to work at multiple levels of abstraction, steps, and paths to solutions and through individualization.

> Schools that lack a critical mass of active teachers may indeed not matter much; their students will be no less or more capable to meet high academic standards than their talents and home resources will allow. But schools that do have a critical mass of active teachers can actually provide a value-added: they can help their students reach higher levels of academic performance than those students otherwise would reach. (p. 22)

This study does indicate the importance of professional development and that the subjects of these professional development programs should be tailored to include higher order thinking skills and hands-on learning. These indications suggest that the EdS program which focused on conceptual models for the teacher/participants to engage in reflective methods of self-improvement may have been improved by focusing on teaching methods and student achievement, however the program was working with master teachers who

had demonstrated competence in teaching and were focused on continuous self-improvement and leadership in their schools and departments.

Quantitative research on teacher effects on student achievement has mainly been limited to production function studies using general variables which were easy to measure. In these studies, little or no significant teacher effects were noted in comparison to socio-economic status (SES). New research conducted in the last ten years has altered this perception of the trivialness of teacher effects. Use of a cross-classified random effects model allowed Rowan, Correnti, and Miller (2002) to find that teacher "effects (on student achievement) are not only statistically significant but also substantively important" (p. 1532). While this research occurred in elementary schools on grades 1-3 and 4-6, the conclusions of the study have implications for secondary schools and to this study. The importance of teacher effects also implied the importance of the quality of the teacher and their practice. This teacher quality was the program objective for the EdS program.

Social cognitive theory was extended from the individual to the group creating a collective efficacy by Bandura (Goddard, 2001). Another key to collective efficacy was human agency or the ability to make choices and was the belief in one's capability to organize and act to manage possible situations. The collective efficacy of a school was positively related to student reading and mathematics achievement. Again this research worked with grade 4 students and teachers on a state-wide assessment. The study found that mastery experience related to differences in school collective efficacy. The second finding was that "collective efficacy was strongly related to differences among schools in student performance" (p. 474). This research built knowledge on the effect of teacher

efficacy and student achievement. Mastery experiences were essential in increasing teacher efficacy which subsequently builds student achievement. Therefore, the theory of self-efficacy and its implications on teacher and collective efficacy was important for this research in relation to student achievement as well as effects on teachers and schools.

Over the last three years, three studies had indicated that teachers who have achieved National Board Certification (NBC) were more effective in improving student achievement both before and after they receive their NBC than others who unsuccessfully attempted NBC and non-applicant teachers (Goldhaber & Anthony, 2004). The data set for the Goldhaber and Anthony study were elementary students and teachers from North Carolina during the 1996 through 1999 school years. "The statistical significance and magnitude of the "NBPTS effect," however, differed significantly by grade level and student type" (p. 4). These effects were based on data from the early years of the NBPTS program and continued monitoring should occur to see if this "NBPTS effect" still effects student achievement positively after modifications to the certification program. The next study that was published used elementary students, NBC teachers, principals, and districts in Arizona totaling over 200,000 students. The findings again showed that NBC teachers were effective in increasing student achievement (Vandevoort et al., 2004). As their students' achievement indicated, these teachers effectively had 25 additional days in the classroom as their counterparts do. The final study published in 2004 was the Cavalluzzo study of high school students in the Miami-Dade County Public Schools. Indicators in the study were teacher characteristics which included:

- Whether the teacher is new or experienced
- Whether the teacher has a regular state certification in high school mathematics or middle school mathematics

- Whether the teacher holds a teaching position in mathematics or has another primary job assignment
- Whether the teacher has an advanced degree
- The selectivity of the teacher's undergraduate school
- Whether the teacher has National Board Certification (NBC), a pending application, or failed or withdrew from the program (p. 1).

Each of these indicators was significant and aligned with the proper sign with the exception of undergraduate school quality. The findings suggest that NBC was an effective signal of teacher quality. In addition, in-subject area teacher and regular state certification in high school mathematics had the greatest effects. The effect size for NBC teachers was that their students gained 7 to 8 percent of a standard deviation more than others on the end-of-grade exam in mathematics. The coefficient for pending NBC applicants was only about one-fifth the size of the coefficient for NBC teachers. The model that allowed NBC effects for subpopulations found that Black and Hispanic students benefited even more with effect sizes of 14 to 15 percent and were statistically significant. Each of these three studies found that NBC teachers were effective in improving student achievement; however there were studies that conclude that the effects were not significant. There were also policy and political aspects of the costs of the NBC program to school districts, states, federal government, and businesses that must be considered. While these studies do not address the political or policy decisions, the NBC program does seem to be effective as a professional development program and does seem to improve student achievement.

The affect of NBC mastery on teacher efficacy should also increase collective efficacy which has been shown to improve student achievement. This reasoning brought NBC into the EdS program and began the use of the certification program as part of the

advanced degree program. While NBPTS used a reflective process in its program, the EdS program also identified several other conceptual models that, when implemented, assisted in preparation for NBC.

To summarize, teacher improvement has been suggested as one of the best methods for improving student achievement (Borko, 2004; Farmer et al., 2003; Goddard, 2001; Huffman et al., 2003; Ponte et al., 2004; Simon & Schifter, 1993; Vandevoort et al., 2004; Wenglinsky, 2002). While not all professional development increases student achievement singularly, Wenglinsky indicated that the more professional development that teachers participate in, the more their students will benefit. This was especially true if the professional development was developing hands-on learning and higher order thinking skills. Additionally, the length of activities was an indicator of the effect they have on improving teacher practice. The NBC was shown through quantitative methods that student achievement was positively impacted through the certification, especially for students of color or who have been retained in grade (Cavalluzzo, 2004; Goldhaber & Anthony, 2004). Each of these findings should produce mastery of teaching skills and improve teacher efficacy. As teacher efficacy improves, so does the collective efficacy of the school which can be shown to improve student achievement (Goddard, Hoy, & Hoy, 2004). Improving teachers improved student achievement through multiple ways.

Summary

This literature review presents some clear indications and at the same time presents several questions for future study. Indications were that teachers and schools do contribute to student success, not just student background as many of the early production function studies showed. Teacher effects were significant and can be as large as the

effects associated with SES (Wenglinsky, 2002). In preparation for teaching mathematics, the number of mathematics courses taken reaches a point of diminishing returns, while the mathematics education courses which present mathematics pedagogical knowledge continued to increase for all courses taken (Monk, 1994). Teacher knowledge about mathematics was important but this study indicates that the specialized knowledge of how to teach appropriate mathematics in high schools was even more important. This mathematical pedagogical knowledge was learned in a number of ways, including mathematics education courses during teacher preparation or graduate degree pursuit, professional development courses taught at the department, school, district or professional organization level or through a method of reflective action research in the teacher's own classroom. Each of these methods had positive features that fit situations for all teachers. Professional development was one of the keys to continuous teacher improvement, the efficacy of the teacher must be considered in the methods and types of development. Teacher efficacy was shown to impact student achievement and therefore must be a consideration (Goddard, 2001; Goddard et al., 2004).

This research has built a foundation for a program of study which should include mathematical pedagogical knowledge instruction through hands-on learning experiences working collaboratively to improve student achievement. This program attended to the self-efficacy of the participants through an effort to build mastery of material and skills. In addition, the program instills methods for continuing improvement in teacher practice that outlives the program.

In response to this conclusion, the EdS program was designed to incorporate three conceptual models which were each theoretically based and one research methodology

that provided impetus for continuing improvement of teacher practice beyond the life of the program. These conceptual models included reflective teaching methods, determining levels of cognitive demand, and analysis of instruction through small group and whole class discourse. Action research was the research method used in the program. See Figure 7 below for the overlapping models of the program. Individually, each of these was a way for teachers to improve their practice but together they supported each other in a theoretical framework that was built upon the theories of social constructivist learning, metacognition and self-efficacy. Therefore this research studied the effects of the EdS

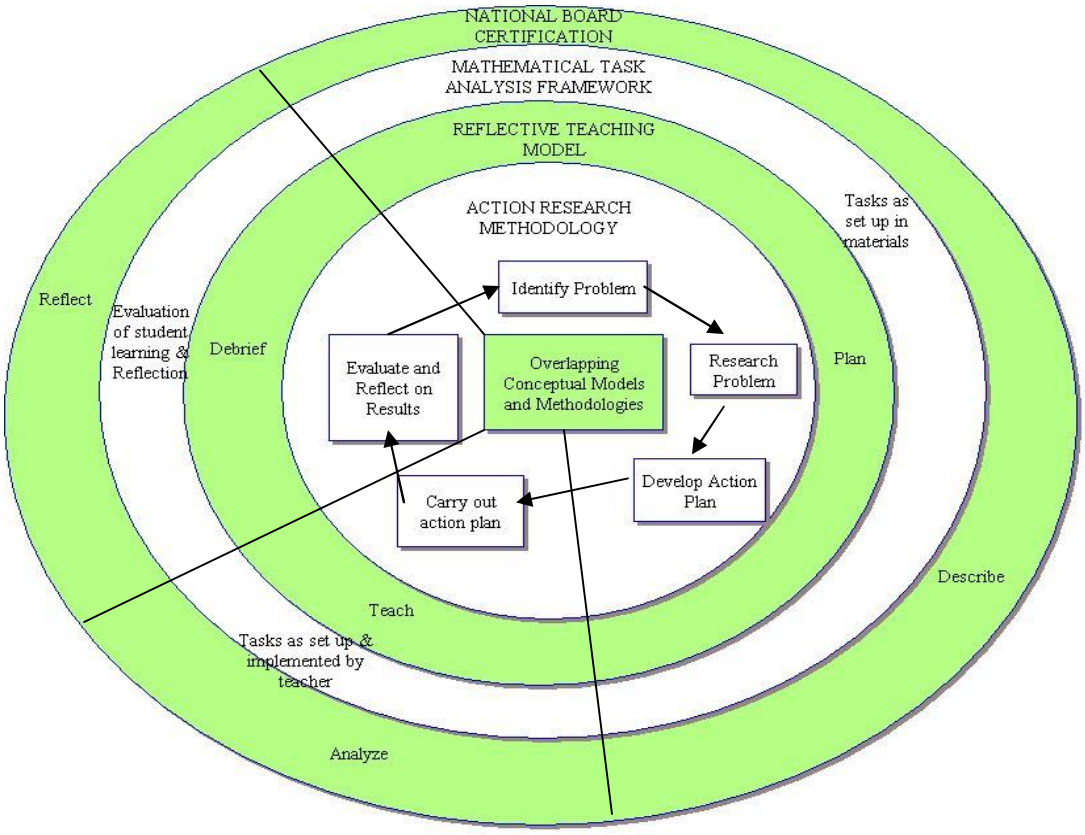

Figure 7. Overlapping conceptual models for program (adapted).

program on the teacher/participants through a self-efficacious lens as to the outcomes experienced by each from the learning objectives of the program. In addition, the effects

investigated over three years after the end of the program to identify possible continuing uses of the programs objectives.

CHAPTER 3

METHODOLOGY

The purpose of the study was to evaluate the EdS cohort program to determine its effectiveness in creating change in teacher practice and increases in student achievement. The focus of the study was to evaluate methods of using mathematical knowledge in teaching and teaching and learning skills for mathematical thinking and problems solving. This research was an evaluative case study and the types of data available and the desired goals of the research dictated a qualitative study.

The study took place in the natural settings of the respective participants and contains the experiences and reflections of these individuals. I was involved in the EdS program as a graduate teaching assistant and from this point forward may use the first person in this manuscript. Participants in the study, six secondary mathematics teachers, played an active role in the study by participating in interviews, providing documents for analysis, and perform member checking of initial analysis of data. Some documents were personal in nature, such as reflections on teaching, while others were available for review through public sources. Although a theoretical framework had been developed for this research, I was cognizant of the possibility of emergent theories and results from constant comparative analysis that changed the questions asked and the direction of the study.

This case study was a form of interpretive research for the purpose of "Understanding the meaning of the process or experience constitutes the knowledge to be

gained from an inductive … mode of inquiry" (Merriam, 1998). Interpretations and conclusions were drawn through my lens which was affected by personal ontological, epistemological, and sociopolitical position (Creswell, 2003b; Lubienski, 2000).

Evaluative Case Study

This research was an evaluative case study of the EdS cohort program as a bounded unit. The boundaries of the study were based on two parameters: first was the program itself, starting in the spring, 2002 and finishing May 2004. Although interviews were outside of this timeframe, they were in reference to the activities and influences of the program. The second parameter was the nine student participants, three other part and full-time instructors, and myself. These 13 people participated in a cohort program that was intended to develop a strong professional community and deep understandings of teaching philosophy, practice and leadership. Participants in the study had insights into the effects of the program on themselves and each of the other participants. The study encompassed almost five years with the same six participants. Any long-term affects of the EdS program were evident at the end of data collection. Interviews with two instructors were not attempted since they were part of this doctoral committee. Interviews occurred approximately 30 months after the life of the program. Although this study was a case study in the sense of being a bounded unit, the research method also embraced action research my method of evaluating the program. These types of evaluative case studies depend on description, explanation, and judgment from an emic point of view (Merriam, 1998).

Action research was an evaluative method to develop understanding of a problem through identifying the problem, researching the problem, making an action plan to

address the problem, implementing the action plan, and evaluating the results from the action (Glickman et al., 2004; Gratton, 2003; Koch, Arhar, & Rumrill, 2004; Obrien, 1998 ; Ponte et al., 2004). This recursive process builds an understanding of how the action taken affected the problem and determines if the action reached the desired goals. If not, the cycle begins again. Each time the action researcher completes the cycle, reflection on results determines if the goals were achieved and if the process should be repeated. While this cohort program was not implemented but once, this study attempted to establish recommendations for future programs that may be similar to this EdS.

Action research was often used when the researcher was the practitioner and to develop ongoing modifications to current practice (Glickman et al., 2004; Gratton, 2003; Obrien, 1998 ; Ponte et al., 2004). In this study, I applied action research to the evaluative case study as a method to determine what recommendations, if any, should be applied to future cohort programs at the advanced graduate level. In addition to possible changes, I investigated methods for continuing interaction with the participants and possible participation by them in future EdS programs.

Participants

The program participants were nine secondary mathematics teachers from five different high schools in a local suburban school system. They included six women, of whom; two were African-American, and three Caucasian men. The women ranged in age from late twenties to mid-fifties and the men ranged from upper twenties to mid-thirties. Each participant completed the prerequisite masters' degree in either mathematics or mathematics education. Undergraduate and previous graduate degrees were diverse in nature and locale. The following table gives information on each of the participants.

Code	Age	Years Teaching	School	Masters Degree	National Board	Pass NBC	Grades Taught	Classes Taught
Gabrielle	53	18	3	Math	Y	1st	9 & 12	Alg I & III
Jacob	33	9	3	Math Ed	Y	1st	9 & 11	Alg I & II
Joyce	48	26	3	Math	Y	1st	9,10 & 12	Alg I, II, & Calc
Jordan	36	13	2	Math Ed	Y	1st	10 & 11	Alg II & III
Rachel	42	19	4	Math Ed	Pre	1st	10 & 11	Alg II & Geo
Kimberly*	28	5	4	Math	Y	1st	11 & 12	Alg III & Calc
Larry*	30	6	1	Math	N		9 & 10	Alg I & Geo
Abigail	32	10	1	Math Ed	Y	1st	10 & 11	Alg I & II
Annette*	30	6	1	Math Ed	Y	2nd	9 & 10	Alg 1 & Geo

Table 1 *Participants in EdS program*. Names are pseudonyms. * Did not participate in study.

Gabrielle had been teaching for 18 years after a short time off taking care of her daughter. When the daughter went back to school, she did too. Gabrielle completed the program and the NBC process successfully and then became an assistant Principal in a school close to her home. She is married. Jacob's wife had a daughter during the program and Jacob's time was split between teaching, graduate classes, and his family. He changed schools shortly after the program ended to be closer to his family. Joyce continued to teach in the same school and watched her two sons graduate from that school since the end of the program. Her husband recently retired from the same school. Jordan continues to teach at the same school and is married to a mathematics department chair at another high school. He has two children in elementary school. Rachel is unmarried and focused on her work. She recently helped to open a new magnet school in the same county. Kimberley has gone back to school full time working on her doctorate and was not available for interviews. Larry changed school since the end of the program and is

coaching basketball. Larry chose not to participate in the study. Abigail is unmarried but devoted to her students and her work in the community. She ties these two interests together to affect students' lives in positive ways. Annette is still teaching at the same school, but chose not to participate in the study. As indicated above, Rachel had previously passed her National Board Certification and six of the remaining eight passed on the first time. One passed on the second submission and one never submitted.

Unit of Analysis

The unit of analysis for this study will be the prototypic EdS program. This unit contains nine participants, which allowed a cross-comparative analysis between the participants (Merriam, 1998; Yin, 2003). Of the nine participants of the program, six chose to participate in the study. Of these six, five were still in the classroom teaching mathematics while one had taken a new job as an assistant principal in charge of staff professional development.

Case study overview

Determining if the learning outcomes in the EdS program produced change in teacher practice and efficacy was the focus of this case study. If there was change, did it continue 30 months past the life of the program when interviews were conducted? In addition to understanding what changes occurred, the study investigated how the program could have had a greater effect and through what framework this effect could be achieved in the future.

Case Study Protocol

Reliability of case study research increased through the use of a case study protocol. The case study protocol guided the researcher in carrying out data collection

from a single-case study (Merriam, 1998; Yin, 2003). The purpose of the protocol in this case study was to be a practical guide during each level of data collection and insure that there was a chain of evidence from the collection point through analysis and into the findings of the study.

Case Study Questions

The study was based on the case study questions proposed in Chapter 1. These questions guided the data collection and analysis in determining the types of data and the analysis methods that were used on the data. The case study questions were:

1. Did the learning objectives and outcomes affect teacher practice during the program and if so, how?
2. If so, are the teacher practices related to their learning outcomes evident one year later? Two years later?
3. Is a form of continuing improvement still used and if so, why and how is this continuing to affect teachers' practice?
4. Do the participants continue to achieve the level intended by the NCTM's position statement of highly qualified and if so, what evidence demonstrates this level?

These questions required data from each participant that addressed the questions both during the program and currently. The data from during the program were archival and included the various assignments, reflections, and NBC submissions. Data that indicated current activities that were results from the program were generated through an interview with each of the participants.

Data Collection Procedures

Data collection began after completion of Institutional Review Board approval and the local school system's approval. Once approval was obtained, a listing was developed of documents to be requested by reviewing the syllabi from the program's courses and the requirements from the NBC process. While the selection of data

progressed, requests for participation in the study and Informed Consent documents were sent to program members for completion.

A list of the data items that I requested were reflections on teacher practice, reflections on class activities, journals, NBC submission materials, EdS portfolio and opinion papers. These items came from all participants, at different times during the EdS program, and were prepared with different intentions. This procedure provided for triangulation of data through multiple instruments, multiple participants, and multiple points in time (Merriam, 1998; Yin, 2003).

I collected data from six participants at four different high schools throughout the local suburban school system. The remaining three did not participate in the study. Prior to visiting the sites, I requested the participants provide copies of reflections, opinion papers, and various other assignments produced during the program based on course syllabi. Both the participant and I reviewed these items prior to the site visit to refresh the participant's memory and give me insight into the participant's thoughts. This review assisted me in focusing questions for each participant and developing clear, concise conclusions from each participant.

During the site visit, I conducted a semi-structured interview with each participant, using the interview questions below. This interview provided critical information about the long-term affects of the EdS program on these six participants. The participants were also asked to draw conclusions about any peer observations that they have made during and possibly since the program.

Interview Questions

The following questions framed the semi-structured interview with each participant. These questions were beginning points; they provided the introduction into major points that were investigated with subsequent questions that narrowed the focus based on the participant's response.

1. In reflecting on the prototypic EdS program,
   a) Describe the program through your experiences.
   b) What learning outcomes or activities did you find to be the most influential on your teaching practice?
   c) What concepts and theories did you find to be enlightening to your teaching philosophy and affective on your practice?
   d) What concepts and learning outcomes do you believe prepared you to succeed on the NBC?
   e) Do you believe that you are a better teacher today than you were before you started the program and if so, how?
2. In reflecting on your practice and beliefs,
   a) What concepts, theories, and practices that were learning outcomes in the EdS program did you continue to use one year later? Two years later? Still and if so, why and how was it affecting practice?
   b) Do you believe that you will continue to use these concepts, theories, and practices and if so, what do you hope they will help you achieve?
3. During the last five years, you have completed the EdS program and spent almost 36 months after the life of the program with the knowledge and experiences gained during the program,
   a) Do you believe that the program was worth the time and effort and if so, why?
   b) Do you believe that the program should be repeated and if so, why?
   c) Are there changes that you would recommend for the program and how would you implement the changes for best possible effect?
   d) Are you willing to assist in future Ed S programs of this type?
4. Do you believe that you continue to achieve the level intended by the NCTM's position statement of highly qualified?
   a) If so, what evidence do you feel demonstrates this level?
   b) Will you renew your National Board Certification?

These questions provided a structure to guide the interview, understanding that the answers from these questions determined subsequent questions which refocused the interview. This focus was emergent based on responses to these questions.

Study Database

I developed a database to accept the different types of data, from different participants, and from different points in time with assistance from NVivo 7 software. This database was electronic, so as data was collected, they were efficiently gathered into different folders for search across time, activities, and participants. The same piece of data may was used in an analysis of change in teacher practice over time and in comparison between different participants. An annotated bibliography of the documents stored in the database will allow for ease of future use (Creswell, 2003a; Merriam, 1998; Yin, 2003). The database of excerpts and quotes are included in Appendices C, D, and E.

Chain of Evidence

A chain of evidence was developed to help the reader of this study understand how and why I used the particular data. In addition, I provided citations in the report based on the database (found in Appendices C, D, and E). These citations allowed the reader to refer to the original data and draw his/her own conclusions. Included in the database were statements of how, from whom, and when the data were collected.

Validity and Reliability

Validity and reliability were the primary concerns necessary to assure the study was rigorous and trustworthy. These concerns "can be approached through careful attention to a study's conceptualization and the way in which the data were collected, analyzed, and interpreted, and the way in which the findings are presented" (Merriam, p. 199). There were four tests commonly used to establish the quality of any empirical social research which were construct validity, internal validity, external validity, and reliability (Yin, 2003).

Construct Validity

The first test was construct validity and was established during the data collection phase of the study and identified the correct measures for use with the concepts being studied (Yin). The use of multiple instruments of data from multiple points in time strengthened this type of validity. These multiple instruments were the reflections, journals, and activities from the prototypic EdS program. They were also the interviews, portfolio, and observations. These different types of evidence brought different insight into the practices and beliefs of the participants. In addition, the chain of evidence ensured the data that was collected was handled appropriately and in a manner so readers of the study were able to find the data from which conclusions were drawn and replicate the results. The final method to increase construct validity was through key informants reviewing a draft of the report called member checking.

Internal Validity

The second test was internal validity and was developed during the data analysis stage (Yin). There were a number of ways to enhance internal validity. The first method was through triangulation of data by using multiple instruments of data, through multiple methods, or through multiple points in time (Merriam, 1998). Other methods used to increase internal validity included member checking by participants, peer examination by the research committee, and by making a clear statement of my biases at the beginning of the study.

External Validity

The third test was external validity and was addressed during the design phase of the study and concerns the extent this study can be applied to other situations.

Generalizability was always a question in qualitative studies but there were several ways of strengthening the external validity. First would be through the use of thick, rich description of the case and secondly through applying theory to the case. Both of these methods were included and increased the level of external validity in the study.

Reliability

The final test was reliability. The study's reliability was enhanced through the use of a case study protocol. This protocol would guide another me to be able to investigate the case and produce the same results by following the same procedures used originally. The second step to increase reliability was to establish a database of all data used and they were included in Appendices C, D, and E. This database, as mentioned earlier, allows future researchers to find the data used and replicate the conclusions and provided me the ability to place citations in the conclusions so others may follow their thought process.

Data Analysis

Data analysis began during the initial phase of data collection by using a constant comparative analysis as items were transcribed and read (Glaser & Strauss, 1967; Strauss & Corbin, 1990). This method allowed emergent themes to become obvious early in the research. Emergent themes were generated as patterns develop by repetitive instances of the data. I also developed analysis through the coding of archival documents, interview transcripts, course syllabi, observations, and reflections. Each piece of data was then grouped, based on a codebook developed for this study. The codebook was based on the theoretical framework for the study and the research questions being asked. As each document was coded, I added additional patterns that develop to the emergent themes

from constant comparative analysis to build a more complete picture. Data analysis included, "Classifying small pieces of data into more general categories was the qualitative researcher's way to make sense and find connections among the data" (Gay & Airasian, 2000, p. 243). When specific words, phrases, or intentions were expressed in data collected, I grouped excerpts that fit a general category of data. In addition, emergent, repetitive patterns became evident as I analyzed the data. The theoretical categories included metacognition, social constructivism, and self-efficacy. In addition, learning communities and teacher practice were included in the initial code book. Key words and phrases were:

> Reflection, journaling, evaluation, debriefing, self-analysis, cognition, scaffolding, theory of learning, zone of proximal development, social effects on learning, building knowledge, constructing knowledge, building on previous knowledge, attribute, motivation, attitude, monitoring and control, collaboration, peer observation, discussion.

As data were collected, they were placed in a database for use in the case study report based on the codes represented in each piece of data. I placed data sources in multiple spots during times when they fit different theoretical frames or answer multiple questions. Each time I cross-referenced them with data collected from the same participant and other participants (Yin, 2003). In addition to coding of the data sources, there was a constant comparative analysis that helps to bring out emergent themes as soon as possible. These emergent themes became apparent as patterns developed through each individual participant's data instruments and then through cross-participant analysis.

The data were analyzed at three time frames. The first data were drawn from NBC and EdS reflections at the halfway point of the program. The second data set was drawn from the capstone projects at the end of the program. The third data set was the

interviews which occurred approximately three years after the life of the program. Each of these data sets was then coded based on the searches located in Appendix B and the references to the correlations of data to the constructs were counted. These references were used in drawing conclusions.

Researcher Preconceptions

Researcher biases continue to raise questions in case studies due to the propensity to treat what the researcher, the research team, or the culture value too favorably (Stake, 2004). This created a situation where not only our interpretations of the data, but also the design of the study and even the collection of the data were influenced by the very culture that we live in and value (Merriam, 1998). In many aspects, this is a weakness of case studies. I assisted in organizing the way courses were presented to the program participants and instructed three of the ten courses. This creates a true understanding of what the teachers were saying in the archival documents generated during the program and in the interviews almost three years after the life of the program. These understandings helped to create a clearer picture of how the theories and learning objectives of the program affected the program participants and helped to determine the design and actual research of the study.

Bias might affect a study in numerous ways. First, the case study design that was used here, presented difficult decisions to the researcher. The researcher must understand that the study was a small part of the whole due to insufficient time or money, or if there was enough of both, creation of a study report that was too long, detailed, or involved for those who should read it to do so (Merriam). The researcher determined the amount of data description, analysis, and summary material.

Although researcher's ethics and conscience helps to prevent these biases, the researcher might not realize that they were even present (Creswell, 2003b; Merriam; Stake; Yin, 2003). The researcher or research team was left to their own instincts and abilities to collect and analyze the data for the study. Unethical researchers can produce a report that says basically anything they want by selectively choosing the data to be used in the analysis and findings.

Recognition of these problems in researcher bias was a key in developing the case study design, collecting data, analyzing data, and producing final conclusions to reduce effects of bias. There were a number of additional ways to reduce the effects of researcher bias by involving fellow researchers (doctoral committee) from its initial planning phase through its culmination. These researchers provided insight into possible alternative conclusions to the data analysis. Member checking was also done by the participants in the study. Each member was asked to read and comment on the patterns I derived from their data and also on the conclusions drawn from the whole case. The final method to reduce bias was by providing sufficient support material for readers of the final report to understand and develop their own conclusions.

Summary

In summary, action research was an evaluative tool (Glickman et al., 2004; Gratton, 2003) used by many teachers on a daily basis to determine if their classes were meeting the goals and objectives of the class. The use of action research as the evaluative basis for this case study followed the process that the EdS program used as one of the overlapping frameworks and methods.

The data were a combination of archival instruments from the Ed S program and current interviews. Triangulation of data was achieved through use of multiple participants, multiple instruments, and multiple points of time. The archival data were from various assignments at different points of time during the program and the interviews occurred after the approval of the prospectus and Institutional Review Board.

A case study protocol was developed to guide the collection and analysis of data. This protocol increased the reliability of the study while the triangulation of data and member checking strengthened the construct validity. Internal validity was increased through triangulation of data, member checking, and clear explanation of my biases. External validity increased through the use of thick, rich description and through the application of the three theoretical frameworks to the study. The final test according to Yin (2003) was reliability. In addition to a case study protocol being used to increase reliability, a case study database was established. Through each of these methods, the strength of the case study was increased until rigor and trustworthiness were satisfactory.

CHAPTER 4

RESULTS AND DISCUSSION

The purpose of the study was to determine how a unique Educational Specialist (EdS) program might have affected its participants at three points over a five-year period. The research was focused through the social constructivist, metacognitive, and self-efficacy lenses but receptive to emergent data.

This chapter reports the results and discusses the findings of the study. The questions were:

1. How did the teacher learning outcomes affect their practice during the program?
2. How are the changes in the teacher practices related to their learning outcomes evident one year later? Two years later?
3. What form of continuing improvement was still used? Why and how was this form continuing to affect teachers' practice?
4. The participants attained NBPTS certification during the program. What level of teaching was demonstrated today and does it meet the NBPTS or the NCTM position on highly-qualified teaching? What evidence supports this level of teaching? What program learning outcomes are present in this evidence?

As data analysis proceeded, I realized that questions 1, 2 and 3 coalesced into the same question, *How did the teacher learning outcomes from the EdS program affect teacher practice?* But this question was viewed at three different points in time. As my analysis continued, I found that the analysis was more easily understood by using a reverse chronological order of the data. Using the three points in time as a guide, I separated the data into three sets. The first data set was interview transcripts three years after the end

of the program; the second was the capstone project at the end of the program and the last were reflections at the end of the NBC process which culminated halfway through the EdS program. The two combined questions were answered simultaneously due to the rich, thick context of the data.

Since the research participants had each become National Board Certified either during or prior to the program, they were considered by definition of the U. S. Department of Education (2006) now highly qualified. Question 4 compared participants' perceptions of their teaching with what highly qualified meant according to NCTM and NBPTS. This comparison was to determine if almost four years after they were NBC certified they were still teaching at a highly qualified level as defined by NCTM.

The data for this study included archival documents produced during the program from August, 2002, to May, 2004, and interview transcripts produced in May, 2007. Each participant provided the archival data requested in an electronic version with the exception of Gabrielle and Jordan, who were not able to provide their NBC reflections and Abigail who could not provide her capstone project. All six agreed to and completed 35- to 55-minute interviews which were later transcribed.

I analyzed data in two stages assisted by QSR's qualitative software, NVivo 7. The first stage identified the uses of EdS learning outcomes and the effects of the uses on each teacher practice. The second stage included which of the constructs, including the three theoretical frameworks and the one research methodology, were attributed with the most references. Figure 8 provided a graphic organizer for this study and the data analysis.

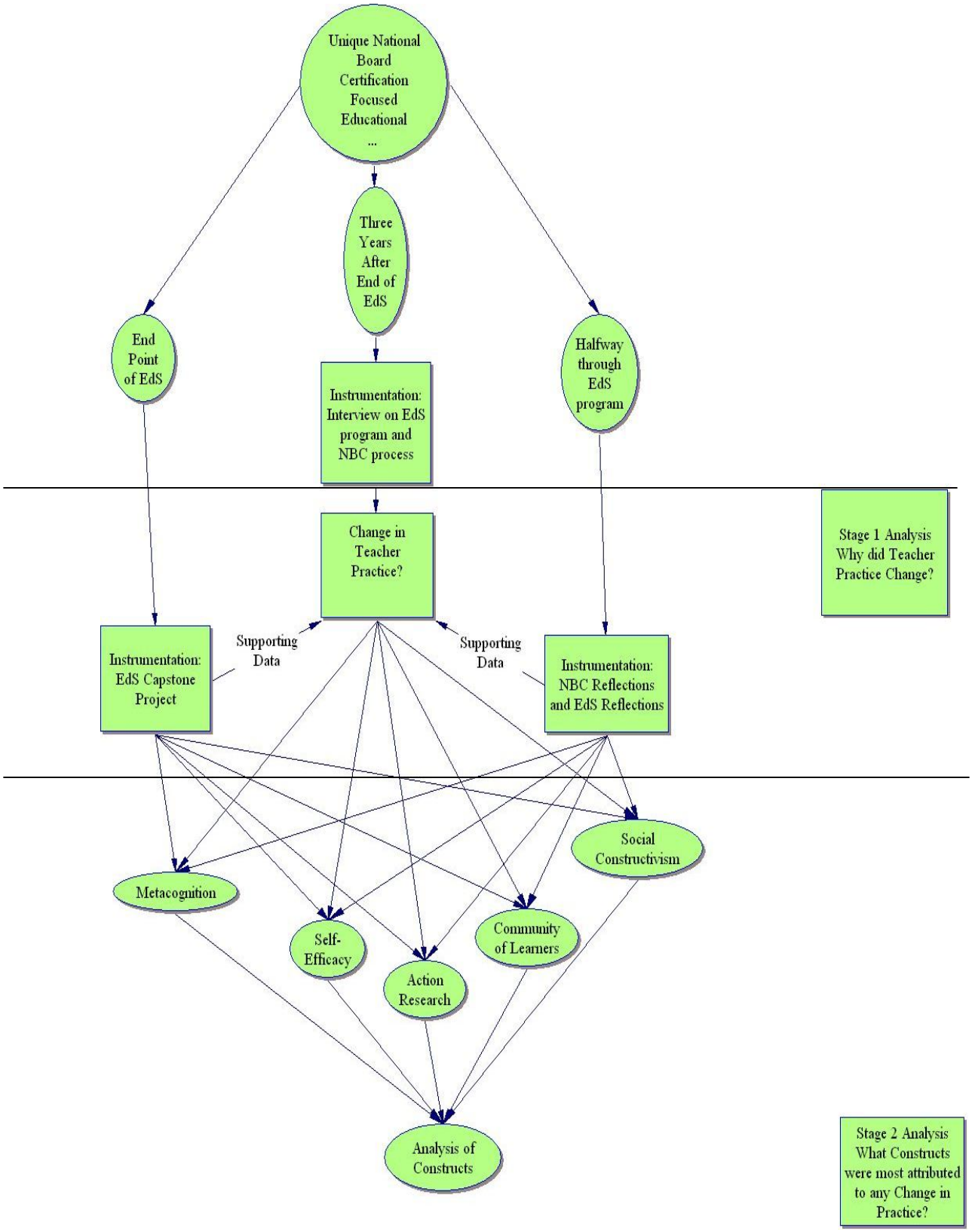

Figure 8. Data analysis overview.

Each participant was contacted through email and by US mail after IRB approval. Information on the study, the purpose of the study, the method for the study and what they were being asked to do was included with the Informed Consent form. I received six positive replies from the teachers and their informed consent forms. A questionnaire was forwarded to each participant to insure they qualified for the study and requested specific archival documents. These requests were for journals, opinion papers, National Board entries and reflections, reflections prepared at the end of the first year and capstone projects prepared during the second year in electronic format. Three of the six participants forwarded all the materials indicated in Figure 8. The journal entry and opinion paper data were in paper form and not available from most of the participant and eliminated from the study. Three of the participants were not able to send parts of their reflections, entries, or capstone materials due to computer storage problems such as corrupted data.

After data were reviewed, the interview questions were modified and the interviews scheduled prior to the end of the 2007 school year. Each 35- to 55-minute recorded interview was transcribed. Each question was asked in multiple formats designed to narrow answers and provides multiple points of view of the program, such as Question 1. *In reflecting on the prototypic EdS program, b) What learning outcomes or activities did you find to be the most influential on your teaching practice?* and Question 2. *In reflecting on your practice and beliefs, a) What concepts, theories, and practices that were learning outcomes in the EdS program did you continue to use one year later? Two years later? Still and if so, why and how was it affecting practice?* Each 35- to 55-minute recorded interview was transcribed. Interview data were organized and analyzed

using QSR International's NVivo 7. These were semi-structured interviews using open-ended questions posed in such a way as to lead the participants through a process of recalling the EdS "learning activities" they completed during the program and what their perceived importance to teacher practice over the five-year period.

In the first stage of analysis, I divided the data into three sets. The first data set included interviews of each participant three years after completing the EdS program. The second data set consisted of the capstone project which consisted of two parts, the first being an action research project about something in their classroom and second a plan for mentoring peers. It was completed at the end of the EdS program during the second year. The third data set was the reflections on the National Board Certification process that were completed at the halfway point of the EdS program and the NBC reflections submitted during that first year.

In the second stage of analysis, I focused on the four constructs of the study which included three theoretical frameworks and a research methodology used in the study and grouped data into four categories which were metacognition, self-efficacy, social constructivism and action research. I was cognizant of emergent themes however and the data indicated an additional construct of community of learners.

During the first stage of data analysis, observed or reported changes in teacher practice were correlated to the same constructs previously mentioned. The purpose of this analysis was to determine change over time and used the three data sets mentioned above were used to determine observed and perceived changes in teacher practice in these data sets. This grouping determined how the participants described the things they did, continued to do, and reflections on accomplishments based on the program's

constructs and methodology. Using the NVivo 7 program, I did several word searches that identified specific learning outcomes built into the NBC process and the EdS program and their theoretical constructs. The word searches were listed in Appendix B.

The purpose of the second stage of data analysis was to determine which of these constructs or methodology might have affected the participants. Determining which appeared most affective provides data for future classes that focus on these constructs and the use of these classes in ongoing programs. This determination may also assist in refinement of understanding of current practices for ongoing teacher professional development.

First Stage of Data Analysis

The study's design used reflections from the NBC process, reflections at the half-way point of the two-year EdS program, the EdS capstone project which was an action research guideline for mentoring peers, and interviews that occurred three years after the end of the EdS program. After each participant completed and submitted their Informed Consent form, I requested them to submit a questionnaire, the reflections, and their final projects. Once these data were received, I considered each piece to determine any changes that needed to be made to the interview questions proposed in Chapter 3. The proposed interview questions were not changed, but I did identify areas in the questions that I wanted to focus on during the interview. In addition to the EdS constructs of the program, areas of interest were identified, including student reflection and interaction, community, and changes perceived in student learning.

The six study participants scheduled an interview time and place, generally after school, and at their suburban high school. I knew each of the participants very well from

my experiences as an instructor in the unique EdS program. This did present an issue of bias in my study, but I have provided detailed information so that others may follow my chain of evidence and substantiate my findings. Additionally, another person who was an instructor during the complete program was asked to read my analysis and findings to determine other areas where I might have been biased and share his perceptions of the data as a means of triangulation.

The participants willingly provided answers to each of the questions to the best of their memory and insights into their feelings about the experiences they had during the EdS program, NBC process, and over the three years since the end of the program. As each participant answered interview questions, I continually refined my questions' focus, and did initial analysis through contrast and comparison prior to the next interview. After the interviews were completed, each was transcribed, and analysis was completed with the assistance of NVivo 7 qualitative research software. Pseudonyms were used in place of teachers' names to protect their confidentiality in this report, and the direct quotations included have not been changed to correct grammar or spelling.

As I began my first stage analysis of data, it became evident that the data presentation would be better understood in reverse chronological order. Drawing conclusions from the convergence of the interview data and then supporting these conclusions by using the excerpts from the capstone project and then the NBC reflections and EdS reflections. Quotes from each interview transcript were used in reporting the effects of the program constructs and other identified areas of interest in each participant's teaching practice. Each of the quotes referenced were included in Appendix C, and the participants were presented in alphabetical order. Citations for each quote

include the Appendix letter, speaker's name, and the quote number identifying the data from which the quote or paraphrase came. Subsequent quotes from the same speaker include the quote number in parenthesis at the end of the statement. Excerpts from the capstone paper on action research were included in Appendix D and excerpts from the NBC and EdS reflections were in Appendix E. In each of these Appendices, the corresponding data were in alphabetical order by participants' name, then numerical order by number which includes the identified quote or excerpt. The paragraph number from the full transcript or paper where it was drawn was included so other interested parties could identify the full quote and follow the chain of evidence.

Five constructs have quotes attributed to them. Four of these were original constructs of the program, and all five were constructs of the NBC process. While these constructs stood individually, they overlap and became intertwined in the data. Therefore the same data were presented in multiple places in this report to build support for the conclusions. The references attributed to each construct were identified by the Nvivo 7 software. The metacognitive construct had 73 references attributed to it. The second construct was social constructivism, and had 56 references attributed. The third construct was community of learners, which emerged during data collection and analysis, and had 44 references attributed. The fourth construct was self-efficacy, and had 28 references attributed. The fifth construct was action research which had eight references attributed. Appendices, names, and quote numbers provided a link to the original data sets. As each construct was analyzed, the three data sets were investigated for patterns and to build explanations. Sincere there were five different constructs of the study, then the three data sets were visited and discussed many times. In addition, the metacognition discussion

was broken into three different emphases for analysis so this increases the number of times the data might appear.

Metacognition

The theoretical construct that occurred most frequently was metacognition with 73 references. Wilson and Clarke's (2002) work described metacognition as "awareness individuals have of their own thinking, their evaluation of that thinking and their regulation of that thinking" (p. 4). In this study, reflection was understood to be a broader evaluation of a process, object, or thought. It provided a basis for evaluation of and change in teacher practice, particular lessons, and self. I attempted to break these references into three broad emphases including reflection on self, reflection on the program and process, reflection on my community, and reflection on students.

Reflection on self was the first area to be discussed. Abigail thought that reflection on self was the hardest thing that she did during the program (Appendix C, Abigail, 1). She expressed concerns about knowing whether she was doing the "right thing or the wrong thing" (8) and realized that only reflection would help her evaluate her actions (9). So Abigail found that "The self-analysis, I thought was awesome…" (11). In discussions that occurred during the program and NBC, Abigail watched how others handled that moment of silence after she asked a question and realized for the first time that this silence was important (16). This silence allowed her students to think and formulate ideas and answers to the question. She identified that silence was a positive thing and was in the best interest of the student and classroom (16).

Abigail's capstone project, which focused on action research as a mentor to another teacher, was not available for this study's data set due to computer problems;

however, in Abigail's reflections on the NBC and EdS, she claimed that the NBC process helped her to be more aware of what was going on in the classroom for her students' (Appendix E, Abigail, 1). This process encouraged Abigail to analyze her teaching and evaluate her students' learning (Appendix E, Abigail, 14), and to reflect over experiences to determine if she could have had a better outcome (15). Abigail claimed, "I learned a lot about myself and my dedication to teaching mathematics, but also teaching the tools of life" (2). As Abigail reflected on her practice, she found in addition to teaching her students mathematics, she spent considerable time teaching them to be better human beings (2).

Gabrielle had taken a position as an administrator in a different school in charge of professional development. She had a different perspective on the learning objectives and presented her ideas with a different slant. Due to staffing shortages occurring midway through the year, she taught an Algebra 1 class in addition to her administrative duties. Her answers to the interview questions addressed her personal teaching practice and how she hoped to use the constructs and methodology from the EdS program to strengthen staff at her new school. Gabrielle believed the reflective teaching model was a positive for her teaching and for her staff. It was much like peer coaching where two people work together and then reflect on how to improve (Appendix C, Gabrielle, 2). She found that this reflection gave her self-confidence to try new things and then evaluate them to determine if they improved her teaching practice (2). Gabrielle continued to consistently reflect on herself and her actions even in her administrative capacities. These reflections empowered her to determine whether her actions were good or not and how she might be able to handle things next time either in the classroom or as an

administrator (6, 10). Questions that she asked during staffing interviews were driven by the experiences that she had during the EdS program. She identified the parts of the program that she believed make a good teacher and asked questions about those during the interviews (Appendix C, Gabrielle, 14). Three years later, Gabrielle continued to use the knowledge and experiences of the EdS program to create positive learning environments for her students and the teachers with whom she worked.

Recall that the second data set was drawn from the capstone project at the end of the EdS program. Gabrielle was a secondary mathematics teacher at the time of the program, but subsequently became an assistant principal the following school year. She taught one class per day due to staffing shortages in addition to her duties as an administrator at the time of the interview. She was primarily in charge of professional development at the school at the time of the study. Gabrielle wrote in her capstone project how her action research study affected her and her practice. She wrote, "As a design, action research provides educators an opportunity to reflect on their own practices" (Appendix D, Gabrielle, 4). She found that action research in lay terms was looking, acting, and thinking about your practice (6). She also identified the process as a spiral (recursive), when an educator thinks about practice, they actually think about what changed when they acted on their practice. If you did not reach a goal, then you would look at your practice again and refine your actions and then think about it again. This was a recursive process used to improve the practice of education and where researchers study their own problems (8). As part of her action research study, Gabrielle had students writing in a journal for ten minutes each week about a question posted on the board (14). She found that these writings garnered students' beliefs, attitudes, and

dispositions on mathematics which intern provided her insight into better ways to reach her students. This journal became a window into each student's mind and helped her realize how large her influence was on a student to become productive. Gabrielle went on to write, "Once we start focusing students on their role in learning mathematics through self-reflection, we can see real changes in student engagement during our classrooms" (Appendix D, Gabrielle, 18). She found that by going through the student reflection questions in their journals, and reflecting on her practice at the same time, she was then able to address ideas, strategies, successes, and failures (20). Gabrielle continued to feel that working with colleagues to expose students to the idea that learning mathematics was more than learning concepts, procedures, and applications was vital to creating positive mathematical dispositions (21).

Just as Gabrielle believed working with other teachers helps her to create positive mathematical dispositions in her students, Jordan claimed that his personality was reflective in nature, but he found through the reflective teaching model that it was more "beneficial" when it was a shared experience (Appendix C, Jordan, 1). His experience with the Mathematical Task Analysis (MTA) and through Entry 1 of the NBC process caused him to begin to analyze students' learning and evaluate what they should know and how he might work to increase the students' knowledge (3). Jordan said, "I think that that area [MTA] was something that we really did hit on the nail" (9). Jordan also said that analyzing videos of each other while teaching (or in the classroom) was very good for professional growth. He went on to say that "…there is nothing like watching yourself, or watching someone else teach, and having a relationship with that person, and

the fact that we could be so open and honest about ourselves and each other", and this was the way to improve (7).

As part of Jordan's capstone project, his action research study was on homework and its effects on student achievement. During one unit of Algebra II, he attempted daily homework quizzes that totaled the value of his typical quiz schedule. His question was whether daily quizzes would encourage more students to complete homework regularly and therefore increase student understanding and achievement. Jordan wanted students to reflect on the unit when completed, and these reflections and results led Jordan to realize that the daily homework quizzes did not create much change (Appendix D, Jordan, 2). He did determine by contacting parents about their students' grades led to an increase in those grades (5). Some students reported changing their homework regimen during the unit but Jordan did not determine if this occurred due to change in quiz schedule or parent contacts. Jordan found that of the nine parents he communicated with regularly, eight of those students consistently performed well. The ninth student made progress to improve his test scores (6). Jordan found that by starting early in the year and increasing parent involvement; he created a positive effect on student achievement.

Joyce agreed with Jordan's evaluation of the implications of the MTA that with one sentence she could lower the level of cognitive demand of her students' tasks by simplifying the task to a procedural one. She determined that she must be very cognizant of this point (Appendix C, Joyce, 2). Joyce went on to say that sometimes a teacher may have to lower the level of cognitive demand of a task in order to allow the students to move to the next level, but if this decision was made after reflection, she was aware of what she was doing and did not just let it slip out. A teacher must be aware of the zone of

proximal development of the students and determine the desired level of mathematics to know how to situate the task they were asked to do. This thought process that teachers make, sometimes hurriedly, may expect too much or too little of the students' (Joyce, 3). Joyce thought that good teaching requires that once a teacher had taught something, then "you must think about what you taught and … you do it better then next time" (Appendix C, Joyce, 6). She asserted that collaboration built knowledge through a joint reflecting process (7). She thought that the NBC was the focus of most of her reflections since it was the center of the EdS program for the first year (12). Joyce continued to reflect over the program and process and discovered several changes that she made in her teaching practice due to the EdS program and the NBC process. First, she developed a systematic method to insure that she conversed with every student in the classroom at least once each day (11), and she allowed students to be the center of the discussion instead of herself (12). Reflection was the primary response to the program and process according to Joyce (13). Additionally, she pointed to the community of teachers in the program that were together for two years and how the collaborative reflection was so effective (13). "Introspective learning" was a phrase that Joyce used to represent the continuous reflection that was asked of each teacher during the NBC process and the EdS program (14).

Joyce's capstone project included an action research study investigating the effects of homework on test scores. The second part of her capstone project was a manual on how to mentor new calculus teachers through action research. During Joyce's action research study, she concluded that not having a homework policy resulted in student grades falling and having a policy was all that mattered, not whether you check

homework randomly or give homework quizzes (Appendix D, Joyce, 13). The action research helped her understand the student's motivations as she assigned their homework.

In Joyce's NBC and EdS reflections, she wrote about changing her "old school" methods in the classroom and making sure that every student in the classroom actively participated and creating a student centered class (Appendix E, Joyce, 1). She also changed her teaching practice for students compared and contrasted related topics through a reflection assignment (2). Joyce wrote that the NBC process was "very enlightening", and she claimed to be a better teacher because of it. Her reflections on the process and program were useful to her practice (3). Joyce's NBC Entry 2 taught her the importance of student communication with each other, not just between her and students (4), and she claimed that collaboration was one of her strengths. She collaborated with peers to create web pages for her classes, and believed that this collaboration was good for her students and made her a better teacher (5).

According to Jacob, the program was terrific, and he recommended it to every teacher. Also, he recognized that many teachers do not have the time or willingness to go through such a rigorous course load and work load, but he "would not trade it for anything" (Appendix C, Jacob, 1). He believed that every teacher employs plan-teach-debrief cycle in some form, maybe not as formal as the model proposes, but still the three steps of planning a lesson, teaching the lesson and then reflecting on the way the lesson went (2). He went on to talk about the Reflective Teaching Model (RTM) and described it as "priceless" and that everyone who teaches does this at some level. The reflection on teaching was the step that teachers needed to improve (2). Jacob also described what had

happened to him when I asked about specific models used in the EdS program and he described it this way,

> Maybe the terminology, kind of, breaks down a little bit in your memory, but there were those moments when you find yourself – when you're questioning your students, and you're listening to their answers, and you're, kind of, letting them develop their own thought processes, and their own thoughts about a problem, … and you can see the light bulb go off, and you kind of know, "Okay." Now, I remember- and the one phrase I do remember of the whole thing is the, "Doing Math" (Appendix C, Jacob, 3).

He described the MTA and how he realized that he was still using the model discussed during the EdS program (4). He felt that he was reflective before he started the program, but by the end of it, he had developed a more formal, better technique of reflection (6). Jacob continued to recognize activities, lessons, and accomplishments that would have been good for the NBC certification process, which was valid for ten years, and planned to use them for his recertification after eight years (7). Jacob continued to talk with others in his school about how his classes were going; reflecting on what he was doing and how to improve his teaching on a daily basis (6, 12, & 13). He asserted that reflecting collaboratively was much more effective in changing practice (9). Jacob also pretended that the principal was sitting in the classroom to help him do his very best for the children (19). He remembered that when going through the program he was driven to succeed because of the community of learners of teachers, not just because of each individual (13); the cohort drew on each other's experiences and the stories that he told were typically positive ones based on the high achieving school, teachers, and students (14). He said that the RTM was the most important model used in the EdS program and that the NBC process was another way of doing the same thing as the RTM. He also felt that the second most influential model was the MTA (15) to insure that he was not asking

"lame" questions (16), and Jacob still felt that reflecting collaboratively helped improve his teaching. After working with the professor on his writing in the last semester of the EdS program, he even went back and checked sentences to ensure that he was writing appropriately for emails (17). Jacob believed that the program and process were effective in improving his practice, and at the same time, he continued to improve his practice through collaborative reflection.

Jacob's capstone project included an action research study of assessment on female student athlete's academic success. He wanted to determine if peer encouragement, time management skills, or parental influence were keys to student success on assessments (Appendix D, Jacob, 17). In Jacob's NBC and EdS reflections he made several critical points. First, he wrote that the NBC process made him a more sophisticated learner (Appendix E, Jacob, 1). Also that he was more conscientious of the discussions in the classroom and what the students were really saying (2). He promoted this classroom discourse by changing the arrangement of the desks (5).

Rachel was excited to be able to participate in the program. She had previously completed her National Board Certification and was hoping to help others achieve the certification as the National Board of Professional Teaching Standards encourages (Appendix C, Rachel, 1). In thinking back over the learning experiences, she identified the "reflection stuff" was the biggest part of the NBC process (9) and was "…the best way to learn who you are as a teacher…" (10). The collaborative reflection also helped others to become better teachers (10).

In Rachel's capstone project, she included an action research study on determining whether her assessments evaluated the students' knowledge (Appendix D,

Rachel, 4). As she began the study, her students told her what they liked and disliked about her assessments (2). Rachel agreed that alternative assessments were good for the students and the teacher, but also realized that she and most other teachers do not have the time to work with those types of assessment (7). Rachel's NBC and EdS reflections provided an insight into her vision halfway through the program. She had successfully completed her NBC on the first try two years before the program started. Rachel claimed that the NBC process made her grow as a professional and gave her more self-confidence as a teacher and a leader (Appendix E, Rachel, 1).

While the first metacognitive emphasis was on reflection on self; the second metacognitive emphasis was when the teachers reflected about the EdS program and the NBC process and how these affected their practice. Abigail told that reading the scholarly papers during the second year of the EdS program allowed her to open her mind to differing views. She continued saying that the discussions on these scholarly papers had a "depth" to them, helping each of the participants to move away from being narrow-minded (Appendix C, Abigail, 6). Abigail spoke of how the program developed an awareness of the broad basis of the learning outcomes and the NBC process (12). Discussions with others outside the program led Abigail to believe that the NBC process was a two- or three-year process to be certified. From these discussions, she realized that few people passed the certification the first year and many went back to finish the second, but some took a third year of work to complete the certification (14). She acknowledged the surprise when all five of the participants' success on the NBC on the first attempt and the overall success of 10 of 11 people involved in the program. These included participants and instructors, and on the periphery, teachers who participated in some of

the sessions, were successful the first year and the one who was not certified during the first year, was successful the second year. She realized, after the NBC process had concluded, that it made her analyze and evaluate the teaching and student learning of her class (Appendix E, Abigail, 14). The NBC was one of the models incorporated into the EdS program and Abigail went on to say, "So the EdS program is needed. It helps not only the kids, but it helps you define who you are as a teacher..." (Appendix C, Abigail, 18). She also went on to say that she learned to reflect to see if she could have done things better (Appendix E, Abigail, 15).

Gabrielle spoke of the NBC as one of the "big" things for the rigor that it required, but also for the endurance it commanded. She went on to say that she liked the RTM and felt that it was very similar to peer coaching (Appendix C, Gabrielle, 2). After studying the NCTM's standards, Gabrielle found that mathematical disposition was a driving force in students' abilities to learn and the better the disposition, the better the learning of mathematics (Appendix D, Gabrielle, 1). The NBC reinforced this thought that a positive environment in the classroom leads to a better mathematical disposition (2). Gabrielle's capstone action research project was to improve mathematical disposition in high school mathematical students (9) and led her to conclude that "Teachers and supervisors working together, coordinating and presenting issues, problem solving, and negotiating ideas will maximize the learning environment for all students" (7). She found through this project, including reading scholarly journals and listening to teacher discussions, that they have a tremendous influence on creating a more productive mathematical disposition for each student (12). Unfortunately, circumstances prevented Gabrielle from providing her reflections from the NBC and EdS.

At the same time, Jordan felt like he "...was in the presence of really good teachers and people who cared about the profession as a whole", and this group of teachers provided him with a positive community which he never expected (Appendix C, Jordan, 6). He thought that watching other teachers' classroom videos and analyzing the teaching that occurred was a positive experience, but what made it even better was that people in the cohort could be "open and honest" with each other (Appendix C, Jordan, 7).

Jordan's action research project led him to conclusions that he did not expect (Appendix D, Jordan, 5). He found that parental involvement, not homework, seemed to correlate with students' test scores. This action research led him to thinking of future studies that he could use to find more ways to increase student achievement (7). Jordan did not discuss other learning outcomes of the program in his action research paper. Unfortunately, Jordan was not able to provide the reflections from the NBC and EdS.

When Joyce reflected on the program, she remembered the scholarly articles that were read and presented to the cohort. She had a hard time with the vocabulary of the articles, but when the cohort discussed the article and each of her peers' insight helped her make meaning of it (Appendix C, Joyce, 4). When Joyce reflected on the program, the most vivid memories came from the NBC process. In a broader sense, she also emphasized the reflection required by the program and the community of teachers who helped each other develops methods of doing things (13).

Joyce's capstone project included an action research study of homework and grades. She assigned a reflective journal entry for students to tell her what they liked or disliked about her homework assignments and what they liked to see in their homework assignments (Appendix D, Joyce, 5). She also investigated pertinent literature and

determined that homework increases retention and understanding (3). Her study helped her see that not having a homework policy was bad for the students' grades (13). This indicated that the cyclical process of social constructivism applied to homework and grades and there were always some students who completed homework and some that did not (Appendix D, Joyce, 13). She agreed with the literature that homework helps with self-discipline, time organization, inquisitiveness, and independent problem solving (3).

After the first year of the EdS program, Joyce said, "The whole process has been very enlightening and I believe I am a better teacher because of it. I also think that reflecting on it has also been useful!" (Appendix E, Joyce, 4). She identified the large group videos and Entry 2 to be a key for her by realizing that student to student interaction was a positive thing (5). Joyce also learned that collaboration was her strong suite, and was motivated to continue collaborating with fellow teachers. She found it to be, "...better for the students and makes me a better teacher."(6)

Jacob agreed with Joyce that there was an emphasis on reflection in the program, and there were several models that each required teachers to reflect on their practice. First, he discussed how important the RTM was in improving practice, but he also emphasized the use of the MTA to know what level of cognitive demand her students were in, and finally the NBC (Appendix C, Jacob, 2, 3, 6, 12, 15, and 16). Each of these models required the teacher to be reflective. Jacob said that he might not know the name of each of the models or theories that were discussed, but he had continued to utilize the parts of the program (20).

Recall that Jacob's action research was about assessment and female student athlete's academic success. He wanted to determine if peer encouragement, time

management skills, or parental influence were keys to student success on assessments (Appendix D, Jacob, 17). As Jacob began his action research, he understood that the steps of action research were social constructivist in nature. As he evaluated the results, he made judgments about them and determined if he had reached his goal or needed to change another aspect and then rework the plan. He found that communities of learners formed and peer pressure could be positive as student athletes pushed each other to do better (Appendix D, Jacob, 10). Jacob also found that reflective processes were needed to determine when he had reached the conclusion for which he was looking (6). In his NBC and EdS reflections, Jacob claimed that his teaching had changed and that he was more aware of the questions and comments of the student and allowed them to determine the flow of the class (Appendix E, Jacob, 2). Jacob wrote that some of the learning outcomes of the program, including watching video as part of the RTM, did not create change in his teaching practice. He claimed he was a reflective teacher before the program and that the program did not change his metacognitive practice (4). Jacob also felt that the process of analyzing student work was new for him (3). He did not believe the RTM and the MTA, which helped analyze student work, helped him accomplish this task. While this may be true after the first year, by the time of the interview four years later, he believed that the RTM was the most important model of the program and the second most important was the MTA.

In contrast to some other participants of the study, Rachel felt that the MTA would have helped the most in her NBC (Appendix C, Rachel, 5) but reflection was the biggest part of the program (9). In Rachel's capstone project, like Jacob, she included an action research study determining whether her assessments effectively evaluated

students' knowledge (Appendix D, Rachel, 4). As she began the study, her students used reflective skills to tell her what they liked and disliked about her assessments (2). She kept a list of what types of assessments students liked to take and which the literature said were better. Rachel agreed that alternative assessments were good for the students to show what they know and teachers to see what the students know. Rachel also realized that she and most other teachers did not have time to work with those types of assessment (Appendix D, Rachel, 7). In the EdS and NBC reflections, Rachel believed reflection proved helpful in all her classes. She took her time grading and analyzing student work to help them know what they did not know (Appendix E, Rachel, 1). She claimed that through the analysis of student work, she needed to find each mistake and understand what students did wrong to find a way to correct their understanding (2).

The third reflective emphasis was how the participants applied the program outcomes and generated student improvement. Each participant presented situations and places where they had taken something from the program and used it in the classroom to increase student learning. Abigail talked about her reflection and how she believed that her students became stronger by her teaching them to reflect (Appendix C, Abigail, 4). As her students began to reflect, they developed a stronger mathematical disposition and their self-efficacy became more positive. Her kids were, "...reflecting. They're thinking about it (the task). They're planning it out. They're seeing it through. They're making sure their answers are reasonable, and that's not all of the kids, but that's the majority of the kids" (5). She continued to reflect on how students were affected by the learning outcomes of the EdS program and by asking questions at the highest possible cognitive level. She created discussions in which the students broke down the problem and learned

to problem solve through their interactions in the classroom. These interactions caused students to reflect on possibilities as they discussed them with their peers (13). Abigail had her students own their grade. This ownership developed responsibility for their learning and instilled pride in grades when they did well (19). Abigail was an effective teacher who had a passion for her students and their overall education, not just in the mathematics classroom but as a citizen of their school and local communities.

At the end of the first year and after the completion of her NBC, Abigail said that "I do know that NBC has made me more aware of the teaching and learning going on in my classroom for the students and me [teacher]," which led to the betterment of her student learning (Appendix E, Abigail, 1). Abigail also became more convinced of her dedication to teaching life lessons. She tried to teach students to be better human beings by "…show[ing] them how to make a difference in others lives while at the same time it was making a difference in each of out lives"(2). She believed that by showing the students that they could make a difference in others' lives, then they could make a difference in the larger community, which increased their self-efficacy. This increased self-efficacy created a more positive attitude and one that could persevere and be successful in difficult times.

Like Abigail, Gabrielle tried to increase student self-efficacy. She was an encourager of students. She told them that they could do the work and that they were college material over and over, until they started believing that they could do it (Appendix C, Gabrielle, 10). Making students the focus of her classroom became more important. There was a need for Gabrielle to be a "facilitator …encourager …guide" (1). For example, she organized an activity for her ninth-grade students that encouraged them

to help other people first. This activity required them to help three classmates with a mathematics puzzle and then they could complete their exercise (4). When she was in the classroom with her students, she focused on hearing their voices, not hers.

In Gabrielle's action research project on mathematical disposition, she found that students "...had questions about learning mathematics and how it would actually play out in their lives" (Appendix D, Gabrielle, 3). She used a variety of instruments to determine how students learn, and how they view their mathematics and themselves (11). One method was writing in a journal about a question on the board. These writings revealed the feelings that students had about themselves and mathematics (14). Gabrielle concluded that students who were focused on their learning through self-reflection made real changes in engagement in the classroom (18), and it exposed them to the idea that mathematics extended beyond concepts, procedures and applications to a powerful way to view real world situations (21).

Jordan's interview transcript and his NBC and EdS reflections did not attribute any references to reflections with his students or how the reflections in the program affected them, however in his action research project; he recognized that by having students reflect on any changes they made during the study, they built a relationship between these changes and material results that might occur (Appendix D, Jordan, 2). The students also thought that the daily quizzes lowered their grade since missing one problem on a three-problem quiz gave a much lower grade than missing one on a 10-question quiz (3). In the reflections, some students reported changing their homework regimen during the unit, but no evidence suggested this change would be long-lasting (5).

As Joyce began reflecting during the interview, she commented several times in the interview that the program's MTA helped her to realize how easy it was for her to lower the level of cognitive demand due to a simple statement that she might make to the group working on the task (Appendix C, Joyce, 2). She found from the NBC's Entry 2 on whole group discourse that a principle of good teaching was student interaction with each other (Appendix C, Joyce, 4). In Joyce's action research project, she studied the effects of homework on student success. As she started her project, she gathered information from professional literature and from her students through a reflective assignment on her website (Appendix D, Joyce, 5). When she categorized this input she decided to create a homework policy for each class of Advanced Placement Calculus (7). Joyce worked out the homework policy of each class based on the majority wishes of the class and she developed a different policy for each class. In the second class, she continued to randomly collect homework assignments as she had done previously. In the first class, she gave homework quizzes where the students could refer to their completed homework, and in the third class, she neither graded nor collected the homework she assigned. Each of these policies created different results during the six week study. The first two classes results were very similar, but the class's average without a homework policy dropped over five percentage points. She determined from this study that students needed some type of homework policy (9). In her study, Joyce allowed her students to help guide the boundaries of the research and through their participation build a proven long-term homework policy that does match most of the literature. During the NBC process, Joyce began to assign reflections where students had to compare and contrast related topics. This process showed how she applied the metacognitive theory to her

classroom to try to improve student achievement (Appendix E, Joyce, 3). Joyce also realized in working with the NBC process that during a whole class discourse, students should interact with each other and not just the teacher, changing her "old school" ideas (2).

Jacob agreed with Joyce in the use of the MTA. He started discussions and then allowed the students to carry the conversation and "...develop their own thought processes,...and you can see the light bulb go off, and you kind of know,..." that they were Doing Math, the highest level of cognitive demand in the MTA (Appendix C, Jacob, 3). He also acknowledged that he does not always spend time determining the cognitive level of a lesson, but does recognize the levels when he reflects (3 and 4).

As previously discussed, Jacob's action research followed female student athletes from the court to the classroom to determine how their motivation on the court affected their motivation in the classroom. Through an interview process with several female athletes that were his students, he determined that these student athletes understood academics were more important in secondary school (Appendix D, Jacob, 16). He identified several factors that these girls thought as important in their success. They included parental influence, time-management skills, and peer encouragement (17). During the interviews, Jacob also found that student athletes were leaders in their classroom and willingly put in more effort to succeed in their classes (19). After completing the NBC, Jacob realized that his teaching had changed and he shared his authority allowing his students to dictate the flow of the class. He felt hat he was being more conscientious of what his students were saying to him (Appendix E, Jacob, 2). He also constantly tried to find better ways to teach his students (1).

In contrast, Rachel thought that getting her kids to reflect together was very important (Appendix C, Rachel, 3). She encouraged students to "pair and share" to reflect on what was happening (2). Rachel's capstone project determined better ways to assess what her students knew compared with what they should know (Appendix D, Rachel, 6). Again, like Jacob, she used input from her students and from literature to determine the plan for study. The literature acknowledged alternative assessments as being useful in evaluating students and directing instruction (7). Rachel's students indicated that most of them wanted to continue with the assessments she had required, however they indicated that they preferred handwritten tests to typed tests (10). The students reflected on their previous assessments and the assessments during the study were chosen to fit their style (14). Rachel found at the end of her NBC that the process made her more aware of how analyzing student work was important to determine if the student was learning the content intended (Appendix E, Rachel, 4). She also found the need to include the family and community in the education of a child (4).

The metacognitive summary shows each participant recognized the importance of the things that they learned during the EdS program and their reflections on the experiences showed their belief that the program did affect their teaching practice. These beliefs included that reflection in their personal practice and through collaborative settings had improved their teaching. Several identified the RTM as the most important model they learned, but Jacob recognized that the NBC process of describe, analyze, and reflect was basically equivalent to the RTM's process of plan, teach, and debrief. Jacob further elaborated that while the RTM used the plan-and-teach components of the cyclical model, the NBC used a description of the plan and lesson. Secondly, the NBC used the

analyze-and-reflect steps which were mimicked by the "debrief" step of the RTM. The second most important model, according to several people, was the MTA, which allowed each participant to analyze student lessons and understand the cognitive level that occurs in their classroom and how easy it was to change that level. But again, Jacob and Joyce agreed that the MTA had the largest affect. Additionally, they agreed that the RTM was very important and reflection entered into almost everything that a teacher did or tried to do. Abigail and Gabrielle expressed how they had taken the EdS learning outcomes and adapted them for use in their classrooms, applying the theoretical constructs for student lessons. They exhibited several situations where their experiences in the EdS program affected their students. Other participants did not exhibit as many references nor did they talk about the effects on their students in detail. All but one, Jordan, expressed how their students developed some reflective skills while in their classroom.

After I interviewed each of the participants, I reflected on the program myself and here are some of the beliefs that I hold. I believe the program should occur again and that teachers were better for having participated in the EdS program; I also believed that the NBC process as a useful tool for the program. In addition, I believe the need for this type of program to be a cohort so that a community of learners might develop. I discussed this later in the reporting of the community of learners construct.

Social Constructivism

Learning that occurs through interactions with a person's environment was social constructivism. These interactions were varied and produced through different activities, including reading, discussion, observing, social interaction, and even watching television. These interactions also provide the impetus for change and the construction of new

knowledge. Abigail talked about the EdS program's classroom interactions and felt that the discussions were deep enough in theoretical and philosophical meanings to enable the participants to keep us from being narrow-minded (Appendix C, Abigail, 6). She also remembered in one of the classes, each pair of students had to develop a curriculum for the specific purpose of teaching a mathematics strand to the group. She believed this process helped to show the depth of the group and their caring and togetherness demonstrated during the process (7). Abigail reflected on the program and the things that she learned. She began to realize that if all teachers knew the things that she had learned, then we would all be on the "same page" and students would learn more (12). She agreed that NBC influenced on everything about a teacher's life. It makes teachers more aware of what was going on in their classroom. The student learning was important and she taught the content to the students. After her students learned the content, she allowed them to share it with each other. For students to understand and share the content and their ability to apply it to differing scenarios was the goal of student-centered mathematics teachers. Abigail believed that each student as a "living creature" not "stagnated things sitting down" (21).

Her students became the focus of analysis also. She looked at social constructivism as a way to organize and run her classroom. She found that when her students were able to think about the task and then plan it out, they could ensure the answers were reasonable. While not all students did this, the majority did (5). Abigail talked about how she posed a random question to the group and then allowed them to discuss it. As the students did, they would break it down developing methods for solving the problem. Abigail said, "And they learn so much from each other versus hearing me

say it, and they never pick it up" (13). In setting the expectations for students, she found that students may not be happy with the level that a teacher sets, but they would reach that level regardless of where it was (Appendix C, Abigail, 15). She helped the students to understand that everyone in the classroom was a teacher and when she was not next to a particular student, he or she could ask someone else for help. She ran her classroom as a true community of learners with everyone helping each other (17).

At the end of the NBC process and after one year in the EdS program, Abigail wrote, "I learned to become the student and allow the students to teach me what they actually knew" (Appendix E, Abigail, 6). This change in her practice provided evidence that new knowledge was constructed. She went on to say she learned that she could express her opinion on paper and to a group and also be able to accept someone else's opinion as their opinion.

Gabrielle took the MTA to heart and began moving her students to higher levels of cognitive demand (Appendix C, Gabrielle, 3). She developed lesson plans that encouraged students to work together to solve problems and assisted each other to understand the content (4). Her interest level increased to improve her teaching techniques, and she had the self-confidence to try new things (6). Gabrielle thought it was wonderful to be able to talk mathematically with peers and discuss how each person would teach a particular lesson (12). As she moved into her duties as an administrator, Gabrielle used the EdS learning outcomes to help her assess teachers seeking jobs because she felt the program helped her to understand what was necessary to be a highly qualified teacher (14).

During the capstone project, Gabrielle completed an action research study which she decided to be on mathematical disposition in her classroom and then prepare a plan to use action research to mentor another teacher. Most of her writings focused on the completed action research. In researching the problem, Gabrielle found that mathematical disposition included many different qualities, but NCTM's standards led her to contend that the better a students' mathematical disposition, the better they learned mathematics (Appendix D, Gabrielle, 1). In this thought process, the key was how people thought about the problems they faced and applied their knowledge and skills to solving the problem. She found action research to be basically a spiral of looking at practice, thinking about practice, acting on practice, and then repeating until the problem was solved. This was a constructivist process, and since it relied on interactions within the classroom, it was a social constructivist process (6, 7, & 8). Gabrielle encouraged students to discuss their mathematics with other people in the classroom. Through this discussion, students built their knowledge through the interactions with their peers (12). She also had students write in journals for ten minutes on a question on the board. These journals revealed their inner feelings to Gabrielle, which allowed her to adjust instructional plans to better fit the students (14). She also wrote, "Good problems give good students the chance to solidify and extend their knowledge and to stimulate new learning" (16), and she found that through student self-reflection on their responsibilities in learning mathematics, a real change would occur (18).

Jordan believed in self-reflection, but he found the interactions of collaborative reflection from the program to be a benefit. He continued to use this more than anything else in subsequent situations. He compared it to the RTM and thought that the process

used in the EdS program was not just paired, but a group model, and this was positive to have more people involved (Appendix C, Jordan, 1). The MTA helped Jordan to identify the cognitive level of the tasks he proposed in his classroom, and his students have a tendency to ask questions which force him to teach at a higher cognitive level (Appendix C, Jordan, 2). He was reflective about his students in trying to determine if they really knew what they were supposed to know. Jordan had someone observe his teaching and Jordan watched them teach. Then being open and honest with each other in reflections was the way to improve teaching practice. This social constructivist process not only reflected on the lesson taught but also used the collaborative reflection to instigate change in teaching practice (7). Analyzing student work was the area that the program "really did hit on the nail" (9). This process was highlighted during the NBC process in Entry 1 and again in the EdS program through the MTA and the NCTM standards. Each of these added to the teacher's tool kit of models and methods to understand and successfully understand the level of student knowledge and assess it.

In Jordan's preparation for his action research project, he found several points that led him to develop his project. First, he found that more time students spent on homework, on average, the better these students did academically; second, that homework completion developed self-discipline and time management skills; third, that mathematics required active participation for understanding; and fourth, that the consistent completion of homework led students to better grasp the idea that mathematics was a web of connected ideas (Appendix D, Jordan, 1). He saw that as students established positive homework habits, their achievement increased (5), and that parental involvement was more effective to increase achievement than homework (7). Each of

these points established that learning was taking place by both the teacher and students, but the best learning happened when they were working together to accomplish their goals.

Analyzing student work was a highlight for Joyce. She had little experience and the NBC Entry 1 required analysis of two work samples from two different students at different points in time. She contemplated the ease of lowering of the cognitive level of an assignment. She recognized the wish to keep the cognitive level as high as possible, but also recognized that sometimes students did not work at the highest level, and some needed assistance. Joyce acknowledged the MTA and its process of gauging the cognitive level and still remained aware about these levels (Appendix C, Joyce, 2 and 3). Her reflections on the research articles that were one of the EdS learning outcomes indicated that she "had a hard time getting through them," but when the group talked about the articles, they helped her decipher the intended meanings of the article (5). She went on to talk about the constructing of knowledge through collaborative reflection. Joyce said this occurred because the group was reflecting on a teacher's "craft" (8). The cohort brought together good teachers to think and talk to other teachers about various ways of doing something. This collaborative effort built upon the prior experiences of the teachers and as they listened to someone poses a problem and others' individual responses or reactions, they were able to construct their knowledge (14).

In Joyce's capstone project, she completed an action research project that determined the effects of homework policies on grades. This action research was a constructivist process where new knowledge was built through interactions with outside influences that included other people, books, activities, and new experiences. Joyce read

literature which demonstrated that homework was important for students to improve their grades (Appendix D, Joyce, 4), but it also helped with retention, study skills, and attitude (10). The students were asked to reflect on how homework affected their grade, and this input helped Joyce prepare her homework policies (Appendix D, Joyce, 11). During the NBC, Joyce learned that she needed to be a facilitator and allow the students to carry the discussion (18). After the NBC process ended and the EdS program's half-way point, Joyce reflected on what she had learned in a reflection paper. The first thing that she wrote about was changing her classroom operation (Appendix E, Joyce, 2). She learned through this first year that it was acceptable for students to move around a room and talk with other students. She found ways to ensure that she would talk to every student in the class every day to make them actively involved. She started using the board less and allowed students to demonstrate their learning on the board (9). Joyce also implemented a process of her students completing reflection assignments on her web page (3). These assignments asked the students to compare and contrast related topics. Each of these things might seem small, but the overall process demonstrated her learning and applying those new concepts and knowledge she had attained to her classroom.

Jacob reflected on a typical situation in which

> there are those moments when you find yourself-when you're questioning your students, and you're listening to their answers, and you're, kind of, letting them develop their own thoughts about a problem, or a series of problems, or an overall task, and you can see the light bulb go off, and you kind of know, "Okay." Now, I remember—and the one phrase I do remember of the whole thing is the "Doing Math" (Appendix C, Jacob, 3).

In this quote, he talks of how through the questioning and ensuing conversation students began to build the knowledge that they needed to be successful. Jacob continued reflecting about the other learning outcomes of the program and the action research was

one that “most teachers do on a daily basis without even thinking about it,” but when a teacher discussed the results from their impromptu research, this became an environment for the construction of knowledge (6). He also talked about the many experiences that he reflected on in front of the cohort group and allowed them to participate in his reflection to improve his practice (Appendix C, Jacob, 9), and he was able to “draw on each other’s experiences” (11). Entry 2 presented a challenge to Jacob. It was developed with video recording of a whole class discourse and analyze and reflecting on this lesson. While the students were learning through the discourse, Jacob was having a learning experience through description, analysis, and reflection on the whole of the video. He was able to identify ways to improve practice from the experience (15). Jacob was convinced that, while he could not recall all the phrases, his current teaching utilized the methods and models of the EdS learning outcomes (20). His answers to the final questions in the interview led to the understanding that he found the EdS program and the way the NBC process occurred to be a social constructivist environment, through the constant interaction with the other teachers who participated in the program. This interaction allowed him to become a better teacher and he felt that everyone improved his or her practice. He went on to say that learning how other teachers do things and just going back to school was important to make an educator grow. He was impressed with what he was able to accomplish through this interaction (21 and 22).

Jacob’s capstone project was an action research project on the student athletes in the classroom. During this project, he understood that evaluating the results of the study was important in the construction of knowledge (Appendix D, Jacob, 7). Jacob learned that female student athletes carried specific traits from the court to the classroom (14).

Some of these traits include fear of failure and embarrassment, and positive peer pressure, which leads students to have a positive self-efficacy (14). He also relied on fellow teacher/coaches for input on these concepts and traits. In Jacob's reflections from the NBC process and EdS program at the end of the first year, he did not discuss social constructivism.

While Jacob visualized the many places social constructivism appeared in his classroom three years after the program ended, Rachel implemented a pair and share model in her classroom to start her students building their knowledge. These interactions helped students to better understand and construct knowledge on top of their prior knowledge and experiences (Appendix C, Rachel, 2).

Rachel's capstone project led her to investigate, through action research, if students knew what they were suppose to know (Appendix D, Rachel, 3). She also investigated whether her current assessments determined student understanding (5). Several alternative assessment strategies were included in the literature as a method to fully understand what the student might know (7). At the end of the first year of the EdS program, Rachel had written an EdS reflection and also submitted her NBC reflections. The points she wrote about were focused on the analysis of student learning. She first wrote, "It made me aware that when I grade my student's work, I need to analyze each paper and find the mistakes and understand what they did wrong and discuss it with them. I have tried to do this since the NBC process" (Appendix E, Rachel, 4). Rachel also indicated that she was involving more students in their learning process by allowing them to talk to each other and by using peer-coaching in the classroom (9). She talked about how her students discussed their thought patterns and took peers through the process (9).

Each of these changes in her classroom resulted from the creation of new knowledge and insights that came from the NBC process or from the EdS program.

In summary, the participants' reflections indicated that each person used social constructivism in their classrooms. The methods might be different, but each used this construct. Abigail and Jacob used classroom discussions to break down a problem into its parts and then to plan a method to solve the problem and calculate a solution. They both determined that this method allowed the students to develop their thinking processes and build knowledge of how to solve problems. Rachel used a pair-share process for her students to interact and create knowledge as they worked together. She believed that each student, by working with a peer, would be able to better construct mathematical knowledge by having an ongoing dialogue about the task at hand. Gabrielle used a process of encouragement to get her students to move through the room, finding at least three people to help before they were able to work on a puzzle. This process again offered an opportunity for students to speak to each other, centered on problems or tasks. Joyce and Rachel did not talk as much about their classrooms, but discussed the program and how it used social constructivism as a construct. Joyce spoke about the interactions that the cohort had in discussing lessons that had been video recorded. Additionally, Joyce found that she could not make sense of many of the research articles the group read until the cohort started discussing the article and then it made sense. These social interactions provided for the building of knowledge when she was not able to do so, on her own. Jordan indicated that the time the cohort provided for discussions of teaching practice-reflecting on the practice and then determining what would be a best practice was social constructivism. Every participant agreed with the point that Joyce made about

the group discussing video taped lessons and the articles. Without the group, a teacher could not have understood the article or would not have had as strong a feel for what the reflections really meant. The key to each of these social constructivist findings was the cohort itself.

Community of Learners

A community of learners was a group of people with a common purpose and goal. This group provides mutual support and provides a social constructivist environment. There were two communities in this report. The first was the community of students in the classroom, and the second was the community of the EdS cohort program. Abigail reflected on the program classroom and found that everything that was accomplished was enhanced through the community that developed (Appendix C, Abigail, 6). She also believed that the cohort had a togetherness that made her willing to talk in front of the group (6 & 7). In attending other professional development programs, Abigail found that these learning outcomes were being advocated on a national basis, and when this collaboration occurred, then the kids learning increased (12). The NBC process increased her awareness and helped her see more of what happens in the classroom (21). Abigail also developed a community in her classrooms. She had her students reflect and share the reflections about assignments, and through this sharing Abigail believed they became stronger students (4). She placed expectations on the class for their success, and although they grumbled, they reached those expectations when they worked together (15). They also took ownership of their grades and their successes (18). Abigail also talked of the ways she interacted with the local community through outreach programs. She used

these things to help her students see that they could make a difference in their local community by helping others (20).

At the end of the first year of the EdS program, Abigail's "students feel more comfortable asking each other questions on daily work or homework than asking me" (Appendix E, Abigail, 10). She had also started using games and board work to get all students involved in their education (9). She continued to provide access to activities in the local community for the students to learn what it was like to help other people (11). Abigail shared with others about how she achieved her goals and helped them to achieve their own (12). She also continued to participate in jobs that determined the future of education by setting curriculum and adopting books. She believed, "We learn from each other and if we don't share our opinion as a diverse group of people, someone might be left out or neglected, so I must help change education instead of complain without a solution" (13). Abigail built her communities on several levels; her classroom with students, her school with students and with teachers, and her community with people inside and out of the school.

Jordan agreed with Abigail that the shared reflective experience was more beneficial than an individual one (Appendix C, Jordan, 1). He expressed that the community of teachers he participated with helped him to see differing points of view (4). Jordan thought that being a part of a group of highly qualified teachers increased his self-image (8).

Jordan tried to create a community of learners during his action research project through student reflections about the homework quizzes and surveys of parents about their child's homework habits. By doing these things, he was able to determine that

parental involvement in their students' assignments created higher student achievement, while increasing homework quizzes did not have the desired effects (Appendix D, Jordan, 5 & 6). Jordan did not collaborate with other teachers during the action research project, but he reported back to his course team of teachers about the results (Appendix D, Jordan, 4). Jordan's action research capstone project involved a classroom study about homework and its impact on student achievement and an action research mentoring manual. He did develop a community of learners in his classroom for his project on homework. This community included the teacher, students, and parents (5). While his research did not provide the answers he anticipated, it did lead to other methods that will benefit students (6). He also discussed his results with his fellow Algebra II teachers for their reflections on his action and how they might be able to apply his findings in their classroom (4).

Gabrielle thought that everything she did was through reflection (Appendix C, Gabrielle, 5), and when it came time to participate in the EdS program, she saw it was "so neat to be able to talk and speak mathematically to peers" and to discuss how they would teach a specific concept and develop new ideas on the best way for her to accomplish the task (12). Joyce agreed and said, "Well, that was the best part of the entire program. Whether it was the end part or the beginning part, the best part was being able to interact with the other teachers." (6). She went on to say that an educator builds knowledge through collaboration and shared reflection.

Included in the capstone project at the end of the EdS program, Gabrielle developed a plan to mentor peers using action research. She also had to complete an action research study about mathematical disposition in her classroom. During this study,

Gabrielle invited her colleagues to participate in the action research in order to improve their practice (Appendix D, Gabrielle, 5). She talked about how working together to coordinate and present issues, problem solve, and negotiate ideas maximized the learning environment (Appendix D, Gabrielle, 7). Gabrielle also saw that creating a community in her classroom of students who were willing to openly discuss their mathematics was a positive step in creating this strong mathematical disposition, but could present a challenge (12). After she had each student write in his or her journal, she found reading through the students' answers provided a chance to reflect on her practice, and then she was able to use a collaborative process for "addressing ideas, strategies, successes, and failures together will help improve our practice" (20). Gabrielle was unable to provide her reflections from the NBC process and the EdS program.

Joyce confirmed what others had said when she pointed out that many things were important or good about the EdS program, but basically the collaboration with the other teachers was most important (Appendix C, Joyce, 10), just thinking and talking to other teachers even if it was only to catch a phrase like "Ask three then me" (14).

In Joyce's capstone project, she had the students of each class help to determine a homework policy that the students felt would best fit their learning styles and help them to do their best (Appendix D, Joyce, 1). She studied three classes and had different policies for each class. One had no homework requirements, one had random homework checks, and the third had homework quizzes (7). Joyce found that it was better to have a homework policy based on the research previously done and on a comparison of her three classes. In Joyce's reflections from the NBC process and the EdS program, she realized that by answering every question from a student, she was not giving other students in the

classroom a chance to respond (Appendix E, Joyce, 11). She began making an effort to ask another student to answer fellow student's questions. She felt this built a community in the classroom so students depended on each other when the teacher was not there. Joyce also believed that collaboration was one of her strengths. She claimed she would continue to collaborate with other teachers because, "It is better for the students and makes me a better teacher" (Appendix E, Joyce, 12). Joyce claimed to feel more like a leader in the professional community after completing her NBC (13).

Jacob talked about how important it was to share his own experiences with the group and reflect on those with others (Appendix C, Jacob, 9). The cohort drew from different schools in different socio-economic areas, and the schools or participants had differing levels of achievement, but everyone had a basic desire to succeed and to participate as a community of learners (13). Jacob felt good about having other teachers see what he was doing and talking about it through the RTM and the NBC process (18). Jacob went on to say that he knew he became a better teacher because of the program, and he further believed that everyone did (22).

In Jacob's capstone project, he determined that collaboration with a colleague was valuable in evaluating an action research plan (Appendix D, Jacob, 5). In the action research project, he found that student athletes were leaders, not only on the court, but also in the classroom. By being a leader, the athlete created a community of learners in the classroom (19), and a positive form of peer pressure was generated to help the athletes with their academic success (17). At the end of the first year of the EdS program, Jacob wrote that student-to-student communication was much greater due to placing the students' seats in clusters so they would naturally work together more

(Appendix E, Jacob, 5). He also wrote that he had implemented more group work and the students seemed to enjoy this opportunity.

Rachel had previously completed her NBC process about two years prior to the EdS program beginning. She did not talk about the community of learners like several of the other participants, but during the interview, she said that she wished she had had a group of mathematics teachers to collaborate with when she was working on her NBC (Appendix C, Rachel, 4). One of her last statements when asked if the program should be repeated was, "I think it should. I think people will – I think that's just the best way to learn about who you were as a teacher and watching other people do their thing and talking about what they do, just the collaboration. So I – yeah, I definitely think it should be repeated" (10).

During the capstone project, Rachel completed an action research project on assessment in her classroom and then wrote a manual for peer mentoring. Much of the literature that she read emphasized that students should be involved in their own learning (Appendix D, Rachel, 9). Previously, she had attempted to use journals to spur interaction between herself and the students (8). Rachel had also found these journals might create opportunities for activities that involved student interactions, but the time required was excessive and it was difficult to fit them into the curriculum (8). In the reflections from the NBC process and the EdS program, Rachel wrote that she had become more "cognizant" of having all of her students be involved in the classroom (Appendix E, Rachel, 10). She had implemented more student interaction and peer-coaching to increase the community of learners in the classroom (4) and taught them to express their thought processes and help others to understand how they solve problems

without just giving them an answer (9). Both of these items have increased the community in her classroom.

A synopsis of findings on community of learners demonstrated that each of the participants believed that the communities of learners that were formed during the EdS cohort program were the real driving force behind the success on both the NBC and the EdS program. They each identified how the learning community affected their experiences in the program and that they would encourage the program to be repeated. Abigail and Jordan both told of how the interaction of the other teachers played such an important role in the program and that shared reflections were much more effective than individual ones. Abigail further discussed the multiple ways she developed community with her classroom students and the affects of the sense of community, but Jordan talks about the other professional communities in which he had become a part. At the same time, Gabrielle did not talk about students at all, but emphasized the program's community of learners. She believed that speaking mathematically with peers was most important to her. Joyce emphasized that the community was the best part of the program.

Self-Efficacy

Self-efficacy beliefs regulate human functioning through cognitive, motivational, affective, and decisional processes (Bandura and Locke, 2003). These self-beliefs were important to a teacher's self-confidence and motivation to execute their teaching practice and were also affective on students. These quotes will reveal the state of each participant's mind and attitude in relation to their teaching practice. Abigail found the reflection paper on herself to be the hardest thing. She said, "...this is my accomplishments and achievements, but still be humble, that was difficult." (Appendix C,

Abigail, 1). Abigail found that she was lacking self-confidence and did not want to strongly advocate for herself. She talked about the self-analysis and how it showed her that she was on the right track and that it made her a "stronger person" (Appendix C, Abigail, 10 & 11). She felt that being a stronger person helped the students have a higher self-esteem (11). She again emphasized that she was doing the right thing in the classroom, and she had more confidence (15). Abigail went on to talk about her classroom and her method of discipline. She said, "I don't have discipline problems. I don't have arguments among the students within the classroom. I make them respect each other, and they're respecting each other, they automatically respect me. Did I learn that through EdS? Most definitely." From this, the conclusion can be drawn that not only did the learning outcomes affect the participants, but they also affected their students (17). Abigail also talked about how her outreach programs affected her students. She attempted to get students involved in things like the AIDS Walk or the Diabetes Walk to open their eyes to the world. She worked with them to make a friend by being open-minded, learning to accept people as they are. She talked about trying to apply mathematics to real life, but the real reason for opening minds was "didn't we just make better humans?"

The reflections from the NBC process and the EdS program indicated that Abigail had been forced to look at her accomplishments and indicate why they were accomplishments in addition to how they impacted students, parents, and the community (Appendix E, Abigail, 3). She wrote about how hard it was for her to talk about these things because she felt it was bragging. At the end of the study, she was still working on getting better at allowing people to know what she had accomplished (4). In her

classroom, she had her students taking responsibility for their learning, and they were enjoying the responsibility. They were feeling confident and safe to ask questions on things they did not understand. The students even volunteered to answer questions for other students. She went on to say that her test scores had never been better (Appendix E, Abigail, 5).

Gabrielle adapted a model used in the EdS program and was using it for professional development at her new school where she was an assistant principal at the study's conclusion. Her experience was the driving force behind the push to use the RTM in her school. Not only the reflection on the teacher practice, but also the building of a community of learners was important parts of the process (Appendix C, Gabrielle, 2). Gabrielle was convinced that the program cohort was the driving force behind the success of the EdS program and NBC process (12). At the study's conclusion, she was still visiting and talking to students who aspired to be teachers even though she has moved to a different school. The students who heard her had been excited about the possibilities of going into education. She encouraged them to pursue their dream (13). Gabrielle found the most significant thing was to move her from the center of the classroom and place the students there. This was such an important concept, and, yet so hard for many teachers (1). She also gave students a chance to help at least three other students (4), and this opportunity to help others increased their self-efficacy.

Gabrielle, in her capstone project on action research, completed an action research study on mathematical disposition and produced a manual on mentoring peers through action research. She found through the action research study, "Watching and listening to them (her students) over the semester has given me evidence I needed to realize that

teachers have a tremendous influence on creating a more productive mathematical disposition for each student" (Appendix D, Gabrielle, 12). As students wrote for ten minutes in their journals, they revealed their beliefs, attitudes, and dispositions on mathematics (Appendix D, Gabrielle, 14). These journals affected the teacher self-efficacy due to what was written, but also it strengthened the students' self-efficacy. She wrote of how Lappan contends that students not only learn mathematics better, but also gain a self-awareness that gives them the confidence to continue to learn (18).

While Gabrielle discussed her work to increase her student's self-efficacy, Jordan had a positive self-concept when he began the EdS program and the NBC program. When he was successful on the NBC, he realized that the things he was doing were the right things. He felt good because he had not change anything from what he had previously done (Appendix C, Jordan, 8). Parts of the program empowered Jordan and made him more self-assured. He felt that the community of learners formed in the program cohort made him a better teacher and increased his self-efficacy (1, 4, and 8).

During Jordan's capstone project, he found that through student reflections, he was able to determine the students' attitudes toward homework as a means of improving their achievement (Appendix D, Jordan, 1). This student attitude component was one of the keys to a student's self-efficacy, so when Jordan read each of the reflections, he had a view of what the students' mathematical disposition was and therefore the students' self-efficacy (5). In his research, Jordan indicated that consistent homework assignments to reinforce classroom instruction also helped develop self-discipline and time management (1).

While Jordan discussed his student's self-efficacy, Joyce agreed that participating in collaborative reflection of a teacher's craft, built teacher knowledge and increased teacher self-efficacy. The cohort was the best thing about the program (Appendix C, Joyce, 6). Joyce went on to elaborate about the most important learning outcomes of the program saying, "... you know, you could put reflection in there, a lot of things, but I think basically it was the collaboration with the other teachers" (Appendix C, Joyce, 10).

In Joyce's capstone project, the literature stated that homework teaches students self-discipline, time organization, inquisitiveness, and problem solving (Appendix D, Joyce, 10). She found that some kind of homework policy was better than no homework policy. This was a motivator for students to become better (13). At the end of the first year of the EdS program, Joyce had prepared reflections for the NBC process and one for the EdS program. She indicated that "The whole process has been very enlightening and I believe I am a better teacher because of the process" (Appendix E, Joyce, 4). She wrote about how the completed list of accomplishments made her realize that she had made a difference (8). Joyce went on to say,

> This entry has given me more confidence in myself and my teacher. I think all teachers need to feel that what they do is important and that they made a difference in many peoples lives. It is this feeling that makes me want to go to work another day, another week, another year (8).

Joyce claimed that this program and all its models, processes, and methodologies proved to increase her self-confidence and strengthen her commitment to continue teaching. This was an important statement, indicating increased self-efficacy.

Jacob said, "Oh, the program was a terrific experience," further suggesting that every teacher should go through the program (Appendix C, Jacob, 1). He talked about how rigorous the program was and about the work load (1). Jacob stated that he was a

better teacher for having been through the experiences of the program and NBC (9). He found that all the teachers were driven to succeed, but not at the sacrifice of others, suggesting their camaraderie (13). Jacob's final statement during the interview was "...the most important thing was that we became better teachers out of it, and I felt like we did, and I felt like – I know I did" (Appendix C, Jacob, 22).

In Jacob's capstone project, he read Creswell (2001), saying action research empowered individuals (Appendix D, Jacob 2). He added that this empowerment helped teachers to feel in control of their own situation and built a positive attitude. In Jacob's action research project, he studied the relationship between female student athletes and their academic life (14). In this study, he found that the "fears of failure and embarrassment from the field (or court) and transfer those fears in a positive manner into the classroom" (14). One of the findings was that female athletes have an intrinsic motivation to do well and when this was active in a classroom, and they become very competitive. Jacob also found that parental support was a very strong motivational factor in their success (15). In the NBC reflections and the EdS reflection, Jacob wrote that his students had increased their enjoyment in the classroom due to the increased level of group work and their ability to communicate with each other. This, he claimed, had renewed his energy for teaching (Appendix E, Jacob, 5).

Rachel did not talk much about the community of learners, but she did indicate the EdS program should be repeated because

> I think it should (be repeated). I think that's just the best way to learn about who you are as a teacher and watching other people do their thing and talking about what they do, just the collaboration. So I – yeah, I definitely think it should be repeated. (Appendix C, Rachel, 10)

During the capstone project, Rachel completed an action research study on assessment in her classroom and then wrote a manual for peer mentoring. Much of the literature that she read emphasized that students should be involved in their own learning (Appendix D, Rachel, 9). This involvement included expressing their needs and their wishes in the classroom, and through discussion determining attitudes and beliefs of each student. Rachel also wrote of how alternative assessments were recommended, but she found them "incredibly hard to do, and I have had little, if any, instruction in these types of assessment tools" (Appendix D, Rachel, 7). Rachel wrote after her NBC process that it had changed how she saw herself, increasing her confidence as a teacher (Appendix E, Rachel, 5). She asserted that the process had made her a stronger teacher. It has also made her a more self-confident leader (1). Through reflection, she realized that there were strong areas and weak areas in her practice, and she began to work on the weak areas. Rachel wrote, "I continue to grow as a teacher and a learner" (4).

In summary, each participant reflected on the EdS program and its effects on them and determined that their self-confidence increased. Abigail believed that she was a better teacher and identified ways that she applied her knowledge and helped her students to increase their self-efficacy and make them better humans. Gabrielle felt she was a better teacher and saw students helping others as part of their community, but by helping others, their self-efficacy also increased. Jordan had a positive self-concept before the program, but the program, made him a better teacher, and Jacob agreed with the other participants that he was a better teacher after the program. As a person's self-efficacy increased, they became stronger in their convictions and were able to sustain their effort

levels for longer periods of time and withstand failures. So it was important for teachers to have a strong self-efficacy to deal with their daily trials.

Action Research

Action research was one of the constructs used in the EdS program and the basis for the capstone project at the end of the program. The theory of action research includes the following steps:

1. Identify a problem
2. Research the problem
3. Develop a plan
4. Implement the plan
5. Evaluate and reflect on the results.

This methodology was often used by teachers when they were faced with a problem in their classroom. While many times, action research was done in an individualized setting, this project targeted mentoring a new teacher as the leadership part of the program objectives. The participants did not point out the use of action research at the time of the interviews, but some quotes did give an insight into how this methodology might apply. Abigail identified times when her students were carrying out action research in her classroom. She said the majority of her students began a task by reflecting, thinking about it, planning it, carrying it out, and making sure their results were reasonable (Appendix C, Abigail, 5).

Abigail's students researched tasks that she gave them using the action research methodology, while Gabrielle talked about how she would wake up in the middle of the night and have an idea come to her on a new method to present some mathematical content. She would think about that and say "why not?" and then try and evaluate the new idea. Sometimes it would become better and sometimes it would not, but she had

the confidence to try new approaches (6). Gabrielle concluded that action research was a spiral of looking at practice, thinking about practice, and acting on practice (Appendix D, Gabrielle, 6). According to Gabrielle, action research was a dynamic process where teachers try new ideas, make adjustments, and then explore other ideas to improve teacher practice and student learning (,8). She used multiple instrumentation to gather data and determined the mathematical dispositions of her students. She had other teachers collaborate on the project and do similar data collection in their rooms (20). Through a collaborative effort, these teachers determined new ways to approach mathematics in their classrooms in order to improve students' mathematical disposition.

Jordan stated that in his team meetings at school they identified a problem like getting kids to see things from a certain point of view. Then they discussed the point of view, and then identified methods, implemented the methods, and then evaluated the methods (Appendix C, Jordan, 4). Jordan went on to say that the action research project during the capstone project "influenced me to work toward getting more parental involvement with regards to homework effort and study time" (Appendix D, Jordan, 7). He concluded action research did not always provide the answer that an educator thought it would (7). Jordan's project led him to conclude that parental involvement was more influential than homework consistence (7).

Joyce's capstone project had two parts, the first being an action research study about the effects of homework on grades and the second being a manual for mentoring peers. She found in her action research project that the participants of her change in policy actually did worse than those who maintained the same homework policy. She determined what the change in her policy would be through a reflective assignment on

her web site (Appendix D, Joyce, 5). Her research led her to believe that student's retention and understanding of material improved with homework (3). Joyce also read that homework helped study skills and attitudes toward school and that homework helped with self-discipline, time organization, inquisitiveness, and independent problem solving (Appendix D, Joyce, 3). The second part of the project helped a teacher transition into teaching calculus through an action research methodology (14). Her action research study helped Joyce to think about being a facilitator and relinquish control of the lesson and guide students to their own solutions (18).

Jacob talked about how most teachers do action research on a daily basis without even thinking of the methodology (Appendix C, Jacob, 6). He emphasized that evaluating a lesson or anything else that an educator does on a daily basis was one form of action research (5). Jacob's action research project focused on the assessment of students athletes (Appendix D, Jacob, 13). During his research, he found that action research, unlike formal research, had an audience of practitioners (4). As Jacob prepared his mentoring manual, he also read that the first purpose of assessment was to monitor student progress (9) and the second purpose of assessment was to help the teacher make instructional decisions (10). He had to determine whether to maintain the formative assessments as they were, alter them to fit his needs, or throw them out completely (12). In his project, Jacob asked student-athletes and coaches/teachers to examine whether they were successful in the classroom like they were on the court (14). Jacob also determined that another influence on female student-athletes success was parental support (15). His purpose for this study was to determine what motivates female student-athletes to enable him to have a positive influence on communication both in and out of the classroom (20).

Rachel said, “Okay, this is what I want to work on and then you do what you think is, you know, it’s kind of, it’s just sort of a spiral,” and she was trying to present in her capstone project the idea of action research (Appendix C, Rachel, 4). She went on to say that she was not sure the action research would have helped her when she completed her NBC (7). In Rachel’s action research project, she also focused on assessment. She found a large quantity of literature supporting alternative assessments such as teacher observations, personal communication, and student performances, demonstrations, and portfolios, but she found them to be very difficult (Appendix D, Rachel, 7). Rachel said, “I have been teaching at the high school level for 19 years and I am constantly perplexed by the concept of assessment” (1). She made an assessment of the situation in today’s educational environment when she said,

> Educators are given the task of taking a curriculum that is designed for them, and presenting it to their students in a way they think the students will best learn it. Then, they are asked to assess the learning that took place. This is a great challenge. (11)

Her students were asked to reflect on whether Rachel’s assessments actually measure what they knew (5). She wanted to know how they wanted to be assessed. These reflections were included in her students’ journals which had been shown as a vent for math anxiety (8). They also expressed to Rachel about their beliefs and attitudes toward her classroom. Again, Rachel found these journals to be difficult to fit into the curriculum time wise regardless of their value. She was surprised to find that her students preferred traditional written mathematics tests of all types (12). Rachel concluded that action research gave her a structured way to analyze her problem and find solutions (16) and made her more comfortable in trying to determine the solutions.

In summary, every participant remembered the capstone project as a difficult time of the program and did not emphasize action research as being part of their active pursuits. Jacob talked about how he felt that action research applied to everyday life, but he did not identify specific examples. Action research appeared to be in the study participants' vocabulary and when it was pointedly brought up in the interview, each participant seemed to remember the use and purpose of the methodology.

Second Data Analysis

This data analysis was a simple correlation of the number of references in the database to a particular construct as a time series analysis. In each of these time series analysis, I identified constructs that may or may not have been evident early in the program or after the program was over. I constructed a table with the number of references for each construct in each of the three data sets. These data sets were ordered chronologically developing a time series.

In Table 2, the columns contained references divided by the three data sets of the study, including the first data set at the halfway point of the EdS program and the end of the NBC process, the second data set at the end of the EdS program, and the third data set three years after the end of the EdS program. The rows contain the original three constructs and the one methodology of the study and the final construct that emerged during data analysis. The word searches that generated these reference counts for each construct were located in Appendix B. The numbers were bias to the interview data set since all six participants were involved in interviews, five of the participants provided their capstone projects and only four of the participants provided their NBC and EdS reflections. The adjusted numbers represent a per participant number of references.

		Dates		
		Halfway of EdS Finish NBC	End of EdS	Three Years Later
Constructs	Metacognitive	51	202	234
	Social Constructivist	16	55	76
	Community of Learners	34	58	96
	Self-Efficacy	32	61	131
	Action Research	0	146	101
	Metacognitive, Adj.	12.75	40.4	39
	Social Constructivist Adj.	4	11	12.67
	Community of Learners Adj	8.5	11.6	16
	Self-Efficacy Adj.	8	12.2	21.83
	Action Research Adj.	0	29.2	16.83

Table 2. *Construct References (program and adjusted) versus Data Sets*

The following histograms were developed to give a visual representation of the level of recognition and use by the participants for each construct and when the number of references for each construct peaked in the study. In Figure 9 below, the number of references for metacognition in the first data set was 51. This number represented total references made to a term identified as metacognitive in the NBC entry reflections and the composite reflection required for the EdS program. The second number represented 202 references to metacognition in the second data set which consisted of the capstone projects and collected at the end of the EdS program, and the third number 234 represented references to metacognition in the third data set which consisted of interview transcripts collected three years after the end of the EdS program. The graph shows how the participants recognized reflection as required in the EdS program. At the end of the EdS program, the second data set, the participants again used reflection in the evaluation of the action research studies in their EdS capstone projects. The final number represented the quantity of reflection references identified in participant's interview. The adjusted figures represent the data per participant, since some participants were unable to

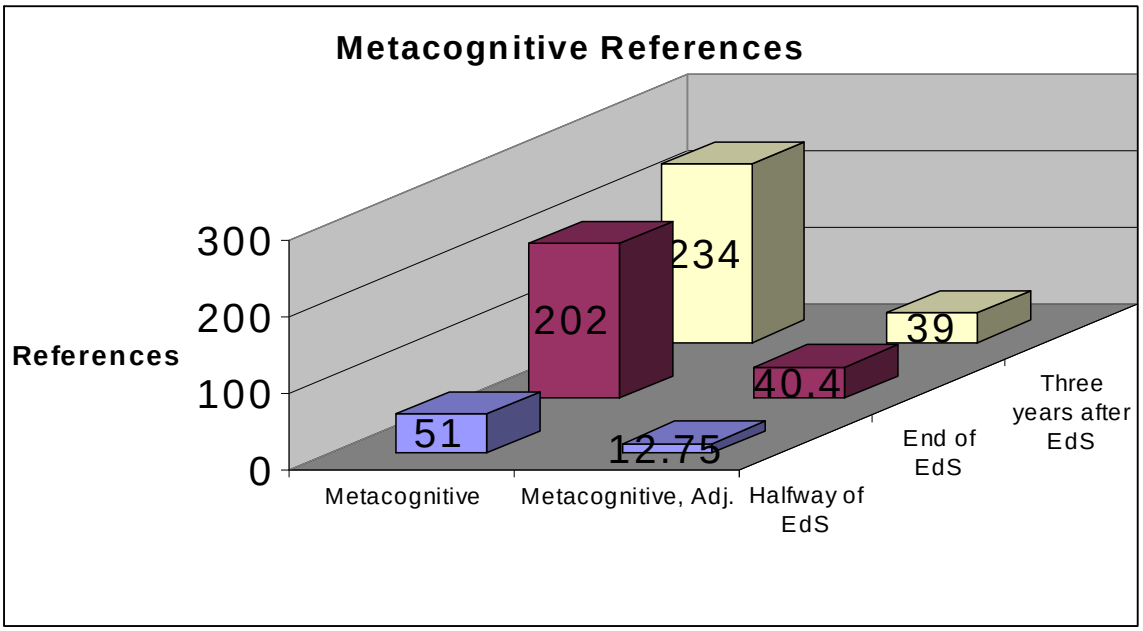

Figure 9. Metacognitive references versus data sets.

(Program and adjusted per participant)

provide all data. This presents a somewhat different perspective since the number of references per person went down between the end of the EdS program and three years later.

In Figure 10, the numbers of references that were identified as social constructivist in nature were correlated to the three data sets. There were 16 references for the first data set, 55 to the second data set, and 76 to the third data set. The construction of knowledge through an interactive classroom setting has always been a part of the participants' knowledge base in this study as evidenced by the videos that were viewed and critiqued in the EdS classroom as well as the videos that were submitted in the NBC process. However, the number of references increased with each subsequent data set possibly indicating an increasing awareness of the social constructivist educational philosophy to the point of talking in those terms. The adjusted values did not

change basic conclusions since they continued to rise per person through each of the study's data sets.

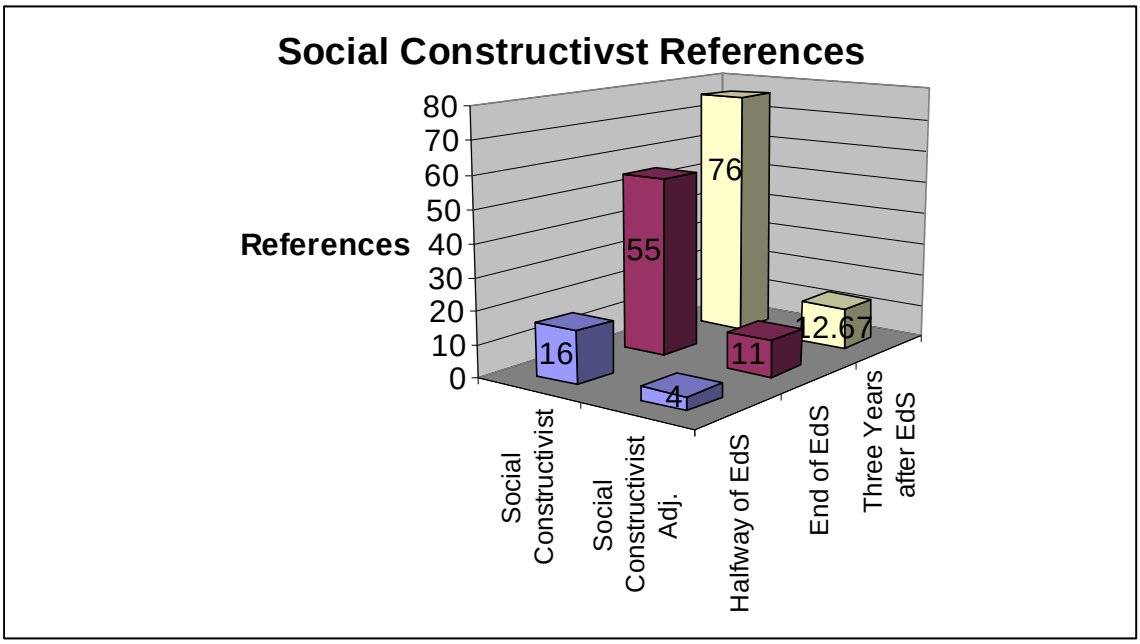

Figure 10. Social constructivist references versus data sets. (Program and adjusted per participant.)

In Figure 11, the numbers of references for community of learners in each of the data sets were represented. The first data set had 34 references, the second data set had 58 references, and the third data set had 96 references to communities of learners. These communities included the classroom settings with teachers and their students, a broader classroom setting of with parents added, group settings of teachers and their peers, and a setting including all of the above and the participation of those in the surrounding locale. During the first half of the EdS program, all but one participant submitted their NBC materials for assessment and the one who did not submit her papers had been previously certified. During the preparation of the materials, each participant developed a better understanding of the communities in which they participated. In the second half of the EdS program, the capstone project was finished including action research of interest to

the participant. These action research projects again expanded their understanding of how communities of learners were formed and how everyone's participation in these

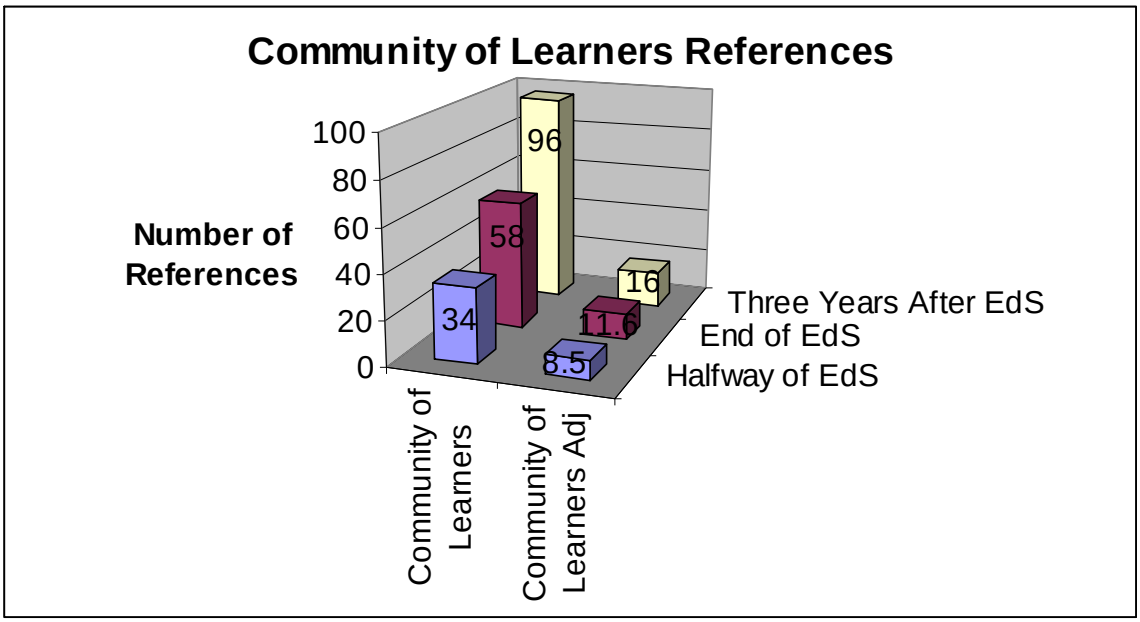

Figure 11. Community of Learners references versus data sets. (Program and adjusted per participant.)

communities increased the learning that can be attained. The final data set three years after the end of the program indicated another increase in the number of references to communities of learners. These reference numbers indicated increases in the number of communities that each person developed and in which they participate. The adjusted values per person confirm the program indications.

The numbers of references for the self-efficacy construct were included in Figure 12. The first data set had 31 references, the second data set had 61 references and the third data set had 131 references. Again, there may be some bias in direct comparison of the number of references per data set due to the varying number of documents in each set; however another explanation could be due to the types of data included in each set. The first data set included reflections about classroom discourse, student work assessment,

and accomplishment in the professional arena. The second data set included an action research study and manual for mentoring through action research in their capstone projects. The third data set included interview transcripts in which the participants were asked their feelings, perceptions, and attitudes toward the EdS program. The third data

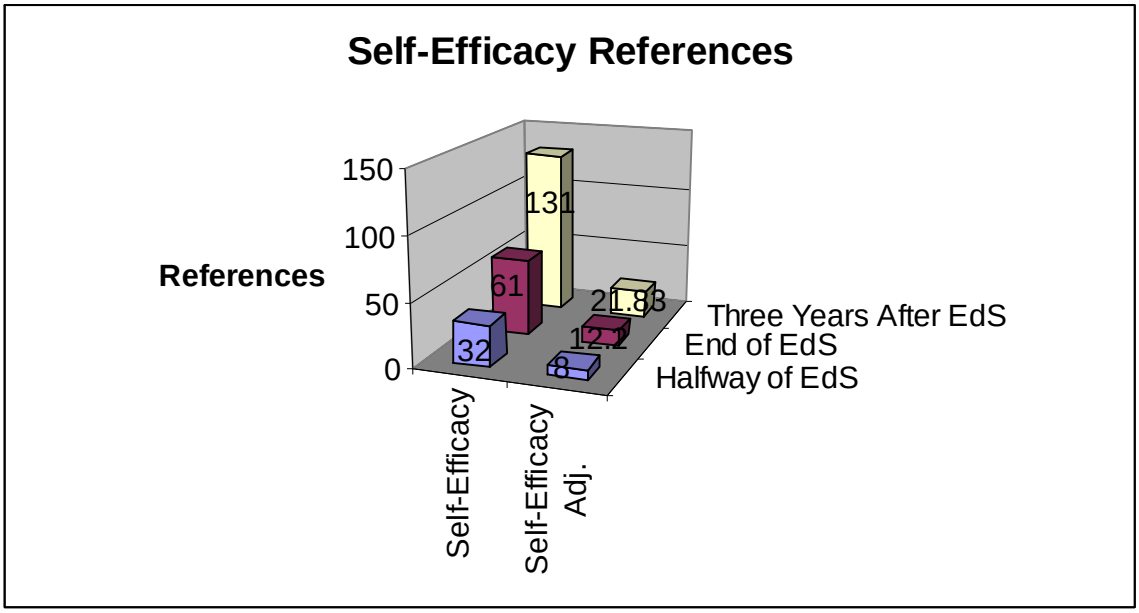

Figure 12. Self-Efficacy references versus data sets. (Program and adjusted per participant.)

set was designed to elicit these types of answers and may be the reason for the more than doubling of the number of references compared to the second data set and more than four times the number in the first data set. The third data set provided substantial evidence on the increased efficacy of each participant in the form of self-confidence and positive attitude about their teaching. The adjusted ratios of per participant confirm the program wide indications.

Figure 13 shows action research references across the three data sets. The action research methodology was implemented during the second half of the EdS program for use in the capstone project. This was the reason that action research had zero references

in the first data set. Since the capstone project, which was the data for the second set, focused on an action research study and the manual to use action research to mentor people, it was understandable that the number of references for action research would peak at the second data set. It was also encouraging that the number of references to action research stayed as high as it did when the participants were interviewed three years after the completion of their EdS program and capstone project. The adjusted ratios of per participant references confirmed the program wide indications.

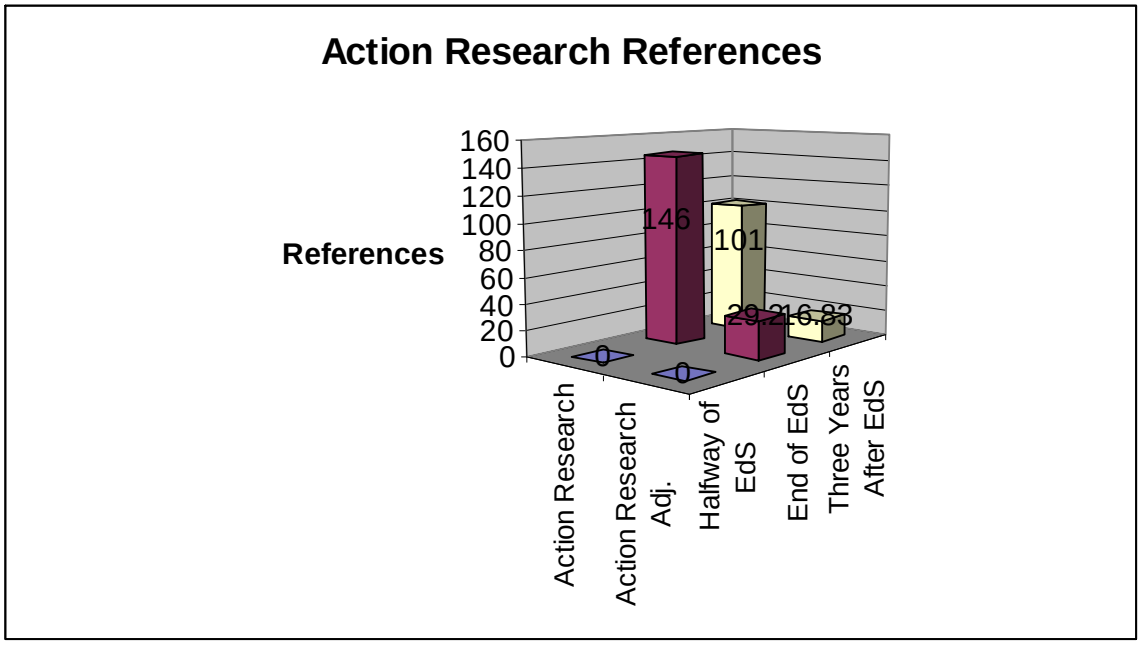

Figure 13. Action Research references versus data sets. (Program and adjusted per participant.)

In summary, this table and these histograms provided an insight to how the constructs and methodology of the study affected the participants and the correlation there was between when the constructs were introduced and the number of references in each data set for those constructs. The metacognitive references were evident in the first data set, but continued to increase during the second year of the EdS program and over the following three years which was very encouraging for long-term change. Social

constructivism references were also present during the first data set and increased over the following year in the second data set and increased again through the next three years indicating that this construct had affected participants in building a new level of thinking. They do not just think about their teaching, but they were concerned about the students' learning. The construct that emerged during the data analysis was community of learners. It became evident in the first data set and continued to increase during the second data set and has continued increasing during the three years of the third data set. As this construct increased, the participants continued to see the value in developing communities of learners and participating in them. These communities not only improved teacher practice, but increased student interaction and learning. Self-efficacy was a construct that all the participants struggled with during the first data set. They did not find a place to discuss it, nor was it emphasized during the first year of the program. Their references to self-efficacy more than doubled in the second data set, which included the following year and more than doubled again in the third data set when they were specifically asked how they felt about the program and themselves at that time. The action research methodology references peaked at the time when the participants were developing action research studies and plans for future mentoring through action research and then dropped during the following three years, however it did not leave the mind of each participant. They continued to think of their continuous growth as action research studies in which the participants tried new approaches to see if they generated better results. Each of these constructs and the action research methodology has been shown to affect teachers practice and as these participants completed the EdS program and

continued their teaching careers, they continued implementing things learned during the program.

Summary of Changes in Teacher Practice

Metacognition provided the basis for reflections on how this certification process and graduate program affected the participants' teaching and its effects on students, specific learning outcomes that affected teacher practice, and on community and self-efficacy. Each teacher reflected on how their practice changed and specifically how it affected students. The teachers recognized the need to involve more students in class on a daily basis and identified ways to encourage students to think deeply and reflect on this thinking. Another concept that surprised some of the teachers was the NBC process's emphasis on communication in the classroom among students and not just between the teacher and students. Some of the teachers recognized that the changes in their practice were due to the NBC process or the EdS program, while one felt that he was already at a level of reflecting while in the classroom already.

Community and self-efficacy were two additional constructs that were included in the reflections by the teachers. Teachers used the terms "enlightened" and "better" when they discussed themselves after the NBC process and at the end of the first year of the EdS program. Some identified their dedication and responsibility to their community as important in their teaching practice and professionalism. Others simply indicated they felt they were a better teacher at this point in time. The teachers identified communities that they either developed, such as their classrooms, or others that they participated in due to the experiences of the program and process.

Self-efficacy, which indicates the beliefs that someone has about him- or herself and the person's abilities to reach personal goals was the second construct discussed. This construct included self-confidence, attitude, and motivation. The teachers provided documentation that they felt more positive about themselves after the NBC process and first year of the EdS program. Terms used were "stronger teacher," "better teacher," "more self-confidence," and "made a difference," and the participants discussed the ways their self-efficacy had increased and made them more positive about their practice and its effects. Consideration was also given to the self-efficacy of their students. They found that students liked increased responsibility and the opportunity to share their experiences with each other.

The third construct was social constructivism, and it had the fewest number of references in the first data set, but the references continued to increase throughout the five-year span under investigation. The few references made were important to show that teachers were learning and changing their teaching practice and that this change in teaching was affecting student success. At the same time, the changes they adopted were important indicators of the building of new knowledge. Understanding that this construct had the fewest references to begin with, social constructivism was much more difficult to identify due to its underlying level of reflection and the changes that should accompany this building of knowledge.

I believed that community of learners would be an emergent theme in this research and it did during the data analysis. After having taught three of the program's courses, I witnessed the close, cooperative nature of the cohort of teachers so this did not surprise me. I did reference community of learners during the original plan, but

community was not one of the original program theoretical constructs. I felt that the first three constructs would be a part of all aspects of the study, but the emergence of this fourth construct in every data set did not surprise me. The emphasis that the teachers placed on it was much larger than I had anticipated. Three focuses were identified in this construct. The first was classroom community, the second was the local community both inside and outside the school and including teachers, students, parents, and others living in the school's district, and the third was the community of peers. In classroom community, teachers found that students enjoyed working together and providing support for each other. They found that peer coaching became an important part of the teachers' efforts to increase learning. Teachers increased group work to provide more student-to-student discourse and increase the classroom community. The second community dealt with everyone in the locale. Teachers identified ways they worked to get students involved in community service projects so they could find the joy of being in service to others and change others' lives at the same time. Also, the teachers recognized their responsibility to the community as a whole. The final community was of peers and the teachers found that collaboration was important for their good and their students. At the same time, another teacher was compelled by her sense of responsibility to participate in curriculum and material panels to provide voice to some that may not be heard otherwise.

The third data set of interview transcripts indicated that the teachers who participated in the unique EdS program that focused on the NBC made changes in their practice due to the program. They began to look at reflection as a broader tool to use in the classroom and in their practice. Teachers changed their practice based on their evaluation and reflection and it affected student success. Teachers constructed new

knowledge for themselves as they reflected on and evaluated their classrooms. These same teachers helped students to construct knowledge through social interactions inside the classroom and sometimes in the community as a whole. Teachers who completed this program felt better about themselves and their abilities to make a difference. As teachers' self-efficacy improved, they felt more confident to make changes and they also created an environment in the classroom that helped students to increase their self-confidence and enjoy class more. Teachers recognized their responsibilities to their students to create a community that empowered the students, a community where access was to the locale and all its individuals, and a community of their peers where they collaborated and helped each other to become better teachers.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This paper describes a study of a set of teachers who participated in an Educational Specialist program that was unique at the time due to use of the National Board Certification as one of the conceptual models. Three theoretical constructs were originally designed into the program and became the framework for this study. They were metacognition, social constructivism, and self-efficacy. This theoretical framework overlaps in all aspects of the program. The fourth part of the program was an action research methodology that was to be used in the final semester of the program and developed both mentoring methods with action research and formalizing the daily evaluation of teaching and results. A forth theory, community of learners, entered into the planning of the program without forethought and was implemented through the use of the cohort system for this EdS program. Cohorts were designed for a group of people to start taking classes together and continue in the same classes throughout the program and finish together. As the program participants began classes, these students and their instructors developed a strong bond through the theory of situated learning and community of practice (Lave & Wenger, 1991).

This program began in the Fall, 2002 semester with nine teachers participating and ended with the Spring, 2004 semester with all nine graduating. These nine teachers were secondary mathematics teachers from a local suburban school system so that their

courses could be planned around system parameters. The nine teachers were from four different high schools and taught a diverse course-load from Algebra 1 to Advanced Placement Calculus.

The conceptual models for instruction used in this program included the Reflective Teaching Model, the Mathematical Task Analysis, and the National Board of Professional Teaching Standards certification process which presented a different view than the other models because of purpose. Each of these models provided learning opportunities which built knowledge through a social constructivist process that involved reflection on their successes and failures and helped each of them to feel positive about their teaching practice. Of the nine teachers in the EdS program, seven submitted materials for NBC and six of those became certified during the first year. A seventh became certified during the second year. One was previously certified by NBPTS and the final teacher decided not to attempt certification due to other commitments. In addition, three instructors and two teachers who held the EdS degree from GSU were also certified in the first year.

Six of these teachers were subjects of this study. All of these participants were certified by NBPTS prior to or during the program. The remaining three teachers in the EdS program did not respond to request for participation or have left the teaching profession. The participants were asked for their reflections from the NBC process and the EdS program, the first data set, their capstone project, the second data set, and for an interview approximately three years after the end of the program, the third data set. As the data was analyzed, a number of findings were made specifically answering the questions of this study,

1. How did the teacher learning outcomes from the EdS program affect teacher practice?
2. The participants attained NBPTS certification during the program. What level of teaching is demonstrated today and does it meet the NBPTS or the NCTM position on highly-qualified teaching? What evidence supports this level of teaching? What program learning outcomes are present in this evidence?

Conclusions

As the analysis was progressing, a constant comparative evaluation was followed. The questions focused on the relationship between the EdS program and the participants. The questions concerned the learning outcomes changing teacher practice and if these changes were long-term. These questions were answered through the following discussion about the models and theoretical constructs of the program.

I found that through the theoretically based models, the metacognitive and social constructivist theories were encouraged in each of the participants and that the data conclusively led to the belief that the EdS program was successful in creating change in the teachers who participated in this study. The second question was harder to answer through conclusive data but with the participant perceptions, this question was also positively answered.

First, each participant consistently reported that reflection was one of the daily events in most teachers' lives, but that this program added a second level of reflection that was even more powerful through collaborative reflection. This collaborative reflection occurred in two different but similar situations during the program. First, through instruction on the RTM, teachers shared their classrooms and instruction by way of video tape with other members of the cohort. This process allowed others to see into the classroom and critique their instruction through the debriefing procedure in the model. At the same time, these observers were gathering suggestions from the video;

they also grew through the discourse concerning the video. The second instance of collaborative reflection occurred when the teachers assisted each other in video taping their NBC entries. These video tapes were critiqued by fellow participants and suggestions were made prior to submission for NBC. Again, these teachers through social interactions were constructing new knowledge and learning different methods for their teaching practice. So during the EdS programs' RTM instruction and the NBC entries, the Reflective Teaching Model, which was based on the theories of metacognition and social constructivism, provided evidence that the participants teaching changed during the EdS program due to the first model that was taught.

The second model taught in the EdS program was the Mathematical Task Analysis. This model involved a process to determine the level of cognitive demand of a particular lesson. This process included several steps; set-up proposed in materials, set-up in the classroom, presentation of the task, and doing the task. This process assisted two of the participants as they worked on their NBC Entry 1 which required the teacher to pick a series of lessons and follow two students from the beginning of this series through the lessons and analyze their learning. The MTA helped the teachers to understand the level of cognitive demand of the tasks and how they might have lowered or increased the demand through too much or too little explanation about the task. Again, understanding the MTA allowed teachers to create lessons appropriate for their classroom and in the zone of proximal development. This analysis provided crucial evidence to the NBPTS about the demands of the lessons. Additionally, one of the participants discussed that even though he had been assessing students for nine years, this was the first method he had experienced that demonstrated how to create tasks at different levels of cognitive

demand. This model had its theoretical foundation in social constructivism. The interactions that occurred between the teacher and student determined the level of cognitive demand of the task and as each teacher sets up a lesson, implements the lesson, evaluates the lesson, and reflects on the lesson to determine cognitive demand, they were moving through the steps of the social constructivist and metacognitive theory.

These two models provided the participants processes to change their practice and became better teachers. Each of the participants experienced the learning outcomes and identified parts of their teaching practice where the processes would apply and initiated change. Their quotes and excerpts from the interview transcripts, capstone projects, and reflections discussed the different situations where these changes made a positive difference with themselves and their students. These changes were due to new knowledge when applied to teacher practice developed increased student success.

The third theoretical construct of this study was self-efficacy. The data provided evidence of higher levels of teacher self-efficacy after the EdS program, because they knew they were "doing it right". Every participant felt the program was worth the effort and that they were better teachers today than when they began.

The participants also believed that the program should be offered again because every teacher needs long term professional development that builds a community of learners for mutual support. Additionally, the teachers talked about how they believed that their students were happier and more productive in the classroom due to the changes that occurred during the program. When students have a positive self-image and confidence in themselves, then their mathematical disposition was stronger.

Five of the teachers attributed these changes in the classroom to the EdS program. They identified several aspects of their teaching practice that they changed so that the classroom became more student centered and that created these improvements in student self-efficacy. Some teachers increased student work at the board while others increased the amount of collaborative work in the classroom. Some teachers changed their assessment methods to fit the students' learning styles while others developed methods to help with peer encouragement and coaching. Each of these methods was important in making the students involved in their education and helping them to feel responsible for their own education.

The fourth theoretical construct was the community of learners. The program was originally designed as a cohort program and I agree with the participants that the program would not be as successful if not accomplished with the same group of people from the beginning to the end. Five of the six participants explained that the most important part of the experience were the people who were a part of it. They believed that each participant supported everyone else during the difficult parts of the program. This exchange during Joyce's interview really provides an insight into how the participants felt about the camaraderie:

Interviewer:	During the program, what do you think that we did during that program that helped you to succeed?
Joyce:	I think it was definitely the collaboration.
Interviewer:	Okay.
Joyce:	And, you know, you could put reflection in there, a lot of things, but I think basically it was the collaboration with the other teachers.
Interviewer:	Okay.
Joyce:	We all made each other better.

Each participant said this a little differently, but provided the same insight. The cohort method for this program was essential because it built a community of learners who cared for and supported each other through the rigorous and extensive process. I agree that the cohort program provided elements of close long-term interactions which improved the success of the participants in completing the EdS program and the NBC.

The research methodology that was part of the EdS program was action research; this was used to develop an experience in research on problems that were important to each participant and to develop a mentoring strategy for each teacher with peers. Action research methodology was identifying a problem, designing a plan to eliminate the problem, implementing the plan, and then evaluating the results and reflecting to see if you have reached your goal. This methodology was a daily occurrence in many classrooms, but teachers do not always identify the process as doing research, but they think of it as evaluating the lesson and changing something to make it better. By formalizing this process, this daily research took on more meaning for the participants and provided support for their decisions made based on these daily evaluations. Action research was not the most influential part of the program, but it provided support for the concept of the life long learner and method to ongoing action research in each classroom to better their practice.

The final key part of the EdS program was the NBC process which created the uniqueness of the program. It was composed of four entries, analyzing student work, small group discourse, whole group discourse, and you as a professional. The NBC had a process of describe, analyze, and reflect on the each of the entries and required two video taped lessons, one of small group and one of whole group discourse. This process took

place during the first year of the program and provided the focus for the first four mathematics education classes.

As participants prepared their entries for the NBC, the RTM and MTA models were used as a guide for completion of the entries. The first entry was analyzing student work and the MTA had great application. The second and third entries involved video tapes of small and large group discourse and the RTM helped guide them through each entry. The fourth entry was designed for participants to describe their professional development over the previous five years, analyze this development and what it has meant to their students, parents, community, and self, and then reflect on this development. Most of the participants identified this entry as the most difficult to write.

Question two was much more difficult to answer. One of the participants was able to quickly identify evidence that she felt indicated that her teaching was still "highly qualified" based on the NCTM standards. She recognized that through the changes she made in the program, her Advanced Placement students had a 92% pass rate on the Advanced Placement Calculus exam with a three out of five or higher. Other participants pointed out that they were identifying things that they can use as evidence in the renewal process for the NBC and others were continuing to discuss and make points of how they continue to implement parts of the EdS program into their practice three years after the end of the program. This question was designed to be answered by the perceptions of the participants and myself. I do not believe that I have substantial evidence to find that this highly-qualified teaching was still occurring daily with each of the participants, but I do believe that they have made long-term changes in their practice instigated by the models

and processes of the EdS program and these changes would push them toward this highly-qualified teaching.

The use of the three models or processes, the RTM, the MTA, and the NBC, to support the theoretical framework developed a systematic method to instruct teachers to formalize their reflection, build new knowledge and evaluate how to use that knowledge, recognize the level of cognitive demand that was required of students and judge if it was appropriate, and formalize the daily evaluations that teachers do in their classrooms through the action research methodology. Each of these integrated pieces increased teacher self-efficacy which helped teachers conclude they were better teachers today then they were in the Fall of 2002. This increased self-efficacy helped participants to persevere and become teachers who provide the highest quality teaching to their students.

An additional finding in the study revolved around how in this cohort program, the teachers developed a plan to recruit a university to help them reach their goals of completing an EdS program and successfully completing their NBC. The teachers recognized that they needed to improve their practice for both students and themselves. As the program began, the motivation was the increase in income provided by these accomplishments, but by the end of the program, money was not the primary motivation. These teachers continued to push themselves and their peers to achieve and become the best teachers they possibly could.

I found that the theoretical framework for the program was a woven multi-colored tapestry with each theory, model, process, and methodology providing different but complementary colors, where changing one strand would change the picture woven into the tapestry. The teachers who participated in this cohort were the pictures that this

tapestry presents to the world and if the program had not had the colors necessary and the weaving of the theory together as it did, these teachers would not have turned out to be the teachers they were. All of the cohort teachers except one were found to be highly-qualified during the EdS program and as the tapestry ages, the strands do not leave, the colors just grow richer and mingle until the lines between the colors were unrecognizable.

Limitations

This study provides evidence of improved teacher practice with a small group of secondary mathematics teachers in a suburban county in Georgia. The study was limited in the scope and confined the research to changes that were self-identified by the study participants. Additionally, the study may not be generalizable to other content areas nor to other grade levels, however the study may provide a guide to the expansion of the same program to other areas. I was both a researcher and instructor in the program. This presented positives and negatives. A positive aspect was being close enough to identify concepts early in the research and gain entrance to the community of learners through this closeness. However this also presents a negative in that I was so close to the program. In order to alleviate this negative, I provided data in the Appendices so readers can make their own determination.

A final limitation is due to the type of research used in the study. A case study developed strong data to support the conclusions; however this data is subject to interpretation by the reader, who could find their own conclusions.

Recommendations

These data sets were rich in detail about the EdS program and could provide other insights for researchers evaluating the program. If I find myself with a desire to pursue

this research farther, I would do additional interviews after two years to again determine the effects of the EdS program on the participants. Secondly, I would suggest that a researcher spend time with the capstone projects that are on file in the university library for their teacher mentoring plans using action research. These mentoring plans built individual methods to help peers improve their practice and provide a rich data set for further investigation. Further investigation concerning the effects of the learning outcomes on the success of participants in the NBC process would also be an interesting finding with both practical and social implications.

Reference

Adler, J., & Davis, Z. (2006). Opening another black box: Researching mathematics for teaching in mathematics teacher education. *Journal for Research in Mathematics Education, 37*(4), 27.

Baird, J. R. (1994, July, 1994). *Classroom collaboration to diagnose and improve the quality of teaching and learning.* Paper presented at the Annual Conference of the Australian Teacher Education Association Brisbane, Queensland, Australia.

Ball, D. L. (2003). *Mathematical Proficiency for All Students: Toward a Strategic Research and Development Program in Mathematics Education*. Pittsburgh, PA: Rand Corporation.

Bandura, A. (1989). Regulation of cognitive processes through perceived self-efficacy. *Developmental Psychology, 25*(5), 729-735.

Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*(1), 87-99.

Begle, E. (1979). *Critical variables in mathematics education; Findings from a survey of empirical literature.* Washington, DC: Mathematical Association of America.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*(8), 3-15.

Carlson, H. L. (1999). From practice to theory: a social constructivist approach to teacher education. *Teachers and Teaching: theory and practice, 5*(2), 203-218.

Cavalluzzo, L. A. (2004). *Is national board certification an effective signal of teacher quality?* Alexandria, VA: The CNA Corporation.

Cobb, P., & Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. *Educational Psychologist, 31*(3/4), 175-190.

Cooney, T. J. (1999). Conceptualizing teachers' ways of knowing. *Educational Statistics in Mathematics, 38*, 163-187.

Council, N. R. (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Academy Press.

Creswell, J. W. (2003a). *Research design: Qualitative, quantitative, and mixed methods* (Vol. 2nd). Thousand Oaks, CA: Sage.

Creswell, J. W. (2003b). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Darling-Hammond, L. (2003). Wanted: A national teacher supply policy for education: The right way to meet the "high quality teacher" challenge. *Educational Policy Analysis Archive, 33*(11), 1-57.

Darling-Hammond, L. (2006). Assessing teacher education: The usefulness of multiple measures for assessing program outcomes. *Journal of Teacher Education, 57*(2), 19.

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Heilig, J. V. (2005a). Does teacher preparation matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. In S. Dorn (Ed.), *Education Policy Analysis Archives* (Vol. 13, pp. 1-28).

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Heilig, J. V. (2005b). Does teaching matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. *Educational Policy Analysis Archives, 13*(42).

Darling-Hammond, L., Wise, A., & Klein, S. (1995). *A license to teach: Building a profession for the 21st century schools.* Boulder, CO: Westview Press.

Dawkins, K., & Penick, J. (1999). *Teacher preferences for an Advanced Masters degree based on NBPTS and NCATE standards*: North Carolina State University.

Education, D. o. (2006). No Child Left Behind Retrieved 9/10/06, 2006, from http://www.ed.gov/nclb/landing.jhtml?src=pb

Farmer, J. D., Gerretson, H., & Lassak, M. (2003). What teachers take from professional development: Cases and implications. *Journal of Mathematics Teacher Education, 6*, 331-360.

Flavell, J. H. (2004). Theory-of-mind development: Retrospect and prospect. *Merrill-Palmer Quarterly, 50*(3), 274-290.

Frykholm, J., & Glasson, G. (2005). Connecting science and mathematics instruction: Pedagogical contest knowledge for teachers. *School Science and Mathematics, 105*(3), 15.

Gay, L. R., & Airasian, P. (2000). *Educational research: Competencies for analysis and application* (6th ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Georgia State University. (2002). *Georgia state university graduate catalog 2002-2003*.

Georgia State University, Department of Mathematics and Statistics. (2006). Program of Study, Bachelor of Science in Mathematics. Retrieved 8/21/06, 2006, from http://www.mathstat.gsu.edu/students/undergrad/Program%20of%20Study.pdf

Glaser, BG. & Strauss, AL. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York: Aldine De Gruyter.

Glickman, C. D., Gordon, S. P., & Ross-Gordon, J. M. (2004). Action research: the school as the center of inquiry. In *Supervision and instructional leadership: A developmental approach* (6th ed., Vol. 6th). Boston: Pearson.

Goddard, R. D. (2001). Collective efficacy: A neglected construct in the study of schools and student achievement. *Journal of Educational Psychology, 93*(3), 10.

Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2004). Collective efficacy beliefs: Theoretical developments, empirical evidence, and future decisions. *Educational Researcher, 33*(3), 3-13.

Goldhaber, D., & Anthony, E. (2004). *Can teacher quality be effectively assessed?* Seattle, WA: Urban Institute.

Gratton, R. (2003). Professional development through action research. *Management in Education, 17*(5), 13-15.

Grossman, P. L. (1990). *The making of a teacher; Teacher knowledge and teacher education*. New York: Teachers College Press.

Harel, G. (1994). On teacher education programmes in mathematics. *International Journal of Mathematics Education in Science and Technology, 25*(1), 113-119.

Harel, G., & Lim, K. H. (2004). *Mathematics teachers' knowledge base: Preliminary results.* Paper presented at the 28th Conference of the International Group for the Psychology of Mathematics Education, Bergen, Norway.

Hart, L. C., Najee-ullah, D., & Schultz, K. (2004). The reflective teaching model: A professional development model for in-service mathematics teachers. In R. N. R.

G. W. Bright (Ed.), *Perspectives on the Teaching of Mathematics* (pp. 207-218). Reston, VA: National Council of Teachers of Mathematics.

Henningsen, M. A., & Stein, M. K. (2002). Supporting students' high-level thinking, reasoning, and communication in mathematics. In J. S. B. Schappelle (Ed.), *Lessons Learned From Research* (pp. 27-36). Reston, VA: National Council of Teachers of Mathematics.

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

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371.

Hill, H. C., Schilling, S. G., & Ball, D. L. (2004). Developing measures of teachers' mathematics knowledge for teaching. *The Elementary School Journal, 105*(1), 20.

Huffman, D., Thomas, K., & Lawrenz, F. (2003). Relationship between professional development, teachers' instructional practices, and the achievement of students in science and mathematics. *School Science and Mathematics, 103*(8), 10.

Hussar, W. J. (1999). Predicting the need for newly hired teachers in the United States to 2008-09 [Electronic Version]. *Educational Statistics Quarterly*, 1. Retrieved 8/23/06 from http://nces.ed.gov/programs/quarterly/vol_1/1_4/3-esq14-g.asp#header2.

Intime, P. (1999). Teacher's in-depth content knowledge. Retrieved 8/27/06, 2006, from www.intime.uni.edu/teacher/teac2summary.html

Kinach, B. M. (2000). A cognitive strategy for developing pedagogical content knowledge in the secondary mathematics methods course: toward a model of effective practice. *Teaching and Teacher Education, 18,* 51-71.

Koch, L. C., Arhar, J. M., & Rumrill, P. D. (2004). Action research in clinical supervision. *Journal of Vocational Rehabilitation, 21*(1), 55-59.

Koellner-Clark, K., & Borko, H. (2004). *Establishing a professional learning community among middle school mathematics teachers.* Paper presented at the International Group for the Psychology of Mathematics Education, Bergen, Norway.

Koelner-Clark, K., & Borko, H. (2004). *Establishing a professional learning community among middle school mathematics teachers.* Paper presented at the International Group for the Psychology of Mathematics Education, Bergen, Norway.

Koency, G., & Swanson, J. (2000). *The special case of mathematics: Insufficient content knowledge a major obstacle to reform*. Paper presented at the American Educational Research Association Annual Meeting.

Lave, J. & Wenger, E. (2003). *Situated Learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Langbort, C. (2000). *Developing teacher-leaders in a Master's degree program in mathematics education*. San Francisco: San Francisco State University.

Lappan, G. (2000). A vision of learning to teach. *School science and mathematics, 100*(6), 319-326.

Leikin, R. (2005). Qualities of professional dialogue: connecting graduate research on teaching and the undergraduate teachers' program. *International Journal of Mathematics Education in Science and Technology, 36*(2-3), 20.

Lennon, A., Rusk, S., Holden, J., & Pulos, S. (1999). Student, graduate, and faculty perspectives on fledgling content-based doctoral programs in science and mathematics education. *Journal of College Science Teaching, 28*(5), 4.

Lubienski, S. T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education, 31*(4), 454-482.

Merriam, S. B. (1998). *Qualitative research and case study application in education.* San Francisco: Jossey-Bass.

Middleton, J. A., Heid, M. K., Larson, M., Fey, J. T., Strutchens, M. E., Gutstein, E., et al. (2006). The challenge of linking research and practice. *Journal for Research in Mathematics Education, 37*(2), 76-86.

Mitchell, J., Levine, R., Gonzalez, R., Bitter, C., Webb, N., & White, P. (2003). *Evaluation of the National Science Foundation Graduate Teaching Fellows in K-12 Education (GK-12) program*. Arlington, VA: National Science Foundation.

Monk, D. A. (1994). Subject area preparation of secondary mathematics and science teachers and student achievement. *Economics of Education Review, 13*(2), 125-145.

NBPTS. (1989, 8/2002). National Board for Professional Teaching Standards: The five core propositions. Retrieved 8/27/06, 2006, from http://www.nbpts.org/the_standards/the_five_core_propositio

NBPTS. (2001). *Advancing teacher development: Institutions of higher education use the NBPTS standards to create communities of professional learning*. Arlington, VA: National Board for Professional Teaching Standards.

NBPTS. (2005). Adolescent and young adult/Mathematics portfolio instructions. Retrieved September 30, 2005

NCES. (2005). *Special analysis 2005: Mobility in the teacher workforce*. Washington, DC: National Center for Education Statistics.

NCRTE. (1991). *Final report*. East Lansing, MI: National Center for Research in Teacher Education.

NCTM. (2000). The teaching principle. In *Principles & standards for school mathematics* Reston, VA: NCTM.

Nyikos, M., & Hashimoto, R. (1997). Constructivist theory applied to collaborative learning in teacher education: In search of ZPD. *The Modern Language Journal, 81*(iv), 506-517.

Obrien, R. (1998). An overview of the methodological approach to action research.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*(4), 543-577.

Pajares, F. (2002). Gender and perceived self-efficacy in self-regulated learning. *Theory Into Practice, 41*(2), 116-125.

Peressini, D. D., & Knuth, E. J. (1998). Why are you talking when you could be listening? The role of discourse and reflection in the professional development of a secondary mathematics teacher. *Teacher and Teacher Education, 14*(1), 107-125.

Ponte, P., Ax, J., Beijaard, D., & Wubbels, T. (2004). Teachers development of professional knowledge through action research and the facilitation of this by teacher educators. *Teaching and Teacher Education, 20*(6), 571.

Renyi, J. (1996). *Teachers take charge of their learning: Transforming professional development for student success*. Washington, D. C.: National Educators Association.

Rowan, B., Correnti, R., & Miller, R. J. (2002). What large-scale, survey research tells us about teacher effects on student achievement: Insights from the Prospects study of elementary schools. *Teacher College Record, 104*(8), 43.

Schwandt, T. A. (2001). *Dictionary of qualitative inquiry* (2nd ed.). Thousand Oaks, CA: Sage.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 11.

Simon, M. A., & Schifter, D. (1993). Toward a constructivist perspective: The impact of a mathematics teacher in-service program on students. *Educational Studies in Mathematics, 25*, 10.

Sparks, D. (1992). Merging content knowledge and pedagogy: An interview with Lee Shulman. *Journal of Staff Development, 13*(1).

Stake, R. E. (2004). *Standards-based & responsive evaluation*. Thousand Oaks, CA: Sage.

Stein, M. K., Smith, S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction*. New York: Teachers College Press.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: The Free Press.

Strauss, A. & Corbin, J. (1990). Basics of Qualitative Research: Grounded Theory Procedures and Techniques. Newbury Park, CA: Sage Publications

Tzur, R. (2001). Becoming a mathematics teacher-educator conceptualizing the terrain through self-reflective analysis. *Journal of Mathematics Teacher Education, 4*, 259-283.

Vandevoort, L. G., Amrein-Beardsley, A., & Berliner, D. C. (2004). National board certified teachers and their students' achievement. *Educational Policy Analysis Archives, 12*(46).

Wenglinsky, H. (2002). How schools matter: The link between teacher classroom practices and student academic performance. *Educational Policy Analysis Archive, 10*(12), 29.

Yin, R. K. (2003). *Case study research designs and methods* (Vol. 3rd). Thousand Oaks, CA: Sage.

Appendix A

Attached are the syllabi for the ten courses of the EdS cohort program from the Fall of 2002 until Spring 2004.

EDMT 8420 Topics in School Math Curriculum

Fall Semester 2002

Edited 8/7/02

INSTRUCTOR:

[redacted]

Office Hrs **By appointment** **Tue 3:00-4:00**
Phone [redacted]
Office [redacted]
e-mail **kschultz@gsu.edu** Mickey_Washburn@gwinnett.k12.ga.us

COURSE DESCRIPTION:
Students explore the content and pedagogy related to selected topics in the school mathematics curriculum. Selected Topic: Developing a conceptual framework toward successful application for National Board Certification in Adolescence and Young Adulthood Mathematics. (Repeatable when topic changes.)

TEXTBOOKS:

National Council of Teachers of Mathematics. (2000) *Principles and Standards for School Mathematics*. Reston, VA: Author.

National Board of Professional Teaching Standards. (2002). *Adolescence and Young Adulthood/Mathematics Standards*. Arlington, VA: Author.

Georgia Department of Education. (2002). *Georgia Quality Core Curriculum Standards*. Atlanta, GA: Author.

Gwinnett County Public Schools. (2002). *Academic Knowledge & Skills (AKS)*. Lawrenceville, GA: Author.

Stein, M. K., Smith, M. S., Hennington, M. A., & Silver, E. A. (2000). *Implementing Standards-Based Mathematics Instruction: A Casebook for Professional Development.* Reston, VA: National Council of Teachers of Mathematics/New York, NY: Teachers College Columbia University.

TIME: Thursdays 4:30-7:00 p.m.

LOCATION: [redacted]

PROFESSIONAL EDUCATION FACULTY ORGANIZING THEME:

Creating Effective Contexts For Learning

PROGRAM THEME: Educator as Reflective Professional

COURSE GOALS AND OBJECTIVES[1]:

GOAL I: CULTURAL DIVERSITY

Objective 1. Students will consider diversity in class discussions and activities.

Objective 2. Students will account for diversity in assignments.

GOAL II. KNOWLEDGE BASE

Objective 1. Students will review and reflect on sound professional practices in mathematics education.

Objective 2. Students will consider theories, content standards, and professional practices associated with mathematics instruction. The GCPS Academic Knowledge and Skills, Georgia QCC [2], the National Board of Professional Teaching Standards, and the National Council of Teachers of Mathematics (NCTM) Standards[3] will be referred to for related content and professional practices.

Objective 3. Students will become critical and independent thinkers through reflective exercises.

Objective 4. Students will improve interpersonal communication by their responsiveness to feedback. They will improve clarity, coherence, and mechanics in verbal and written

---

[1] In accord with Professional Standards Commission (PSC), Quality Core Curriculum (QCC), and national benchmarks per discipline.

[2] **www.glc.k12.ga.us. Select "Quality Core Curriculum Search."**

[3] **www.nctm.org**.

communication and exercise sensitivity to equity issues and the rights of the community of learners in the course.

GOAL III. TECHNOLOGY

Objective 1. Students will use relevant electronic databases in their assignments.
Objective 2. Students will send instructor reflections on the course WebCT.
Objective 3. Students will use the EDMT 8420 WebCT for course management.

GOAL IV. READING PROFESSIONAL JOURNALS

Objective 1. Students will read, discuss, and cite professional journal articles to situate their area of inquiry in a theoretical and conceptual framework.

GOAL V. RESEARCH

Objective 1. Students will investigate scholarly research materials addressing an area of need in
mathematics education.

ASSIGNMENTS

1. **WEEKLY DISCUSSIONS AND CLASS PARTICIPATION 20%**
   Students will (a) attend and participate in real and virtual classes professionally, respectfully, and with substance in the various discussions and exercises. (b) Each week students will submit a journal entry on the WebCT.
   Content 50% + Critical Thinking 50%

2. **MATHEMATICAL TASK ANALYSIS 25%**
   Teachers (aka "students" elsewhere in this syllabus) are to teach a lesson with an identifiable mathematical task to one of their mathematics classes. This lesson must be videotaped and should be part of their curriculum. Each teacher will implement the "plan/teach/debrief" framework of the Reflective Teaching Model with a teacher-partner from this course. Both an oral (15 min) and written Mathematical Task Analysis (5 ± pages) will be completed, each with video support. Evaluation will be based on the written report which will be due no sooner than a week following the oral presentation. The Mathematical Task Analysis will describe the level of cognitive demand of the mathematical task according to four phases of the lesson:
   - **I. The Task,**
   - **II. Teacher Set Up**
   - **III. Student Implementation, and**
   - IV. **Student Learning.**

   Organization 10% + Content 60% + Critical Thinking 20% + Presentation 10%

3. **REFLECTIVE PAPER 25%**
   Students will write a reflective paper consisting of a retrospective glance at learning in this course which is intended to contribute toward the culmination of their EdS degree requirements. Students are to analyze and cite from their journal entries and read and cite from scholarly literature outside this course to write a reflective paper on (a) their mathematics education stance when they started this course; (b) how the texts, assignments, and class experiences shaped their thinking about the teaching/learning process in mathematics; and (c) how they think they may implement the conceptual framework of this course for their application toward NBC. (Approx 10 pages)
   Organization 10% + Content 60% + Critical Thinking 20% + Presentation 10%

4. ONLINE MIDTERM (15%) AND FINAL (15%) 30%
Organization 10% + Content 60% + Critical Thinking 20% + Presentation 10%

TOTAL 100%

Grading: A = 92-100 B = 83-91 C = 74-82 D = 70-73

Comments:

1) **Students are expected to read, reflect, and participate in each class. If a student must miss a class or a portion of one, he or she is expected to check the WebCT for class notes.**
2) **Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. *("The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them"* (AJC, 1/20/02, p. C9).**
3) **Student work to be returned at the end of the term will be placed outside the instructor's door. Materials that are not picked up by the third week of the next term may be thrown away.**
4) **This syllabus provides a general plan for the course; deviations may be necessary. The WebCT calendar tool will provide more specific assignments, dates, and updates.**

Projected Major Dates for EDMT 8420
CHANGES WILL BE POSTED ON WEBCT

8/22	**First Day of Class**
9/12	**2-Minute Tape Due**
10/10	**Mid Term Exam**
10/17	**Mathematical Task Analysis Presentation Due**
10/31	**Outline & Summary of Reflective Paper Due**
11/7	**Amalgamation of Standards Due**
11/21	**Reflective Paper Due**
12/5	**Final Exam**

EDMT 8550 Trends and Issues in Mathematics Education

Fall Semester 2002

Edited 8/13/02

INSTRUCTOR: [redacted]
Office Hrs **Tue 3:20-4:20**
Phone **770-806-3805**
Office [redacted]
e-mail Rick_Creed@gwinnett.k12.ga.us

[redacted] **Liaison for the EdS Program**
Office Hrs **Tue 3:20-4:20**
Phone [redacted]
Office [redacted]

Mickey_Washburn@gwinnett.k12.ga.us

COURSE DESCRIPTION: Trends and Issues of Teaching Mathematics Education. Selected Topic: Developing a conceptual framework toward successful application for National Board Certification in Adolescence and Young Adulthood Mathematics. The focus will be on Professional Development: Reaching out to both the Mathematics Education Community and the school community.

TEXTBOOKS:

National Council of Teachers of Mathematics. (2000) ***Principles and Standards for School Mathematics*****. Reston, VA: Author.**

National Board of Professional Teaching Standards. (2002). ***Adolescence and Young Adulthood/Mathematics Standards*****. Arlington, VA: Author.**

TIME: Tuesdays 4:30-7:00 p.m.

LOCATION: [redacted]

PROFESSIONAL EDUCATION FACULTY ORGANIZING THEME:

Creating Effective Contexts For Learning

PROGRAM THEME:

Educator as Reflective Professional

COURSE GOALS AND OBJECTIVES[4]:

GOAL I: TEACHERS ARE COMMITTED TO STUDENTS AND THEIR LEARNING

- To explore different ways that teachers can effectively collaborate with others in the Mathematics Education community.
- To consider different ways to effectively communicate with students and students' parents.

GOAL II. TEACHERS KNOW THE SUBJECTSTHEY TEACH AND HOW TO TEACH THOSE SUBJECTS TO STUDENTS

- To consider theories, content standards, and professional practices associated with mathematics instruction. The National Board of Professional Teaching Standards, and the National Council of Teachers of Mathematics (NCTM) Standards will be referred to for related content and professional practices.

GOAL III. TEACHERS ARE RESPONSIBLE FOR MANAGING AND MONITORING STUDENT LEARNING

---

[4] In accord with Professional Standards Commission (PSC), Quality Core Curriculum (QCC), and national benchmarks per discipline.

- Develop a method to analyze learning, communicate expectations and results, and motivate students for improvement.

GOAL IV. TEACHERS THINK SYSTEMATICALLY ABOUT THEIR PRACTICE AND LEARN FROM EXPERIENCE

- To utilize the Reflective Teaching Model (RTM) as an aid in developing a class activity to be submitted to NCTM's Student Math Notes publication.

- To reflect about weekly topics in a journal.

GOAL V. TEACHERS ARE MEMEBERS OF LEARNING COMMUNITIES

- To develop and refine Entry 4 (Documented Accomplishments: Contributions to Student Learning) for National Board Certification.

- To improve communication utilizing web pages, chat room, etc.

- To develop the three writing styles that are emphasized in the National Board Certification.

ASSIGNMENTS

1. WEEKLY DISCUSSIONS AND CLASS PARTICIPATION 20%
Students will attend and participate in real and virtual classes professionally, respectfully, and with substance in the various discussions and exercises.

2. REFLECTIVE TEACHING MODEL 40%
Teachers (aka "students" elsewhere in this syllabus) are to teach a lesson with an identifiable mathematical task to one of their mathematics classes. This lesson must be videotaped and should be part of their curriculum. Each teacher will implement the "plan/teach/debrief" framework of the Reflective Teaching Model with a teacher-partner from this course. This lesson ("class activity") will be submitted to the NCTM Student Math Notes Panel for publication. The activity should be designed for one to two class periods and should be between 2 and 4 pages in length. Teachers will submit a journal along with their activity. This journal should contain a written reflection on what the teacher learned and what changes were made during each cycle of the plan/teach/debrief process. The teachers should go through at least 5 plan/teach/debrief cycles. Evaluation will be based on the class activity, an oral report, and the journal.

Class Activity 60% + Journal 30% + Oral Presentation 10%

3. NATIONAL BOARD CERTIFICATION ENTRY 4 20%
Students will turn in a revised draft of the National Board Certification Entry 4. This paper should be 12 pages in length and should follow the guidelines and

criteria discussed in the National Board portfolio. Students also turn in documentation for entry 4. Passing this assignment does not guarantee success on the actual National Board entry.

15% - Entry 4 Draft 5% - Entry 4 Documentation
Content 50% + Critical Thinking 50%

4. FINAL EXAM: NBC ENTRY 4 REFLECTION PAPER 20%
This paper should model the reflection paper requirement for entry 4 in the National Board Certification portfolio. This paper must be two-pages in length.
TOTAL 100%

Grading: A = 92-100 B = 83-91 C = 74-82 D = 70-73

Comments:

1. **Students are expected to read, reflect, and participate in each class. If a student must miss a class or a portion of one, he or she is expected to check the WebCT for class notes.**
2. **Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. *("The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them"* (AJC, 1/20/02, p. C9).**
3. **Student work will be returned at the end of the term through the courier.**
4. **This syllabus provides a general plan for the course; deviations may be necessary. The WebCT calendar tool will provide more specific assignments, dates, and updates.**

Projected Major Dates for EDMT 8550
CHANGES WILL BE POSTED ON WEBCT

8/20	**First Day of Class**
10/08	**Student Math Notes Activity Due**
10/15	**Oral Presentation of Debrief of Student Math Notes Activity**
10/22	**Student Math Notes Activity and Journal Due**
11/05	**Rough Draft of Entry 4 Due**
11/19	**Documentation Due**
12/5	**Final Exam – Reflective Paper Due**

EDMT 8290 The Study of Learning and Instruction in Mathematics
Spring Semester 2003

PROGRAM: Educational Specialist
MAJOR: Teaching and Learning
CONCENTRATION: Mathematics Education

INSTRUCTOR: [redacted]

[redacted] **Mathematics Teacher** **GSU Part Time Instructor**
[redacted] *Rick_Creed@gwinnett.k12.ga.us*

Office Hr.: Tuesdays 3:20-4:20 **Phone 770-806-3805**

TIME: Tuesdays 4:30-7:00 p.m.

LOCATION: [redacted]

COURSE DESCRIPTION: Students[5] examine psychological bases for the study of teaching and learning of mathematics. Findings of research in mathematics education related to the learning of selected topics in the school curriculum are explored. Research methods, theoretical constructs, and research perspectives in mathematics education are investigated. Special Topic: See Conceptual Framework.

WebCT: This course is WebCT based. The syllabus, links, announcements, calendar, discussions, grades, etc., will be posted. Students are encouraged to stay abreast of any course changes and participate as members of a community of learners using this technology.

TEXTBOOKS:

National Council of Teachers of Mathematics. (2000) ***Principles and Standards for School Mathematics.*** **Reston, VA: Author.** www.nctm.org

National Board of Professional Teaching Standards. (2002). ***Adolescence and Young Adulthood/Mathematics Standards.*** **Arlington, VA: Author.** www.nbpts.org

[5] For the sake of clarity and consistency, teachers taking this course are referred to as "students" and their students in turn are referred to as "pupils" throughout this syllabus.

Stein, M.K., Smith, M.S., Henningsen, M.A., & Silver, E. A. (2000).
***Implementing standards-based mathematics instruction*. Reston, VA: NCTM.**

CONCEPTUAL FRAMEWORK:
ADOLESCENT AND YOUNG ADULT / MATHEMATICS

Core Propositions (CP) / Standards (S)	1 Commitment to Students and Lrn	2 Equity, Diversity, and Fairness	3 Knowledge of Mathematics	4 Knowledge of Students	5 Knowledge of Teaching Practice	6 The Art of Teaching	7 Learning Environment	8 Ways of Thinking Mathemaically	9 Asessment	10 Reflection and Growth	11 Families and Communities	12 Contribute to the Prof. Community
1 Teachers are committed to their students and their learning	P/C	P/C		P/C	P	P	P		P/C			
2 Teachers know their subjects and how to teach them			P/C		P/C	P/C	P	P/C	P			
3 Teachers manage and monitor student learning	P/C			P/C	P	P	P/C		P/C	P/C	P	
4 Teachers think systematically and learn from experience.			P	P	P/C	P/C	P	P	P	P/C		P/C
5 Teachers are members of learning communities			P	P	P	P	P	P		P/C	P	P/C

P – Indicates relevance to EdS program. **C – Indicates relevance to course.**

ASSIGNMENTS:

Journal, Discussion Board, & Class Participation	20%
Analytical Paper on Student Work	20%
Analytical Paper on Whole Class Discussion	20%
Analytical Paper on Small Group Discussion	20%
Three Reflective Papers On Analysis	20%
Total	100%

Assessment of student work will be done on the basis of the following rubric unless otherwise noted:

Organization	10%	Critical Thinking	40%

Content 40% Presentation 10%

Course Grade Determination: A = 92-100 B = 83-91 C = 74-82 D = 70-73

COURSE OBJECTIVES:

CP, S	**Learning Opportunities**	*Teaching Strategy*	*Assessment*
CP1,S1 CP1,S2 CP1,S4 CP1,S9	**Students will:** • Review where equity, diversity, and fairness influence math learning and assessment • Read on equity, diversity, fairness, and assessment in math • Report on readings	Instructor will: • Invite guest lecturer to speak • Provide items for students to review & assign readings • Initiate online discussion on changing beliefs & practice	**Evidence of commitment to change beliefs & practice** • Discussion Board Entries • Journal Entries
CP, S	**Learning Opportunities**	**Teaching Strategy**	**Assessment**
CP2,S3 CP2,S5 CP2,S6 CP2,S8	Students will: • Review efforts to maintain high level of cognitive demand • Implement RTM and MTA for two lessons in existing curriculum where technology and whole & small group discussion are present. • Write 6-pg *Analysis of Whole Class Discussion* and 6-pg *Analysis of Small Group Discussion*	**Instructor will:** • Model review process from own classroom & initiate discourse • Invite Schultz to review RTM & MTA • Review NCTM Technology Principle • Review NBPTS rubrics for analytical papers • Facilitate small group discussions	**Evidence of Knowledge of math and instructional decision-making:** • **Analysis of Whole Class Discussion** • *Analysis of Small Group Discussion*
CP, S	**Learning Opportunities**	**Teaching Strategy**	**Assessment**
CP3,S1 CP3,S4	**Students will:** • Review Pupil's Work • Read and report on how	Instructor Will: • Facilitate small group discussions on student	**Evidence of responsible manageme**

CP3,S7 CP3,S9 CP3,S10	to analyze student work • Write 6-pg Analysis of Student Work on two work samples from two different students	work samples. • Invite pupils to discuss their work samples. • Assign readings.	**nt & monitoring of learning:** • *Analysis of Student Work*
CP, S	**Learning Opportunities**	**Teaching Strategy**	**Assessment**
CP4,S5 CP4,S6 CP4,S10 CP4,S12	**Students will:** • Same learning opportunities as under CP2	**Instructor will:** • Same as in CP 2	**Evidence of systematic reflection on practice:** • Journal Entries • Discussion Board Entries • All Papers
CP, S	**Learning Opportunities**	**Teaching Strategy**	**Assessment**
CP5, S10 CP5, S12	**Student will:** • Attend and participate professionally and respectfully in real and virtual classes • Write 2-pg Reflective Paper on each of the three analytical papers written previously	**Instructor will:** • Facilitate small group discussion	**Evidence of responsible participation in learning communities:** • Journal Entries • Discussion Board Entries • Reflective Papers

Comments:

1. Students are expected to read, reflect, and participate in each class. If a student must miss a class or a portion of one, he or she is expected to check fellow students for class notes.
2. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. *("The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them"* (AJC, 1/20/02, p. C9).

3. Student work will be returned at the end of the term through the courier.
4. This syllabus provides a general plan for the course; deviations may be necessary. The WebCT calendar tool will provide more specific assignments, dates, and updates.
5. Class will discuss grading rubric that will be utilized on each assignment.
6. Successful completion of this course does not guarantee success with National Board Certification.

GSU/Parkview Liaison for the EdS Program

[redacted]
Office Hrs Thrusday 3:20-4:20
Phone [redacted]
Office [redacted]
e-mail Mickey_Washburn@gwinnett.k12.ga.us

[redacted]
kschultz@gsu.edu

EDMT 8290 Tentative Schedule

Date	Subject/Core Proposition	Readings	Assignment
1/9	Overview of Course	articles	Prepare Student Analysis Articles for Discussion
1/16	Analysis of Student Work Articles / CP 1,3	articles	Read Two Additional Articles From Classmates
1/23	Student Work Analysis / CP 1,3	Entry 1	Develop two sets of student work to analize
1/30	Samples of Student Work / CP 1,3	Entry 1	Analyze & Outline Student Work
2/6	Analysis of Student Work / CP 1,3		Prepare Whole Class Discourse Article for Discussion
2/13	Whole Group Discussions / CP 1,2	articles	Develop Lesson Plan with Partner for Whole Class discourse
2/20	Video Taping of Whole Class Discourse / CP 1,2	Entry 2	Video Tape Lesson
2/27	Video Analysis / CP 1,2	Entry 2	Outline of Whole Group Discourse Analysis
3/6	Analysis of Whole Group Discouse Video / CP 1,2	Entry 2	Prepare Small Group Discourse Article for Discussion
3/13	Small Group Article Discussions / CP 1,2	articles	Read Two Additional Articles From Classmates
3/20	Small Group Discourse Planning / CP 1,2	Entry 3	Develop Lesson Plan with Partner for Small Group Discourse
3/27	Video Taping of Small Group Discourse / CP 1,2	Entry 3	Video Tape Lesson and Outline Analysis
4/3	Video Analysis / CP 1,2	Entry 3	
4/10	No Meeting		Finalize Entry
4/17	No Meeting		Congratulations Party
4/24	Reflective Discussions / CP 5		Two page reflective papers on Analysis
5/1	Where are we going / CP 5		

EDMT 7560 Theory and Pedagogy of Mathematics Instruction
Spring Semester 2003

PROGRAM: Educational Specialist
MAJOR: Teaching and Learning
CONCENTRATION: Mathematics Education

INSTRUCTOR: [redacted]
[redacted] **Mathematics Teacher** **GSU Graduate Teaching Assistant**

[redacted]

[redacted]

Office Hrs Thursdays 3:20-4:20 **Phone** [redacted]

TIME: Thursdays 4:30-7:00 p.m.

LOCATION: [redacted]

COURSE DESCRIPTION: Students explore pedagogy related to selected topics in school mathematics curriculum. Special Topic: See Conceptual Framework.

WebCT: This course is WebCT based. The syllabus, links, announcements, calendar, discussions, grades, etc., will be posted. Students are encouraged to stay abreast of any course changes and participate as members of a community of learners using this technology.

TEXTBOOKS:

National Council of Teachers of Mathematics. (2000) ***Principles and Standards for School Mathematics.*** **Reston, VA: Author.** www.nctm.org

National Board of Professional Teaching Standards. (2002). ***Adolescence and Young Adulthood/Mathematics Standards.*** **Arlington, VA: Author.** www.nbpts.org

CONCEPTUAL FRAMEWORK:
ADOLESCENT AND YOUNG ADULT / MATHEMATICS

Standards (S) / Core Propositions (CP)	1 Commitment to Students and Their Learning	2 Equity, Diversity, and Fairness	3 Knowledge of Mathematics	4 Knowledge of Students	5 Knowledge of Teaching Practice	6 The Art of Teaching	7 Learning Environment	8 Ways of Thinking Mathemaically	9 Asessment	10 Reflection and Growth	11 Families and Communities	12 Contributing to the Professional Community
1 Teachers are committed to their students and their learning	P/C	P/C		P/C	P/C	P	P					
2 Teachers know the subjects they teach and how to teach them			P/C		P/C	P/C	P/C	P/C	P			
3 Teachers are responsible for managing and monitoring student learning	P/C			P	P	P	P		P		P	
4 Teachers think systematically about their practice and learn from experience.			P/C	P	P/C	P/C	P	P/C	P	P/C		P
5 Teachers are memebers of learning communities			P/C	P	P/C	P/C	P	P/C		P	P	P/C

P – Indicates relevance to EdS Program. **C – Indicates relevance to course.**

ASSIGNMENTS:

Journal, Discussion Board, & Class Participation	20%
Collaborative Mathematical Reviews	50%
Mathematical Content Tests	30%
Total	100%

Assessment of student work will be done on the basis of the following rubric unless otherwise noted:

Organization	10%	Critical Thinking	40%
Content	40%	Presentation	10%

Comments:

1. Students are expected to read, reflect, and participate in each class. If a student must miss a class or a portion of one, he or she is expected to check fellow students for class notes.
2. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. *("The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them"* (AJC, 1/20/02, p. C9).
3. Student work will be returned at the end of the term through the courier.
4. This syllabus provides a general plan for the course; deviations may be necessary. The WebCT calendar tool will provide more specific assignments, dates, and updates.
5. Class will discuss grading rubric for each assignment.
6. Successful completion of this course does not guarantee success with National Board Certification.

GSU/Parkview Liaison for the EdS Program

[redacted]
kschultz@gsu.edu

EDMT 7560 TENTATIVE SCHEDULE

Date	Subject	Readings	Assignment
1/7	Overview of Class		Preparation of Review Lessons in all Areas
1/14	No Meeting		
1/21	No Meeting		
1/28	No Meeting		
2/4	No Meeting		Forward Review to all students before 2/11
2/11	Algebra Review	Review	Complete problems assigned and prepare for Discussions
2/18	Algebra Review	Texts	Complete problems assigned and prepare for Test
2/25	Geometry Review	Review	Complete problems assigned and prepare for Discussions
3/4	Geometry Review	Texts	Complete problems assigned and prepare for Test
3/11	Discrete Review	Review	Complete problems Assigned and Prepare for Discussions
3/18	Discrete Review	Texts	Complete problems assigned and prepare for Test
3/25	Statistics Review	Review	Complete problems assigned and prepare for Discussions
4/1	Statistics Review	Texts	Complete problems assigned and prepare for Test
4/8	No Meeting		
4/15	No Meeting		
4/22	Calculus Review	Review	Complete problems assigned and prepare for Discussions
4/29	Calculus Review	Texts	Complete problems assigned and prepare for Test
5/6	Technology Review	Review	Complete Exercises

EDCI 8400 Dynamics of Teaching, Learning, & Curriculum Development Fall 2003

Syllabus

Instructor

[redacted]
Office Hours are Tuesday, before class and by appointment

Location and Schedule
[redacted] **Tuesdays, 4:30 – 7:00 PM**

EDCI 8400 Catalogue Description

Students explore the theory, research, and practice of curriculum development in school subjects and the aspects of effective teaching and learning.

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDCI 8400 supports the mission of the college by providing insight into the process of curriculum development in secondary school mathematics, and how this curriculum will strengthen the education of high school students. This is a required course for the Specialist Degree with a major in Teaching and Learning which was planned, implemented, and will be assessed to assure that the preparation of educational professionals focuses on student impact.

Program Requiring This Course
EDCI 8400 is required in the Ed.S. Degree with a major in Teaching and Learning**.**

Assumptions Guiding These Programs Also Guide EDCI 8400

1. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
2. Learning is an active process.
3. Quality teaching takes into account individual differences, learning styles, and backgrounds.
4. Learning environments are based on the mutual respect of all participants.
5. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
6. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Burke, Maurice J., Curcio, Frances R., Editors, (2000). Learning Mathematics for a New Century. Reston, VA: National Council of Teachers of Mathematics; and the Companion Website www.nctm.org.
- Additional readings as directed.

Student Learning Outcomes/Professional Standards/P-12 Student Standards. Complete texts of the outcomes, standards, and principles on which this course is based can be found in the following websites:

- College of Education Conceptual Framework and Candidate Outcomes (COE) http://education.gsu.edu/coe/content/initial.htm
- National Board of Professional Teaching Standards (NBPTS / AYA Math Standards 1-12) http://www.nbpts.org/
- Gwinnett County Academic Knowledge & Skills (AKS) http://www.gwinnett.k12.ga.us/aks.nsf/pages/AKSHOME
- Georgia Quality Core Curriculum (QCC) http://www.glc.k12.ga.us/qcc/

- National Council of Teachers of Mathematics Principles and Standards for School Mathematics. (Content, Process, Principles of School Mathematics -PSM) http://standards.nctm.org/

**Note: This course is for a cohort program comprised of secondary math teachers.

Learning Opportunities and Course Assignments

- Demonstrate an understanding of the historical perspectives on teaching, learning, and curriculum development processes;
- Demonstrate an understanding of the current perspectives on teaching, learning, and curriculum development processes; develop a Professional Action Plan related to her/his roles in the teaching, learning, and curriculum development processes; and articulate and support her/his philosophical and epistemological views of teaching, learning, and curriculum development.
- Develop an understanding of current issues and developments in mathematics education.

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to teach in a manner suggested by this course, paying special attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Assignments

- Historical Data from previous years with Reflection (10%)
- Reflective Journal Entries and Class Participation weekly. (20%)
- Leading discussion of assigned readings. (10%)
- Creation of a concept map communicating your understanding of teaching, learning, and curriculum development. (20%)
- Creation of a 5 year Professional Action Plan; (20%) and
- Creation of an opinion paper, based on the literature, reflecting your philosophical and epistemological view of teaching, learning, and curriculum development (20%)

Tentative Rubrics

Distribution of points will be determined with students during the course to assure equitable assessment. Points for each assignment will be distributed across such criteria as the following depending on the assignment:

- Description of Content and Pedagogical Knowledge (explaining what)
- Analysis (explaining why)
- Reflection (retrospective consideration of one's own beliefs and/or practice)
- Development and Implementation of Changes (reflection of practice and improvement)
- Presentation (style, grammar, spelling, readability, general organization)

Grading System

A 92-100 B 83-91 C 74-82 D 70-73

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.
2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student work will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.
6. Tentative rubrics for evaluating assignments are given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:
    a. Give informative subject headings.

b. Change subject heading as discussion changes in a series of communications.
c. If attaching assignments, include name, assignment title, and page numbers on each attachment.
d. When answering a message, include the message to which you are responding in your response.

Candidate Objectives/ Assignments	Professional Standards	P-12 Student Objectives
CO 1 - Teachers are Committed to Students and Their Learning	COE / NBPTS	
Develop Concept Map Acknowledging and Addressing Diversity, Equity, and Fairness	NBPTS 1,2 / PSM	
CO 2 - Teachers Know the Subjects They Teach and How to Teach Those Subjects	COE / NBPTS	
Create Concept Map That Effectively and Efficiently Produce Successful Mathematics Students	NBPTS 3-9 / Content / Process / QCC / AKS	NCTM Content, QCC, AKS
Develop Personal Action Plan	NBPTS 6,10,12 / Content / Process / PSM / QCC / AKS	NCTM Content, QCC, AKS
Prepare Opinion Paper on Mathematics Education	NBPTS 6, 10, 12 / Content / Process / PSM / QCC / AKS	NCTM Content, QCC, AKS
CO 3 - Teachers are Responsible for Managing and Monitoring Student Learning	COE / NBPTS	
Create Concept Map That Effectively and Efficiently Produce Successful Mathematics Students	NBPTS 3-9 / Process / PSM	
CO 4 - Teachers Think Systematically About Their Practice and Learn from Experience	COE / NBPTS	
Reflect on Readings, Discussions, and Experience	NBPTS 6,10	
Create a Personal Action Plan	NBPTS 6,10	
CO 5 - Teachers are Members of Learning Communities	COE / NBPTS	
Develop Discussion Points on Readings and Lead Class Discussion	NBPTS 12	
Foster Professional Relationships	NBPTS 12	

Tentative Schedule

August 26	Discussion of Course Requirements		
September 4	Discussion Reflectively Read Chapter 5		
September 11	Yearbook Chapter 5 Jean Read Chapter 4	Find articles on History of Math Ed	
September 18	Yearbook Chapters 4 Gail Read Chapter 7	Discuss History of Math Ed	Read Articles Instruct Design Classroom Quantitative Results Due
September 25	Yearbook Chapter 7 Jack Read Chapters 8 & 9	Discuss Instructional Design on Curriculum Develop.	Read Articles
October 2	Virtual Class	Draft of Paper #5 Due	
October 9	Yearbook Chapters 8 Robin & 9 Kelly	Read Articles on What Makes a Pro Discussion of Personal Action Plan	
October 16	No Class	1st Draft of #4	Read Chapter 13 & 15

October 23	Yearbook Chapters 10 Luke & Angela 11 Teacher as a Professional Read Concept Map Article	
October 30	Virtual Class – Revision of #4	
November 6	Discussion of Concept Map	Read Personal Action Plan
November 13	Chapter 13 John & 15 Alicia	Personal Action Plan Draft of Concept Map Opinion Paper
November 20	Virtual Class	
November 27	NO CLASS	
December 4	Discussion of Professional Development Map	Final Concept Personal Action Plan, Opinion Paper
December 9	Final Class	
December 16	NO CLASS	

EDCI 8900 Educational Inquiry
Fall 2003 Syllabus

Instructor

[redacted]

Office Hours: Tuesdays before class

Location and Schedule

[redacted] **Tuesdays, 4:00 – 6:30 PM**

EDCI 8900 Catalogue Description

This course examines alternative research paradigms and sound inquiry, critical interpretation and evaluation of research and theoretical writing in the field.

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDCI 8900 supports the mission of the college by providing insight into alternative research paradigms and what constitutes sound inquiry, and critical interpretation and evaluation of scholarly writing in education. This required course for the Specialist Degree in Teaching and Learning was planned, is being implemented, and will be part of the overall EdS program evaluation to assure that it contributes to the advancement of the educational professional's ability to conduct inquiry into student learning and development.

Programs Requiring This Course
EDCI 8900 is required in the Ed.S. Degree in Teaching and Learning**.**

Assumptions Guiding the EdS Program Also Guide EDCI 8900

7. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
8. Learning is an active process.
9. Quality teaching takes into account individual differences, learning styles, and backgrounds.
10. Learning environments are based on the mutual respect of all participants.
11. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
12. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Creswell, J. (1994). *Research design: Qualitative and quantitative approaches.* Thousand Oaks, CA: Sage. (Required)

Students with Special Needs
In accordance with university policy, a student who wishes to receive instructional accommodations because of any documented learning difficulties, such as sensory impairment, learning disability, or

language differences should meet with the instructor to discuss this accommodation. Confidentiality will be maintained.

Professional Standards/P-12 Student Standards.
In addition to being guided by the overall College of Education's conceptual framework and expected learner outcomes for EDCI 8900, this course will show students how to relate what they learn about research paradigms, research design, and critical interpretation of research and theoretical writing by paying careful attention to the National Board of Professional Teaching Standards (http://www.nbpts.org/) five core propositions and its respective disciplinary professional teaching standards. Attention will also be given to the principles of school math published by the national professional disciplinary organizations (NCTM Principles of School Math http://standards.nctm.org) as well as the P-12 content standards published by the national professional disciplinary organizations (e.g., http://standards.nctm.org), and the state's Georgia Quality Core Curriculum (http://www.glc.k12.ga.us/qcc/).

Learning Opportunities and Course Assignments

Portfolio. Students will keep a portfolio (binder) of weekly **national board entry reflections**, **weekly assignments**, **article critique, literature review, and reference material or handouts** worth compiling. Other categories may be assigned by the instructor or desired by the student.

Reflection papers. (20%) Students will write reflection papers on their national board entries. Questions will be formulated by the group and the papers will be discussed during class. At the center of the discussions will be the NBPTS Five Core Propositions below and the 12 NBPTS Standards in AYA Mathematics. Reflection papers are to be kept in the Portfolio.

Core Prop 1. Teachers are Committed to Students and Their Learning
Core Prop 2. Teachers Know the Subjects They Teach and How to Teach Those Subjects
Core Prop 3. Teachers are Responsible for Managing and Monitoring Student Learning
Core Prop 4. Teachers Think Systematically About Their Practice and Learn from Experience
Core Prop 5. Teachers are Members of Learning Communities

Leading Textbook Discussions. (20%) Two Chapters of the course textbook will be assigned to each pair of students. Discussion facilitators are expected to present an overview of the chapter, produce an outline the chapter, and lead a discussion of the material.

Article Critique. (10%) Students will select a research article that most closely matches an area of inquiry and interest that is compatible with their own Professional Conceptual Framework. Due Dec. 9.

Literature Review. (30%) Students are to write an 8-10 page literature review in APA style to conduct research in the area of inquiry and interest compatible with their chosen NBPTS Standard. The weekly assignments in this course are designed to facilitate the development of this proposal. Due Dec 9.

Class Participation. **(20%)** Students are expected to attend classes and come prepared and willing to discuss material. The instructor will assign students to lead chapter discussions.

Tentative Schedule

Date	**Learning Opportunities and Assignments**	**Work to Be Completed for Portfolio**
Aug 26	Introductions Overview of Course	
Sept 2	Discuss **Ch 1 Framework for Design** Class collaboration of reflection questions.	
Sept 9	Discuss **Ch 2 Use of the Literature**	
Sept 16	Discuss **Ch 3 The Introduction to the Study** Discuss reflection on Entry 1 Entry 1 Reflection	
Sept 23	Discuss **Ch 4 The Purpose Statement** Discuss reflection on Entry 2 Entry 2 Reflection	
Oct 2	Discuss **Ch 5 Questions, Objectives, and Hypotheses** Discuss reflection on Entry 3 Entry 3 Reflection	
Oct 7	Discuss **Ch 6 The Use of a Theory** Discuss reflection on Entry 4 Entry 4 Reflection	
Oct 14	Discuss **Ch 7 Definitions, Limitations, & Significance** Discuss composite reflection and Standards Composite Entry Reflection	
Oct 17	**Last Day to Withdraw & Possibly Receive a W**	
Oct 21	Discuss **Ch 7 Definitions, Limitations, & Significance** Discuss Literature Reviews	

Oct 28 Discuss **Ch 8 A Quantitative Method**

Nov 4 Discuss **Ch 9 A Qualitative Procedure**

Nov 11 Discuss **Ch 10 Combined Qualitative and Quantitative Designs**

Nov 18 Discuss **Ch 11 Scholarly Writing**

Nov 25 NO CLASS

Dec 2 Research Proposal Q&A

EDS Paper discussion

Dec 9 Final Class Portfolio Due: Literature Review, Article Critique, NBPTS Entry Reflections, Textbook Outlines

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to pay particular attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Tentative Rubrics

Distribution of points will be determined with students during the course to assure equitable assessment.

Points for each assignment will be distributed across such criteria as the following depending on the assignment:

- Description of Content and Pedagogical Knowledge (explaining what)
- Analysis (explaining why)
- Reflection (retrospective consideration of one's own beliefs and/or practice)
- Development and Implementation of Changes (reflection of practice and improvement)
- Presentation (style, grammar, spelling, readability, general organization)

Grading System

A 100-92 B 91-83 C 82-74 D 73-70

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.
2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student portfolios will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.
6. Tentative rubrics for evaluating assignments will be given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:
    e. Give informative subject headings.
    f. Change subject heading as discussion changes in a series of communications.
    g. If attaching assignments, include name, assignment title, and page numbers on each attachment.
    h. When answering a message, include the message to which you are responding in your response.

EDMT 8420 TOPICS IN SCHOOL MATH CURRICULUM

Spring Mini-Mester I 2004 Syllabus

[redacted]

Location and Schedule

[redacted] **Tuesdays, Thursdays 8:30 – 10:45 PM**

EDMT 8420 Catalogue Description

Students explore the content and pedagogy related to selected topics in the school mathematics curriculum. May be repeated for credit when topics change. (Repeatable)

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDMT 8420 supports the mission of the college by providing insight into the process of action research in secondary school mathematics, and how this action research will strengthen the education of high school students. This course is an elective for the Specialist Degree with a major in Teaching and Learning which was planned, implemented, and will be assessed to assure that the preparation of educational professionals focuses on student impact.

Program Requiring This Course

EDMT 8420 is taken as either an elective or one of several required courses in the Ed.S. Degree with a major in Teaching and Learning**.**

Assumptions Guiding These Programs Also Guide EDMT8420

13. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
14. Learning is an active process.
15. Quality teaching takes into account individual differences, learning styles, and backgrounds.
16. Learning environments are based on the mutual respect of all participants.
17. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
18. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Glickman,C.D., Gordon, S.P., Ross-Gordon, J.M.,(2004). *Supervision and instructional leadership, a developmental approach.* Pearson/Allan-Bacon: Boston.
- Additional readings as directed.

Student Learning Outcomes/Professional Standards/P-12 Student Standards. Complete texts of the outcomes, standards, and principles on which this course is based can be found in the following websites:

- College of Education Conceptual Framework and Candidate Outcomes (COE)
  http://education.gsu.edu/coe/content/initial.htm

- National Board of Professional Teaching Standards (NBPTS / AYA Math Standards 1-12)
  http://www.nbpts.org/

- Gwinnett County Academic Knowledge & Skills (AKS)
  http://www.gwinnett.k12.ga.us/aks.nsf/pages/AKSHOME

- Georgia Quality Core Curriculum (QCC)
  http://www.glc.k12.ga.us/qcc/

- National Council of Teachers of Mathematics Principles and Standards for School Mathematics. (Content, Process, Principles of School Mathematics -PSM) http://standards.nctm.org/

**Note: This course is for a cohort program comprised of secondary math teachers.

Learning Opportunities and Course Assignments

- Demonstrate an understanding of the historical perspectives on teaching, learning, and curriculum development processes;
- Demonstrate an understanding of the current perspectives on teaching, learning, and curriculum development processes; develop a Professional Action Plan related to her/his roles in the teaching, learning, and curriculum development processes; and articulate and support her/his philosophical and epistemological views of teaching, learning, and curriculum development.
- Develop an understanding of current issues and developments in mathematics education.

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to teach in a manner suggested by this course, paying special attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Assignments

- Reflection paper on the topic to be researched.
- Preparation of an Action Research Plan.

Tentative Rubrics

1. Distribution of points will be determined with students during the course to assure equitable assessment.
2. Points for each assignment will be distributed across such criteria as the following depending on the assignment:
    A. Description of Content and Pedagogical Knowledge (explaining what)
    B. Analysis (explaining why)
    C. Reflection (retrospective consideration of one's own beliefs and/or practice)
    D. Development and Implementation of Changes (reflection of practice and improvement)
    E. Presentation (style, grammar, spelling, readability, general organization)

Grading System

A 92-100 B 83-91 C 74-82 D 70-73

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.
2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student work will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.
6. Tentative rubrics for evaluating assignments are given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:

a. Give informative subject headings.
b. Change subject heading as discussion changes in a series of communications.
c. If attaching assignments, include name, assignment title, and page numbers on each attachment.
d. When answering a message, include the message to which you are responding in your response.

Candidate Objectives/ Assignments	Professional Standards	P-12 Student Objectives
CO 1 - Teachers are Committed to Students and Their Learning	COE / NBPTS	
Develop Action Research Concept and Reasoning as it applies to student impact with a commitment to equitable learning.	NBPTS 1,2 / PSM	
CO 2 - Teachers Know the Subjects They Teach and How to Teach Those Subjects	COE / NBPTS	
Develop Action Research Concept and Reasoning as it applies to student impact with a commitment to equitable learning	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
Develop Action Research Plan	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
CO 3 - Teachers are Responsible for Managing and Monitoring Student Learning	COE / NBPTS	
Develop Action Research Concept and Reasoning as it applies to student impact with a commitment to equitable learning	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
Develop Action Research Plan	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
CO 4 - Teachers Think Systematically About Their Practice and Learn from Experience	COE / NBPTS	
Reflect on Readings, Discussions, and Experience	NBPTS 6,10	
Develop Action Research Plan	NBPTS	NCTM Content, QCC, AKS
CO 5 - Teachers are Members of Learning Communities	COE / NBPTS	
Develop Discussion Points on Readings and Lead Class Discussion	NBPTS 12	
Foster Professional Relationships	NBPTS 12	

EDMT 8420 TOPICS IN SCHOOL MATH CURRICULUM

Spring Mini-Mester II 2004 Syllabus

Instructor [redacted]

Location and Schedule [redacted] **Tuesdays and Thursdays**

8:30 – 10:45 PM

EDMT 8420 Catalogue Description

Students explore the content and pedagogy related to selected topics in the school mathematics curriculum. May be repeated for credit when topics change. (Repeatable) Current Topic: What a Teacher should be able to do.

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDMT 8420 supports the mission of the college by providing insight into the process of action research in secondary school mathematics, and how this action research will strengthen the education of high school students. This course is an elective for the Specialist Degree with a major in Teaching and Learning which was planned, implemented, and will be assessed to assure that the preparation of educational professionals focuses on student impact.

Program Requiring This Course

EDMT 8420 is taken as either an elective or one of several required courses in the Ed.S. Degree with a major in Teaching and Learning**.**

Assumptions Guiding These Programs Also Guide EDMT8420

19. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
20. Learning is an active process.
21. Quality teaching takes into account individual differences, learning styles, and backgrounds.
22. Learning environments are based on the mutual respect of all participants.
23. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
24. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Glickman,C.D., Gordon, S.P., Ross-Gordon, J.M.,(2004). *Supervision and instructional leadership, a developmental approach*. Pearson/Allan-Bacon: Boston.
- Additional readings as directed.

Student Learning Outcomes/Professional Standards/P-12 Student Standards. Complete texts of the outcomes, standards, and principles on which this course is based can be found in the following websites:

- College of Education Conceptual Framework and Candidate Outcomes (COE)
  http://education.gsu.edu/coe/content/initial.htm
- National Board of Professional Teaching Standards (NBPTS / AYA Math Standards 1-12)
  http://www.nbpts.org/
- Gwinnett County Academic Knowledge & Skills (AKS)
  http://www.gwinnett.k12.ga.us/aks.nsf/pages/AKSHOME
- Georgia Quality Core Curriculum (QCC)
  http://www.glc.k12.ga.us/qcc/

- National Council of Teachers of Mathematics Principles and Standards for School Mathematics. (Content, Process, Principles of School Mathematics -PSM) http://standards.nctm.org/

**Note: This course is for a cohort program comprised of secondary math teachers.

Learning Opportunities and Course Assignments

- Demonstrate an understanding of the historical perspectives on teaching, learning, and curriculum development processes;
- Demonstrate an understanding of the current perspectives on teaching, learning, and curriculum development processes; develop a Professional Action Plan related to her/his roles in the teaching, learning, and curriculum development processes; and articulate and support her/his philosophical and epistemological views of teaching, learning, and curriculum development.
- Develop an understanding of current issues and developments in mathematics education.

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to teach in a manner suggested by this course, paying special attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Assignments

- Initiate Action Research Plan. Conduct Research. (50%)
- Report on Research. (50%)

Tentative Rubrics

1. Distribution of points will be determined with students during the course to assure equitable assessment.
2. Points for each assignment will be distributed across such criteria as the following depending on the assignment:
    A. Description of Content and Pedagogical Knowledge (explaining what)
    B. Analysis (explaining why)
    C. Reflection (retrospective consideration of one's own beliefs and/or practice)
    D. Development and Implementation of Changes (reflection of practice and improvement)
    E. Presentation (style, grammar, spelling, readability, general organization)

Grading System

A 92-100 B 83-91 C 74-82 D 70-73

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.
2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student work will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.

6. Tentative rubrics for evaluating assignments are given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:
    a. Give informative subject headings.
    b. Change subject heading as discussion changes in a series of communications.
    c. If attaching assignments, include name, assignment title, and page numbers on each attachment.
    d. When answering a message, include the message to which you are responding in your response.

Candidate Objectives/ Assignments	Professional Standards	P-12 Student Objectives
CO 1 - Teachers are Committed to Students and Their Learning	COE / NBPTS	
Conduct research showing a commitment to students and their learning.	NBPTS 1,2 / PSM	
CO 2 - Teachers Know the Subjects They Teach and How to Teach Those Subjects	COE / NBPTS	
Conduct research showing an understanding of the subject and how students learn best. Look at new ways for your teaching practice to better impact students and their achievement.	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
Report on research accomplished.	NBPTS 3-9 / PSM	
CO 3 - Teachers are Responsible for Managing and Monitoring Student Learning	COE / NBPTS	
Conduct research showing an understanding of the subject and how students learn best. Look at new ways for your teaching practice to better impact students and their achievement.	NBPTS 3-9 / PSM	NCTM Content, QCC, AKS
Report on research and develop ideas of how this method better impacts students and their achievement.	NBPTS 3-9 / PSM	
CO 4 - Teachers Think Systematically About Their Practice and Learn from Experience	COE / NBPTS	
Conduct research showing an understanding of the subject and how students learn best. Look at new ways for your teaching practice to better impact students and their achievement.	NBPTS 6,10	
Report on research and develop ideas of how this method better impacts students	NBPTS	

and their achievement.		
CO 5 - Teachers are Members of Learning Communities	COE / NBPTS	
Develop Discussion Points on Readings and Lead Class Discussion	NBPTS 12	
Foster Professional Relationships	NBPTS 12	

EDCI 8960 Seminar in Leadership and Supervision in Teaching and Learning.

Spring 2004 Syllabus

Instructor [redacted]

[redacted] Doug_Wagner@gwinnett.k12.ga.us

Office Hours are Tuesday, before class and by appointment

Location and Schedule

[redacted] **Tuesdays, 4:30 – 7:00 PM**

EDCI 8960 Catalogue Description

Seminar focuses on leadership in teaching and learning and issues of school change, supervision, and curriculum. (Repeatable)

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDCI 8960 supports the mission of the college by providing insight into the process of supervision and leadership in secondary school mathematics, and how these skills will strengthen the education of high school students. This is a required course for the Specialist Degree with a major in Teaching and Learning which was planned, implemented, and will be assessed to assure that the preparation of educational professionals focuses on student impact.

Program Requiring This Course

EDCI 8960 is required in the Ed.S. Degree with a major in Teaching and Learning**.**

Assumptions Guiding These Programs Also Guide EDCI 8960

1. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
2. Learning is an active process.
3. Quality teaching takes into account individual differences, learning styles, and backgrounds.
4. Learning environments are based on the mutual respect of all participants.
5. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
6. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Glickman, C.D., Gordon, S.P., and Ross-Gordon, J.M., (2004). Supervision and instructional leadership: a developmental approach. Pearson/Allan-Bacon: Boston.
- Additional readings as directed.

Student Learning Outcomes/Professional Standards/P-12 Student Standards. Complete texts of the outcomes, standards, and principles on which this course is based can be found in the following websites:

- College of Education Conceptual Framework and Candidate Outcomes (COE) http://education.gsu.edu/coe/content/initial.htm
- National Board of Professional Teaching Standards (NBPTS / AYA Math Standards 1-12) http://www.nbpts.org/
- Gwinnett County Academic Knowledge & Skills (AKS) http://www.gwinnett.k12.ga.us/aks.nsf/pages/AKSHOME
- Georgia Quality Core Curriculum (QCC) http://www.glc.k12.ga.us/qcc/
- National Council of Teachers of Mathematics Principles and Standards for School Mathematics. (Content, Process, Principles of School Mathematics -PSM) http://standards.nctm.org/

**Note: This course is for a cohort program comprised of secondary math teachers.

Learning Opportunities and Course Assignments

- Demonstrate an understanding of the historical perspectives on teaching, learning, and leadership development processes;
- Demonstrate an understanding of the current perspectives on teaching, learning, and leadership development processes.
- Develop an understanding of current issues and developments in mathematics education.

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to teach in a manner suggested by this course, paying special attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Assignments

- Reflective Journal Entries and Class Participation weekly. (20%)
- Leading discussion of assigned readings. (30%)
- Weekly assignments. (20%)
- Final Paper on text and discussions. (30%)

Tentative Rubrics

Distribution of points will be determined with students during the course to assure equitable assessment. Points for each assignment will be distributed across such criteria as the following depending on the assignment:

- Description of Content and Pedagogical Knowledge (explaining what)
- Analysis (explaining why)
- Reflection (retrospective consideration of one's own beliefs and/or practice)
- Development and Implementation of Changes (reflection of practice and improvement)
- Presentation (style, grammar, spelling, readability, general organization)

Grading System

A 92-100 B 83-91 C 74-82 D 70-73

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.
2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student work will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.
6. Tentative rubrics for evaluating assignments are given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:
    a. Give informative subject headings.
    b. Change subject heading as discussion changes in a series of communications.

c. If attaching assignments, include name, assignment title, and page numbers on each attachment.
d. When answering a message, include the message to which you are responding in your response.

Candidate Objectives/ Assignments	Professional Standards	P-12 Student Objectives
CO 1 - Teachers are Committed to Students and Their Learning	COE / NBPTS	
Reflective Journal on how our leadership effects equity, diversity, and fairness. **CO 2 - Teachers Know the Subjects They Teach and How to Teach Those Subjects**	NBPTS 1,2 / PSM COE / NBPTS	
Reflective Journal on how readings and discussions effect teaching practice **CO 3 - Teachers are Responsible for Managing and Monitoring Student Learning** Reflective Journals, Weekly Assignments, and Final Paper on how our leadership in the school and classroom effect students and their learning.	NBPTS 3-9 / COE / NBPTS NBPTS 3-9 / Process / PSM	
CO 4 - Teachers Think Systematically About Their Practice and Learn from Experience	COE / NBPTS	
Reflect on Readings, Discussions, and Experience **CO 5 - Teachers are Members of Learning Communities**	NBPTS 6,10 COE / NBPTS	
Develop Discussion Points on Readings and Lead Class Discussion	NBPTS 12	
Foster Professional Relationships	NBPTS 12	

EDCI 8990 ED SPCIALIST SCHOLARLY INQUIRY

Spring 2004 Syllabus

Instructor

[redacted] kschultz@gsu.edu
Office Hours, Thursdays before class

Location and Schedule

[redacted] **Thursdays, 4:30 – 7:00 PM**

EDCI 8990 Catalogue Description -- Focuses on the design, implementation, and documentation of the scholarly inquiry requirement for the Ed.S. degree.

College of Education Conceptual Framework. *Leadership and Scholarship Focused on Learning and Development.* EDCI 8990 supports the mission of the college by providing insight into alternative research paradigms and what constitutes sound inquiry, and critical interpretation and evaluation of scholarly writing in education. This required course for the Specialist Degree in Teaching and Learning was planned, is being implemented, and will be part of the overall EdS program evaluation to assure that it contributes to the advancement of the educational professional's ability to conduct inquiry into student learning and development.

Programs Requiring This Course

EDCI 8990 is required in the Ed.S. Degree in Teaching and Learning**.**

Assumptions Guiding the EdS Program Also Guide EDCI 8990

25. Learning and teaching must continually adapt to changes in society and expanding knowledge base.
26. Learning is an active process.
27. Quality teaching takes into account individual differences, learning styles, and backgrounds.
28. Learning environments are based on the mutual respect of all participants.
29. A variety of teaching strategies and assessments are used to meet the needs of individual learners.
30. An integrated knowledge base consisting of content, skills, attitudes, technologies, and theories is developed and demonstrated in field-based applications.

Knowledge Base

- Creswell, J. (2002). *Research design: Qualitative, quantitative, and mixed methods approaches.* (Required)
- American Psychological Association. (1994). *Publication manual of the American Psychological Association*. (5th ed). Washington, DC: Author. (Resource)

Students with Special Needs

In accordance with university policy, a student who wishes to receive instructional accommodations because of any documented learning difficulties, such as sensory impairment, learning disability, or language differences should meet with the instructor to discuss this accommodation. Confidentiality will be maintained.

Student Learning Outcomes/Professional Standards/P-12 Student Standards.

In addition to being guided by the overall College of Education's conceptual framework and expected learner outcomes (http://education.gsu.edu/coe/content/advanced.htm) for EDCI 8990, this course will show students how to relate what they learn about research paradigms, research design, and critical interpretation of research and theoretical writing by paying careful attention to the National Board of Professional Teaching Standards (http://www.nbpts.org/)
five core propositions and its respective disciplinary professional teaching standards. Attention will also be given to the principles of school math, science, social studies, etc., published by the respective national professional disciplinary organizations (e.g., the NCTM Principles of School Math http://standards.nctm.org) as well as the P-12 content standards published by the respective national professional disciplinary organizations (e.g., http://standards.nctm.org), and the state's Georgia Quality Core Curriculum (http://www.glc.k12.ga.us/qcc/).

Learning Opportunities and Course Assignments

Portfolio. Preparation of Specialist Degree portfolio.

Introductory Section (10%)
National Board Certification Entries (30%)
Literature Review (10%)
Action Research Plan (10%)
Action Research Report (10%)
Reflective Paper on Specialist Program (30%)

Teaching Strategies

- The instructor will use a variety of teaching strategies including lecture, facilitating small group and whole class discourse, technology, modeling, and coaching student pair and whole class tasks.
- The instructor will attempt to pay particular attention to diverse work backgrounds, cultures, and abilities of the students.
- Formative and summative assessments will use appropriate rubrics. Formative assessment feedback will be given.

Tentative Rubrics

Distribution of points will be determined with students during the course to assure equitable assessment. Points for each assignment will be distributed across such criteria as the following depending on the assignment:

- Description of Content and Pedagogical Knowledge (explaining what)
- Analysis (explaining why)
- Reflection (retrospective consideration of one's own beliefs and/or practice)
- Development and Implementation of Changes (reflection of practice and improvement)
- Presentation (style, grammar, spelling, readability, general organization)

Passing will be based on:
Substantially completes the purpose of the portfolio by demonstrating understanding of the major concepts and intent of the assignments, even though some less important aspects may be missing or communication may need improvement.

In Progress will be based on:
Purpose of the portfolio not fully achieved. May need more detail, some work may be incomplete, some assumptions or understandings may be flawed, or communication may be ineffective.

Grading System **P Passing** **I In-Progress**

Comments

1. Students are expected to read, reflect, and participate in each class. Students, who miss a class or portion of one, are expected to check with classmates first before instructor to determine what was missed.

2. Late assignments will not be accepted without a compelling reason.
3. Students are expected to read and observe the GSU policy on academic honesty, cheating, and plagiarism; attendance; and conduct. See current Graduate Catalog. ("*The same technology that makes it easy for students to cheat also makes it easier for faculty to catch them*" AJC, 1/20/02, p. C9).
4. Student portfolios will be returned at the end of term.
5. The syllabus provides a general plan for the course; deviations may be necessary.
6. Tentative rubrics for evaluating assignments will be given. Students are invited to comment and discuss rubrics to ensure equitable assessment.
7. E-Mail Protocol:
    a. Give informative subject headings.
    b. Change subject heading as discussion changes in a series of communications.
    c. If attaching assignments, include name, assignment title, and page numbers on each attachment.
    d. When answering a message, include the message to which you are responding in your response.

Appendix B

The following appendix contains the word searches used in the NVivo 7 software designed for qualitative research. Each word search was applied to the three data sets and the corresponding references were used in data analysis.

Metacognition -- Metacognition, thinking about, reflect, reflecting, reflection, evaluation, analysis, self,

Social Constructivism --construct, build, social, interactions, knowledge, learning, improvement,

Self-Efficacy -- self, beliefs, myself, feel, feelings, proud, good, poor, down, spirits, self-belief,

Community of Learners-- community, group, town, part of, together, peer, participate, collaboration, collaborate, discuss,

Action Research -- Metacognition, thinking about, reflect, reflecting, reflection, constructivism, building knowledge, community, collaboration, evaluation, analysis, self

Appendix C

The following data were quotes from the interview transcripts of the six participants.

Each quote is listed with the name, quote number, paragraph number from their transcript, the quote, and then the constructs that were seen in each. Complete data sets are available by request to qualified researchers.

The constructs that are listed include M for Metacognition, SC for Social Constructivism, SE for Self-Efficacy, CL for Community of Learners and AR for Action Research.

Name	Quote #	Paragraph	Quote	Construct
Abigail	1	30	But as far as the writing, writing in a certain way, making sure you fulfilled all of the questions, that was a good thing, to see that I could write. But it was just so structured that if it was something that was taught if directed studies was taught towards how to write, the mechanics of writing, it would have been easy. But because it wasn't, and we've had so many different ways of doing things, we get to that final and that final paper – oh my god. And I think the hardest part even of that was the reflection paper of yourself. Everything else was okay. But to be able to be humble and at the same time say, "Hey, I'm doing this. This is what I'm supposed to be doing, and this is my accomplishments and achievements" but still be humble, that was difficult.	M, SE
Abigail	2	37	It's scary how many people don't reflect on what they do. That's the other side of it and understandably so.	M
Abigail	3	52	The one thing that I hate is teaching something, not being able to get back to it. At the end, you gotta re-teach it. Well, if you stabilize that and teach it all along, make them review it, make them use it, and come back and ask them questions about it, they got it.	SC, M
Abigail	4	58	And I do a lot of reflection, and I've made the kids do a lot of reflection to say, "Man, I messed that one up. Wait a minute. I need you all to help me with this. Let me go back and do this." And it's made them stronger students.	M, CL,
Abigail	5	62	So they're reflecting. They're thinking about it. They're planning it out. They're seeing it through. They're making sure that their answers are reasonable, and that's not all of the kids, but that's the majority of the kids, and then they can go back and work with it.	M, SC, AR

Abigail	6	66	As far as – I don't remember any specifically, but I think with our discussions within in the classroom and the depthness that we were able to go, it kept us from being narrow-minded and single-minded. That opened us up because there are so many different views you can get from each article coming from different standpoints. So it just made us more aware of everything versus just our narrow thinking.	SC, CL, M
Abigail	7	70	I think that each one within the group teaching each other showed the indepthness that we had. It showed the caring that we had. It showed the togetherness that we had. Because it wasn't at a point that was everybody was competitive, ever. We were all pulling for each other at the same time of working with ourselves, and I think when we came together and – I know it was crunch time – everybody stressed out. We got people about to take the exams.	SC, CL, SE,
Abigail	8	80	Definitely. Oh my god. As far as that one is concerned, we as teachers never know if we're doing the right thing or the wrong thing. We can have an administrator come in and see us for 15 minutes and give us an evaluation based off of 15 minutes, middle, beginning or end of a course. And then at the end of a course, we look at the grades, and we rate ourselves so harshly because half of our kids failed.	M
Abigail	9	82	But with the reflection, with self-analysis, it gives you a chance to say, "I'm doing something good. I'm doing something right. The majority of the kids are getting it," or, "The majority of the kids are not, so what can I change in this."	M,

Abigail	10	84	As far as self-analysis, it let me know that what I had been doing – and I don't know how it came to me, how I've been doing it thus far, but I'm on the right track. I'm not perfect, but I'm on the right track. And it just reemphasized that to make me a stronger person, believe in myself a little bit more, and that portrayed to the kids and gave them higher self-esteem. "Man, my teacher know what she doin', so if my teacher know, that mean I can do it." And that is evident.	M, SE,
Abigail	11	88	So the self-analysis, I thought was awesome and made me more confident at what I know and what I need to learn to make sure my kids are getting the best education.	SC, M, SE
Abigail	12	90	As far as the metacognitive, I've been doing it, been reflecting. I think it's a plus to know, one, that I'm not in it by myself, everyone else is doing – not everyone, but majority of the teachers are doing it. Maybe not in a structured manner, but when you sit out in your collaborative forums, and you're doing a reflection, you think you just don't know how much of this is national, and you're convincing them, you're encouraging them at the same time. Everybody's getting on the same page. And if everyone's getting on the same page, then kids are learning even more, and hopefully they're taking that to the classroom too.	CL, M, SC

Abigail	13	98	Okay. And with that – I find that a lot of times we like to hear ourselves talk, and the kids have no clue what we're talking about, so I'll lead a discussion, I'll ask just a random question, and I'll let them debate it backwards and forth when in the classroom. I don't say anything. And at first, it's like, "Miss Webb, will you just give us the answer?" And within that, as they're debating, and they're talking about it, they're breaking it down with each other. "Well, it can't be that because blah, blah, blah. And it can be that." And they learn so much from each other versus hearing me say it, and they never pick it up.	SC, CL, M
Abigail	14	104	I think the biggest thing was having a group of people that you didn't wanna fail. You wanted everyone to succeed, but you really wanted to succeed yourself. When I first came into understanding national board, I understood it to be a two to three year process, no ifs, ands, buts about it. The first time, the first go around, that's you getting to know what's expected, and then the second go around, the majority of the people made it. But sometimes it took a third go around. So I came into it saying, "This is a two to three year process. I'm not gonna make it through in a year."	CL, M

Abigail	15	110	Yes, I do. I have more confidence because I know I'm doing right. I've changed some things so that I'm not – I guess my thought was, "If my kids can do a one question, I got 'em over the hump," and now my expectations are so much higher. They can do ones. We're gonna do ones in the classroom. We're gonna do twos in the classroom. But the threes is where I gotta have 'em. My kids come up to that challenge, and it's all about where you set expectations, but I never would have known that before. When we set that bar, our kids are gonna whine; they're gonna complain; they're gonna argue; they're gonna fuss. They can do all of that, but they're gonna come up to wherever you have that bar, regardless of where – and some of those kids thrive on that.	SE, CL, M
Abigail	16	114	I never would have had that courage to stand there and just deal with that time before. But now that I know, "Man, I'm not just doing this on myself. This is what everybody, best practices is all about." Moment of silence. It is. So much better person.	CL, M

Abigail	17	122	I don't have discipline problems. I don't have arguments among the students within the classroom. I make them respect each other, and they're respecting each other, they automatically respect me. Did I learn that through EDS? Most definitely. Because you take the responsibility of ask, three, then me. Well, if you take on that responsibility of, "You have to own your own grade. You have to own that number, and it's not about cheating off of the next person because Miss (W) will give different versions of the test in the same class now." So it's not about cheating; it's about understanding. And then not only is about understanding but being able to explain it to somebody else because, I'm sorry, everybody in the classroom is a teacher. There's gonna be a time that you don't get something quick, so you're gonna have to learn from somebody else, and guess what? Miss (W) might not have the time. It might be over a weekend. You should be able to pick up the telephone, somebody tell it to you, and you got it. And if not, you can call Miss (W).	SE, CL, M, SC
Abigail	18	124	So they took ownership, and where did that come from? That came from higher levels of understanding. That came from being problem thinkers and problem solvers themselves. That's being able to reflect on everything that was taught within the classroom, not just the content of the classroom, the experience of the classroom, to get to know each other in the classroom and be able to apply that to what they're doing.	CL,

Abigail	19	132	Most definitely. And it's not even about a pay raise. It's not about a pay raise. It's about being able to give what is needed. One thing that, I guess, school systems thrive on is teaching everyone equally. That's not it. You can't teach everyone equally because everyone learns differently. So you have to teach them where it's fair but not equal. One person can get it on their own when you ask them one question, and another person, it takes me sitting down, going through steps and understanding multiple times. That's the fairness. So this EDS program is needed. It helps not only the kids, but it helps you define who you are as a teacher and what you're willing to give and what you're willing to accept, what you're willing to tolerate and what you will not tolerate. I will not tolerate failures. It's too many chances for you to have to succeed, and I'm not gonna accept you breaking down and deciding, "I'm not doing anything," because now it's time to get your parents involved. This is a community, and we gotta work with you.	SE, M, CL, SC

Abigail	20	148	As far as the outreach programs, I'm so involved. Oh my god. But it's like just within my community, I'm involved in some of everything, whether it's the AIDS Walk, whether it's Diabetes Walk, whether it's just disseminating information on whatever it might be, being able to research cancer. I talk to my kids a lot about just opening up their eyes to so many other things. You know, you see somebody out in the street, and we stare because we say they're handicapped. Well, we all have handicaps, regardless of what it is. Theirs is just physical. And they're no worse or no better off than you. So be open minded and make a friend. Oh my goodness, this child is thriving to have a friend. Just make a friend. And if you can take the mathematics and apply it to the experience and apply it to real life and show it across the board, didn't we just make better humans?	CL, SE,

Abigail	21	150	National board has so many different spectrums that everything influences your life, and you can't just touch one and say, "Oh, I learned this, and that's it." Everything heightened you. It opens your sense, and it made you more aware of everything across the board. So things that I normally wouldn't pick up on within a classroom – I could be teaching, and I see the kid sitting in the back of the room, and I'll say, "Step out in the hallway," and I'll get them started on task. "Baby, what's wrong?" "I lost my grandmother today." Well, things like that, you didn't see because you're so involved in content and getting this information out that you never really paid attention to the atmosphere of your classroom, and when you get to a point that it's no longer about content – yeah, we get that across, but it's about sharing it, then being able to regurgitate it, give it back to you, give it to you in different scenarios, and they're living creatures in the classroom versus these stagnated things sitting down and just listening to a lecture, then it's all worth it.	CL, SE, SC, M
Gabrielle	1	22	Probably the most significant thing was to realize that it wasn't all about me. It was about the student and student learning, the teaching and learning. Which I, kind of, had in the forefront of my mind anyway, but often times when you're in front of that classroom, you, kind of, get the feeling at times that you are the center, but in actuality you are not. You're a facilitator. You're an encourager. You're a guide, but it's not you. It's all about them. So, that really underscored that it's all about the students and not about the professional instructor, or guide, or whatever.	M, CL, SC,

Gabrielle	2	28	I would say National Board Certification was big. I think for not only the rigor, but you had to endure – the endurance that you had to continue on, and it was a difficult leap. That was – we just kept working, and working, and working to make it better, and better, and better. I liked the reflective teaching model. I think with, like, the peer – I mean, it's, kind of, almost like peer coaching, where you, kind of, work together and then reflected and said, "How could I do things better?" And we're implementing that here, and it didn't get off the ground as much as the person who tried to put it into play would have liked. So, I'm in charge of staff development here, so they said, "Do you think it's worth even messing with next year?" And I'm thinking, "Oh, yes." So, that will not be dropped, because of my experience with National Board and with our EDS Program. So, that will be put into play with a lot more enthusiasm. I don't think the energy was brought to the table with that, and it kind of let it fall, so the ball was dropped. So, that will definitely be something that I'll be working on. Community of learners, that was huge, I think. That, to me, was drawing the mathematics with all of us really, for me, was really quite significant. I really enjoyed that, where you talk about mathematics. You do the mathematics. It was just very enriching. So, of the three – I would say my three favorites would have been the reflective teaching model, National Board, and the community of learners. Although not to put the others down, research articles, I've enjoyed those where we looked, we read, we collaborated, we talked, we went back and forth. Now, remind me, mathematical task analysis –	M, CL, SC, SE
Gabrielle	3	56	So, that was interesting to try to get them involved in higher levels of thinking, which is not what they're used to doing at all.	SC,

Gabrielle	4	174	And I know when we did something the other day, we had an activity, and when they finished the activity they had to pick up a puzzle of identifying hidden pictures to key on on negative signs, and reflect on tuning in a little bit more, focusing. I said, "But before you do the puzzle, on the back you have to have helped three people, and they have to sign off that you helped them, and remember what questions they ask and how you helped them." So, they all went out as little, you know, kind of, campers. They were all coming out to other little people. It was so cute, and they said, "Well, I helped with this, and I helped with that, and I did this, and they signed, and now I can do the puzzle?" I said, "Now you can do the puzzle." But it was so neat to have them out talking mathematics, out and about in the room –	CL, SC, M
Gabrielle	5	192	I think my personality is one to go with – collaboration is – I'm all about collaboration. So, accomplished, I would say, and not so much in the mathematics, but it was like climbing a mountain, and we actually got there.	CL,
Gabrielle	6	196	So, if you start thinking, like, I would wake up in the middle of the night with an idea, and I'll think, "Well, why can't I do that? Why can't I do that?" And so, I would just try things, and some were better than others, but it really gave you self confidence, as far as being able to disseminate mathematics. Not so much, 'cause I could do my math before, but I think it was a lot more interesting in the teaching.	SC, SE, M, AR

Gabrielle	7	198	A lot more fun. The kids, I think you instill in them a wonderful sense of self, when you say, "No, you can actually do this. You can do this. Look what you can accomplish. You can do this." And this year, with my little freshmen, their skill set was weak, weak, most of them, and I kept telling them, "You're college material. You're college material. You're in a college prep class." Which they are, but many of them really were probably slated for tech, if we hadn't done this stretch culture.	SE, M,
Gabrielle	8	204	And I said, "You have to show by example." And the said, "Well, what's a leader?" I said, "Well, what is a leader?" And they said, "Well, punctuality." And so we went through this whole thing about how we bring each other up.	CL,
Gabrielle	9	212	That's another thing for self efficacy. I mean, for them, it was like, "Oh my gosh. I can do something."	SE
Gabrielle	10	260	You know, that one is big, 'cause I mean, when you do things, even in the administrative level, you, kind of, look back and go, "Okay. Now, that was handled well, but ooh, that wasn't so well. Well, I did really well with that parent, and that community member, whatever." Oh, let me – this is a harder one to do. Let's see, reflecting over, let me see now again. I would say, actually almost everything I would have used later. It just – I think because they were so important to us, and they were so – we practiced so much back and forth, back and forth, that they really become a part of who you are.	M, SC

Gabrielle	11	272	You have to draw them out. You don't wanna – you just give them a little bit to think about. You put the seeds down. Let them grow. Let them – you pull them out. You draw the mathematics from them, and change your activity, and then engage the learner. I mean, I would go through this whole thing, and that was real significant. That's a practice that happened after going through National Board. I thought, "Well, you know what, why can't they learn what we learned?"	
Gabrielle	12	304	I just think it was so neat to be able to talk and speak mathematically to peers, and say, "What did you try with this, and what have you done with that?" And then we even broaden it out though, even people who weren't in the program, we drew them in, like, when we were working horizontally. Like, if we had advanced out to trade, we would talk with the trade teachers, and say, "Well, what about this, and what about that?"	SC, CL,

Gabrielle	13	306 & 308	And so it opened it up for the people who were not in the program to help with standards, and the AKS, and RBS, and all kinds of goals, and things that we wanted to achieve. So, that, to me, was really well thought – a good outcome was that. Also, I think it's real important to encourage students who are – 'cause this year I also went to Tammy Thomas' careers in education class she has, and I used to speak every year about that, and I saw her at a meeting at Parkview. It was for AP's, and I said to her, "So, when am I coming?" And she goes, "You really would come back?" And I said, "Well, yeah. Why not?" She goes, "You could take the time?" I said, "No, I'll take the time. I don't have the time, but I will take the time." So, I went over, and I spoke to her fourth and fifth period, and encouraging the kids to make the most, and you know, go into – I mean, they were all excited about going into education, and some, after they had student taught in the various schools, had decided education was not for them, because the kids were fresh — and they were unruly and whatever, and it was hard to, you know, kind of, get order, and you know, classroom management skills and all that. But – so, many of them are really excited about going into teaching.	CL, SC,
Gabrielle	14	340	Because of that, I got the EDS in math, which when people – now this is interesting too, because when we have any math candidates, I interview. The principal, and I, and possibly the math chair, but the math chair is not included in everything, but I am, and there are a lot of different questions that I have that would reflect on what I've learned as far as the right classroom, and what do you do with this, and how do you feel about that how you feel about kids, and how you feel about your math, and so, it really has helped me I think, think differently about mathematics teacher overall.	CL, SC, M,

Jacob	1	8	Oh, the program was a terrific experience. Something that I would definitely recommend that every teacher go through. I'm not exactly sure how practical it is for every teacher to be able to go through such a rigorous course load and work load, especially if you've got family and other obligations, but it was a terrific experience, one that I wouldn't trade for anything. There was a lot of reflecting, did a lot of introspective learning that I had never done before, and you know, haven't – it's hard to believe that it was – how much we were able to accomplish in two years time.	SE, SC, M, CL
Jacob	2	14	Well, the reflective teaching model is, I mean, it's priceless. Everybody at some level, regardless of how long you've been teaching, you do some level of planning as to what, based on what your students are gonna be, what kind of students you have, what kind of learners that you have, what approach is gonna be the best. Then you go through the lesson, and you know, I find myself changing the way I teach a little bit as a result of the whole process, but we can touch on that later. And then after it's all over with, being able to go back and digest what you've done, and kind of, reflect back on the way the lesson went, especially if it was a lesson that you really felt like you had to rush through. You know, with all the different testing that we have going on around the school, your schedule gets altered.	M, SC

Jacob	3	22	Well, unfortunately I guess the way it is with everything, at some point you start to – unless you consistently study the material. Maybe the terminology, kind of, breaks down a little bit in your memory, but there are those moments when you find yourself – when you're questioning your students, and you're listening to their answers, and you're, kind of, letting them develop their own thought processes, and their own thoughts about a problem, or a series of problems, or an overall task, and you can see the light bulb go off, and you kind of know, "Okay." Now, I remember – and the one phrase I do remember of the whole thing is the, "Doing Math," in quotes. And now I really get charged up, and I really get excited, and I go, "Now, we're finally doing some math," you know, and that type of thing.	SC, SE, M
Jacob	4	24	And they really, really enjoy that. Especially when I'm getting energetic about it. Now, as far as how much time do I spend distinguishing between procedures with connections and procedures without connections, probably not as much as I should, but the thing that I spend a lot of time, that as well as the – what was the thing when, you know, years ago we used to study the lowest type of questioning all the way up to the –	SC, M
Jacob	5	40	It was real stressful, I think. I think a lot of the thing about the action research is that there was some, I guess there's some procedures that we had to do for Karen that I just – I was never really felt overly confident about that I was doing the right thing. I guess if there was the one thing about action research is, I never necessarily was 100 percent sure whether I was doing the right thing. Whether I was – all I remember is it's a action re – you're very actively researching. You're, kind of, as you're going through stuff, kind of, evaluating where you are. Do I use it today? No, not really. Unh unh.	SE, AR

Jacob	6	55	I mean, you know, when I think about it we all do that, and I think that what I wanted to point out – the reason why I wanted to point that out is that that is one of those things that, you know, most of the teachers do on a daily basis without even thinking about it. Just like the reflective teaching, most of the time we don't think about it, but we talk to others about the things that we've taught in class, and how it went, and we try to get suggestions from them. That's, in effect, reflective teaching.	M, SC, AR
Jacob	7	72	And every once in awhile they kind of come back up, and I go, "Hey, that would have been a good one for National Board." And I guess as we all are, kind of, going through this, we're four years or so into the process now. In about four more years we're gonna have to start thinking about renewing –	M
Jacob	8	86	Ever once in awhile I'll see a NCTM that I'll flip through, and I'll read some stuff, and I'll particularly pay attention to the, obviously, the high school stuff, the algebra stuff if there's stuff in there that would be useful. I probably don't do as much as I should as far as research is concerned. Unfortunately, you know how it is, you're busy in your doctorate, and I feel like I'm about as busy in my basketball schedule as I am in anything, and then being with my five-year-old, and my family, and all that.	SE
Jacob	9	102	– the folks that got us through, and if it hadn't been for that kind of leadership, we would have really, really – we wouldn't have gotten as much out of it. So, in order to do something like that, and in order to appreciate it, not only from your own personal experiences and reflecting on your own experiences, but being able to share the stories with everybody else, it was very important.	CL, M, SC
Jacob	10	111	– it's all reflection	M

Jacob	11	118	– I mean, and I'm not talking about somebody that's been doing it for years and years like we've been doing it. I'm talking about even as a rookie when you were just first start out, you've got to back and you've got to think about those lessons that you really, really, you know, you really, kind of, felt like the lights were going on with the kids.	M, SC, AR
Jacob	12	120	And you really – what were some of the things that you did right? Did you pace yourself well through this part of the lesson? Did you do the right type of example here? Did you teach it as thoroughly as you should have? There have been sections that, particularly in our Algebra Two Section, in our Algebra Two Book that we have now, and we'll get to a particular type of – or particular lesson and I kind of go, did they do that as deeply as they needed to do? Was that something that I had taught differently in the past, and if I did teach it differently why did I do it? Was it because we were using a different textbook years ago, and something just popped into my head, "Oh wait, we need to do this." So, I think you, kind of, need to be reflective after almost every lesson, just to make sure that you've done it the way – at least daily, and make sure that you've done it the way it was supposed to be done, and if you didn't, then what are you gonna do to fix it? And as challenging as our schedules are now, and I don't know about you, but for me personally, it is almost impossible to get everything done in the bells.	M

Jacob	13	138	Sure, absolutely. It kind of goes – it goes back to what we were saying a minute ago about having the group that we had, because not only were we different personalities, we were all driven. We all had that basic drive to succeed, but not only that, but we were also drawing from people from different schools, and different schools of different socioeconomic status, and different levels of achievement at the schools.	M, CL, SC
Jacob	14	140	And we were able to, kind of, draw on each other's experiences, and one of the nice things about being at (my high school), and working with the group that we had, we had very high achieving teachers, but not only that, we were blessed with very high achieving students, and you know, we were able to tell a lot of the good stories. Where some of the teachers from the other schools weren't able to tell such of the good stories.	M, SE, SC
Jacob	15	164 & 168	Well, I would say the reflective teaching model, was probably the – I would say between that and the mathematical task analysis were probably the two, but the reflective teaching model, I mean, it's as you said, National Board is plan, teach, and debrief. And that's actually the reflective teaching model, but there was a lot of reflection that went on in having to do your lessons, and video them, and break them down and break down every single interaction that happened with every student throughout the video, which was tons of interaction, especially when we were doing the big groups, and having one child on one side of the room responding to another child on the other side of the room – but it was – there was so much reflection. Okay, what was the student thinking, and what would the student think? What could I have done differently? How could I have channeled their thoughts a little differently?	M, SC, CL

Jacob	16	170	I would say that probably the reflective teaching model was the biggest thing, and then the mathematical task analysis and making sure that you're not asking lame questions.	M, SC
Jacob	17	180	– what they've built on themselves, and obviously, the ability to reflect on that is enormous, and the value of it's enormous. Also learning how to write. I mean, that was something else that, you know, talking about the whole program, you know, I felt like the second year – the first year it was, you know, that was one level of challenge, and then it was a different level of challenge, you know, the second year working with Karen, and making sure that we knew how to write. And I catch myself now when I'm even writing an email, something as generic as that, making sure that structure of sentences is right. I thought I was a good writer going in, and then all of sudden come to find out I probably wasn't as good as I thought.	M, SC, SE

Jacob	18	206	I guess the big overall concept is just the reflection. It's just learning how to do what's better, and I think – I guess if anything has come of this and being more experienced. I think at the time when I was teaching I've been teaching nine years, now I've been teaching 13 years, 'cause as you go you, kind of, get a little bit older, people start calling you veteran teacher, you know, and it's kind of neat in a way, but it's kind of like, ooh, I don't know if I like the sound of veteran. I like being the young guy, but those days are obviously over, but being able to have other teachers come in and look at what you do, and I guess it makes you pay attention more, and I mean, everybody kind of goes through this to a point, when you're being observed by one of your peers, or you're being observed by somebody who's really just not necessarily trying to learn math, but trying to watch how you teach and how you do things, and I've been observed several times by other teachers, and it really, kind of – and I, kind of, ask myself, "Okay. Am I doing anything different under this observation than I would be doing if I were just in here by myself?" And a lot of times I find myself up there, okay, pretend the principal is sitting in the back of the room. Now, how are you gonna do it?	M, CL, SC

Jacob	19	210	And so, you know, as I'm going through it – I don't know, maybe this would be in a way, kind of, an action research type of thing, but as I'm going through it, I'm kind of thinking, "Okay. Is this necessarily the best way to handle it?" A lot of times people will tell you, say, "Okay. If you're gonna talk to a particular student, pretend that their parent's sitting right next to them, so that you make sure that you keep yourself in balance." Well, that's kind of what I do. Pretend the principal's sitting in the back of the room, am I teaching it the best way that I could to make sure that principal wants to keep me around next year?	M, SC, E
Jacob	20	214	By name, maybe not, Mickey. You know, as we said a little while ago, I'm not 100 percent sure that I could recall all the different terms that we discussed in that program. Does my general style of teaching utilize that? Absolutely. And will it continue to? Well, I hope so. If I continue to enjoy what I'm doing and intend to get better. If it gets to a point where I'm coming in and feeling like I'm collecting a paycheck, then that'll be about the time to check out of the business.	M, SC
Jacob	21	230	You know, whether it be – like I said, whether it necessarily be the part of the things that the National Board itself required, or the things that the degree required from GSU, the specialist degree, there's something to be said about the whole process. There's something to be said about what you were talking about, learning the personalities, and learning how other teachers do things, and just going back to school. There's something to be said about that, and making yourself grow, and watching yourself grow and watching, and being impressed on how much you can accomplish. And quite honestly, when you first introduced this back in, I think it was December of 2001, and you were sitting at the lunch table, and I'll never forget this, it	

			was you and Rick Reed, and who else was sitting there? Me, and I guess it was Doug, and you were talking about it, and I was like, "There's no way I'm gonna do this. No way I'm gonna do this." And all of a sudden, it made sense, and you go back, and you look at it, and I didn't think I could do it at the time, and as we were going through it, I wasn't sure I was gonna make it through, and then after it was over with – yeah, it's quite – not only is it a relief that we made it through, but it's also quite a sense of accomplishment. And yes, I would – as I said before, I would recommend that anybody that had the opportunity to do something similar to this, they should dive in, because it will make them better. It'll make them better people, I think. I think there's just something to be said for working yourself harder than you thought you were capable of doing.	
Jacob	22	244	Any changes I would recommend. No, because I really think that we – I'm trying to think about the way that it was laid out, the teaching. I mean, I think the, you know, a lot of times if you go through school, and you're graded on certain things that are, you know, whether they're important or not important, I think what the one thing that all of you guys did, you, Rick, Doug, Karen, when y'all were teaching the courses, the one thing that y'all focused on was making sure that we were growing as teachers. You didn't put as much emphasis on the little stuff, and you made sure that we were getting what we needed to be better teachers, and I think that stuff is – that's the most important, and I mean, you could have probably have nitpicked us here and there on grades, and you know, given us a "B" here that, you know, whatever when we probably deserved it, but at the same time, the most important thing was is that we became better teachers out of it, and I felt like we did, and I felt like – I know I did.	M, SE, SC, CL

Jordan	1	8	I think that my own personality is to reflect, but at the same time, I felt like it was a little more beneficial when you did it in a shared experience, versus just thinking about it yourself. 'Cause somebody else would always have an insight, or have a good idea. "Well, what about this?" Or maybe, even if it was a critical idea, that still, it was something that was worthwhile. That's something that I think I use probably more now than any of the other aspects that we did, partially because of how our school culture is organized. We work in teams, and we in our team meeting we talk about, "Well, I did this in class." And some of them might say, "Well, I think – this is how I usually teach it." And then we try to hash what would be a best practice to use. So, I think it's, sort of, a instead of a paired model, it's a small group model –	M, CL, SC,
Jordan	2	14	To be honest, that's not something that I – I never formally incorporate that. I think partially I don't think about it so much, because I teach a lot of gifted classes, and so it sort of is natural for us to – and if I'm not deep, they ask the questions that get me deep.	SC,
Jordan	3	22	I mean, the National Board Model, once I understood really what they wanted us to share, I was very comfortable with that. I felt more comfortable I think writing about the process, rather than trying to capture 15 minutes of that perfect classroom, kind of, scenario, but I do try to think about what kids know, and do they really know and understand what they're doing, and that's what made me feel good, I guess, about, you know, maybe I am doing something right.	M, SC,
Jordan	4	28	Well, in some of our team discussions, I mean, we talk about trying to get kids to see things from this point of view or that point of view. To me, the action research can be really, really helpful if you have it, if you're not going alone.	AR,CL

Jordan	5	34	The part I don't know if we had any specific articles on this, and it's something I've talked with my administration about here, that has been a particular interest of mine. It's something that I wrote one of my papers on is helping the young teacher, or the pre-service, or their student teaching aspect, that's something that I still am wanting to be more involved with.	CL, SC,
Jordan	6	56	I felt like I was in the presence of really good teachers, and people who cared about the profession as a whole as well as just their own classrooms, and that, I felt like, was one of the most impressive outcomes that I had no idea how that was gonna turn out when I went in.	CL, M,
Jordan	7	60	Well, just the opportunity that we had to watch each other, the video analyzations that we did, I thought that was really, really good to – there's nothing like watching yourself, or watching somebody else teach, and having a relationship with that person, and the fact that we could be so open and honest about ourselves and each other, I thought that is the – if you want to improve –	M, SC,SE

Jordan	8	76 & 78	Well, I had a positive self concept when we started the program. I don't think that I am, you know, the Dolly Lama of teaching or anything, but I know that what I do, and what I did before the program better than a lot of people, is that I truly put myself out there and care, and I think that while some kids may not get that, the vast majority do and their parents do, and my colleagues and administrators realize that. Part of that National Board process that made me feel good was that I didn't have to really change anything that I did to pass, or meet the minimums anyway, but at the same time, by being in that group of highly qualified teachers, it helped boost my self feeling even more. I've completely subscribed to the theory, and it's something that I emphasize all the time with my kids is, you know, you can't tell yourself that you're not good at this, and you're not – just let's see what happens, and try to build them through success.	CL, SE
Jordan	9	96	And in terms of the analyzing student work, I mean, through our – just thinking about reflecting on what does the kid really know? What does the student need to improve on? What successes do they have that you need to highlight? I think that that area was something that we really did hit on the nail.	SC, M, CL
Joyce	1	34	We talk about it. And so, to me, it was interesting to be videotaped, and I think it's a great technique for teaching, but something that I felt like I already did a lot of.	SC, M, CL
Joyce	2	36	That was very enlightening. Very, because I realized many times as we talked about this, that with one sentence I could say to a group, and all of a sudden I had lowered the level of their thinking, and so I had not really thought about that before.	SC, M,

Joyce	3	40	Trying not to lower the level of their thinking, or with some groups, depending on the students, sometimes you may have to, to get them to the next step, but it is something that I am aware of.	SC, M
Joyce	4	78	One thing I also learned about with whole group, is one thing they wanted was interaction with students. They didn't want just to – even though it's whole group, they didn't just want to see the teacher teaching. They wanted it interactive, and I guess sometimes, I think when I first started teaching, I felt like a good classroom was a quiet classroom, and that's not really so.	SC, M
Joyce	5	94	You know, many times they'd use words I don't understand, (Laughter) and I have a hard time getting through them. I think the best part about that was when we talked about them a little bit in class, because we could kind of cut to the chase and talk about what did this really mean?	SC, M, CL
Joyce	6	100	Well, that was the best part about the entire program. Whether it was the end part or the beginning part, the best part was being able to interact with the other teachers. To come up with ideas from other teachers.	CL
Joyce	7	115, 119, 121	Well, I think reflection is part of any good – any good teaching means you have to teach and think about what you taught. you reflect. You think about, you know, and sometimes that's nice about teaching more than one Geometry, or Pre-Cal, you know, you do the lesson. You reflect on it, even if it's five minutes between the classes, and you do it better the next time.	M, SC,
Joyce	8	131	Yes. I think that you build knowledge just by the collaboration, because you're reflecting your craft with them. They're reflecting with you.	SC, M, CL

Joyce	9	145	Well, I think my self esteem has always been a little low, and I think just getting through the program, becoming board certified, even writing the book that I wrote the year before, that all helped build my self esteem to feel like that I am a qualified teacher.	SE, SC
Joyce	10	155	And, you know, you could put reflection in there, a lot of things, but I think basically it was the collaboration with the other teachers.	CL
Joyce	11	163	And you know what, even if it's just based on, you know, self esteem being raised. You know, even a small thing like that –	SE
Joyce	12	175	So, I think that that helped. One little thing that I did during National Board was when I had a student check off every time I talked – spoke to a student to see that I would try to get as many students involved, that little thing was important, and I think even now I try to get more students involved. And you know, now that I think about it, when I think about what we talked about the other day, and what I haven't talked about – and man, don't tell me I just lost it. Oh, was that now I try to have the students do more than what I do.	CL, SC, M
Joyce	13	6	You know, when I look back on it, what I think about mostly is the part that we did on board certifications.	M, SC
Joyce	14	20	I think it brings together just thinking and talking to other teachers about different methods of doing things. I mean, even little catch phrases like, "Ask three then me."	CL, SC, M

Rachel	1	31	Well as you said, I already had been through my National Board certification and was interested in doing my specialist, and so this I guess opportunity I guess sort of fell into my lap and I applied and got permission. I didn't know if I would at first because I'd already, since you know, it's going to be the two-year and the first year working on National Board. So I was excited about being able to do that and I was hoping that having already gone through I could help some people with what they were going to be going through. So that's kind of what I thought I was getting myself into, that's kind of why I joined the program.	M, CL
Rachel	2	49	Yeah, I think – not, again, not per se using the model and having them, but we always do pair and share and, you know, I always have kids working with pairs, talking through things that they're doing. This year I taught calculus for a whole semester, so we had a lot of that communication going on and reflecting.	M, CL, SC
Rachel	3	51	I try just sort of in general to get my kids to reflect on what it is that they wanted from this course, and then as the end approaches I ask them to reflect on what they've done and what they think they've learned, if anything. And so it's helped me to try to at least talk to them more about being more reflective	M, SC
Rachel	4	57	Yeah, I kind of did. It was an interesting project. (Another teacher) and I did a project together and it was – I probably should've spent more time with it, but just because of the time constraints, we did what we could do. But I definitely see that there's value there when you kind of, through reflecting you figure out, "Okay, this is what I want to work on" and then you do what you think is, you know, is going to help you in that process. And then, you know, it's kind of, it's just sort of a spiral.	M, SC, CL, AR

Rachel	5	91	So from a personal standpoint it probably helped me more than maybe from an educational standpoint. I don't know if that makes sense. But just more from the inside, for me. And then because I felt better about myself and where I am and who I was as a teacher, I think I was a better teacher for my kids. So that's sort of what I got from it.	SE,
Rachel	6	137	Would that have helped me with my – maybe, because it's been longer for me going, having gone through my National Board. Probably the task analysis. I might've been better at taking my students' work and talking about it better. So I always – I think I always knew how to put something on a higher level for my kids or how to break it down, but I was new at trying to write down what I saw them doing and the levels that I thought they were working on. So that part would've probably helped had I gone before.	SC, M,
Rachel	7	139	I'm not sure that the action research would've helped me per se with the National Board itself, just thinking back on the things I went through. I think reflection always helps, certainly as a teacher, but just going through the action research, I'm not sure that that particular component would've helped me any more.	M, AR, SC
Rachel	8	143	Yeah, I definitely think I am. I think I've grown in that I read so much more now about just educational research. I wasn't that much into that. I was reading other things, but not educational journals and things like that. So I've gotten a lot more involved in that since going through that process, because we had to read things, and so, "Oh this is not quite as dry as I thought it was going to be." So I've started reading more things and I've started going towards leadership more, again, because of the inside things that I got from that program.	M, SC, SE

Rachel	9	161	Yeah, the reflection stuff is – that's the biggest part I think.	M
Rachel	10	189	I absolutely think it is. I think it should. I think people will – I think that's just the best way to learn about who you are as a teacher and watching other people do their thing and talking about what they do, just the collaboration. So I – yeah, I definitely think it should be repeated.	M, CL,
Rachel	11	271	I know I've worked with teachers that I think they need to go through something like that to see what other people are doing in their classrooms and learn other ways of doing things that you don't have to the same thing you've been doing for 20 years. And I'm definitely about change. I'm about to make a big change next year, so. And I'm sure I will use a lot of those things in the future, where I'm headed.	M

Appendix D

The following data were excerpts from the capstone projects of five out of six participants. The sixth participant was not able to provide her capstone project due to computer problems.

Each excerpt is listed with the name, quote number, paragraph number from their capstone papers, the excerpt, and then the constructs that were seen in each. Complete data sets are available by request to qualified researchers.

The constructs that are listed include M for Metacognition, SC for Social Constructivism, SE for Self-Efficacy, CL for Community of Learners and AR for Action Research.

Name	Quote #	Paragraph	Quote	Construct
Gabrielle	1	3	More specifically, a student's mathematical disposition can be evaluated with standards from the National Council of Teachers of Mathematics. These include confidence in using mathematics to solve problems, to communicate ideas and to reason; flexibility in exploring mathematical ideas and trying alternative methods to solving problems; willingness to persevere in mathematical tasks; interest, curiosity, and inventiveness in doing mathematics. Learning mathematics extends beyond learning concepts, procedures, and their applications. It also includes developing a disposition, which is a tendency to think and act in positive ways toward mathematics. I contend that the better the student's mathematical disposition, the better they learn mathematics.	SC
Gabrielle	2	4	After working with the National Board Certification process, I was even more convinced that we, as educators, have a responsibility to create the most positive environment to encourage a productive mathematical disposition for each of our students.	Standards
Gabrielle	3	4	They had questions about the learning of their mathematics and how it would actually play out in their lives.	M
Gabrielle	4	7	As a design, action research provides educators an opportunity to reflect on their own practices.	M

Gabrielle	5	8	I invite my colleagues to participate in action research or in other words to take action with me to improve our practice as we address the issue of increasing the productive mathematical disposition of our students.	CL
Gabrielle	6	25	Action research is looking at your practice, acting on your practice, and thinking about your practice. The process is best reflected in a spiral of looking, thinking, and action.	AR, M, SC
Gabrielle	7	36	Teachers and supervisors working together, coordinating and presenting issues, problem solving, and negotiating ideas will maximize the learning environment for all students. Ideas interchanged as we listen, clarify, encourage, reflect, present, problem solve, and negotiate will benefit the children and the educational environment the most.	CL, AR,
Gabrielle	8	38	Throughout the action research, a dynamic process can unfold with teachers trying out ideas, making adjustments, and then exploring other ideas. The ideas formed help teacher practice and improve student learning. The purpose of action research is to improve the practice of education with researchers studying their own problems or issues in a school or educational setting. Educators engage in reflection about these problems, collect and analyze data, and implement changes or a plan of action based on their findings.	SC, AR, M
Gabrielle	9	44	The issue is improving mathematical disposition in high school mathematical students.	AR

Gabrielle	10	46	The information that will be used is from two sources, the students in the class where the teacher will address the issue of mathematical disposition and the teacher herself/himself. ... This will be done as a collaborative approach.	SC, AR, M
Gabrielle	11	51	Using surveys, questionnaires, interviews, and journals to collect data from the students will help the instructors evaluate how their students learn, view their mathematics and how the students view themselves....A variety of assessments may be implemented and as the teacher(s) and I collaborate, many new ideas may come about.	AR, SC, M
Gabrielle	12	59	Encouraging students to discuss with each other may be a challenge; moderation by the teacher or other student may be decided collaboratively before engaging in a whole classroom discussion so that students feel comfortable with personalizing their mathematics. I found that this has been a window for me to observe individual student's mathematical disposition. Watching and listening to them over the semester has given me evidence I needed to realize that teachers have a tremendous influence on creating a more productive mathematical disposition for each student.	CL
Gabrielle	13	60	The manual that follows is a suggested guide to collaborate with me as we work through our own action research. It will help show how to implement action research while giving ideas with which to begin the collaborative work on affecting productive mathematical disposition of our students.	AR, CL

Gabrielle	14	58	Students wrote for 10 minutes as they reflected on a question that I posted on the board. Across our school curriculum there has been an emphasis on writing and putting thoughts on paper. These writings revealed their beliefs, attitudes, and dispositions that my students had about their mathematics.	AR, M, SC, SE
Gabrielle	15	59	I found that this has been a window for me to observe individual student's mathematical disposition. Watching and listening to them over the semester has given me evidence I needed to realize that teachers have a tremendous influence on creating a more productive mathematical disposition for each student.	SE, CL, SC, M
Gabrielle	16	80	Lappan (2003) summarizes in her article, *Fostering a Good Mathematical Disposition*, that we as mathematics' professionals need to make more efforts to emphasize assessing mathematical dispositions and work habits-so that when students go on to college or careers, they have the essential desire to solve difficult problems.	SC, AR, M
Gabrielle	17	81	Good problems give good students the chance to solidify and extend their knowledge and to stimulate new learning.	SC, SE
Gabrielle	18	83	Once we start focusing students on their role in learning mathematics through self-reflection, we can see real changes in student engagement during our classrooms. Lappan contends that students not only learn mathematics better but also gain a self-awareness that gives them the confidence to continue to learn.	SC, M, SE
Gabrielle	19	83	Once we start focusing students on their role in learning mathematics through self-reflection, we can see real changes in student engagement during our classrooms.	M, SC

Gabrielle	20	139	Going through the questions individually as you reflect on your practice and then addressing ideas, strategies, successes, and failures together will help improve our practice and give a chance for each of us to set goals for our next action research.	AR, CL, M, SC
Gabrielle	21	171	Working with my colleagues to help students view their mathematics in new ways was very important to me. Continuing to expose students to the ideas that learning mathematics extends beyond learning concepts, procedures, and applications and to see mathematics as a powerful way to look at situations were invaluable opportunities for me to dedicate my research to these goals.	CL, M, SC
Jordan	1	2	According to Paulu (1995), children who spend more time on homework, on average, do better academically than children who don't, and the academic benefits of homework increase in the upper grades. Homework also allows a student to develop habits such as self-discipline and time management. Mathematics is a subject that is understood by active participation both inside and outside the classroom. Students should be assigned homework regularly that reinforces classroom instruction and helps students form connections to previously studied concepts. The consistent completion of homework can lead students to better grasp the idea that mathematics is a web of connected ideas.	SC, M, SE
Jordan	2	13	I also wanted students to reflect on the change after the unit was completed.	M
Jordan	3	22	The reasoning seemed to be that fewer questions on a quiz meant one mistake counted significantly more.	M

Jordan	4	25	I did not use a high level of collaboration with other teachers or school personnel. I did report to the team of college prep algebra II teachers of my desire to increase the time spent completing homework by using shorter and more frequent quizzes. The team meets twice a week for approximately 45 minutes per week to discuss instruction and assessment issues.	CL, AR,
Jordan	5	28	As previously stated, some students reported changing their homework habits during the unit, but the most long-lasting change may turn out to be how I try to establish positive homework habits in future classes. I see a need to determine past homework habits earlier in the school year. I also noticed from the initial survey about homework completion that student test scores seemed to correlate with parental involvement.	M, AR, SC
Jordan	6	28	Of the nine parents with which I have communicated regularly, by email or in person, eight of their children have consistently performed well on tests. The one exception in the group has recently begun to improve his test scores due to an increase in communication with his mother. I will develop a plan for increasing parental supervision as a next step in action research later in this paper.	M, AR, SC

Jordan	7	38	The action research experience with this group of students has influenced me to work toward getting more parental involvement with regards to homework effort and study time. This appears to hold more promise toward increasing test scores than merely increasing the number of quizzes. My experience with students and parents at my current school suggests that when parents realize their child is experiencing problems, they make an honest effort to correct the situation.	M, AR, SC
Jordan	8	43	The grades from previous mathematics courses will the baseline data for the group. I will determine if an increase in parental involvement leads to an increase in course grade by comparing their answers in the parent survey to their actual involvement during the semester. I would closely look for a connection between the previous mathematics grades, the homework completion rate, and the parental involvement. I will answer my question of the influence of parental involvement on grades in mathematics by comparing the parents that have increased their involvement to the grades of their children. I can also compare the grades of students whose parents choose not to be involved or that cannot be involved for one reason or another.	AR

Joyce	1	8	According to Paulu (1995), children who spend more time on homework, on average, do better academically than children who don't, and the academic benefits of homework increase in the upper grades. Homework also allows a student to develop habits such as self-discipline and time management. Mathematics is a subject that is understood by active participation both inside and outside the classroom. Students should be assigned homework regularly that reinforces classroom instruction and helps students form connections to previously studied concepts. The consistent completion of homework can lead students to better grasp the idea that mathematics is a web of connected ideas.	AR, M, SC
Joyce	2	9	Since the averages went down the most in the class where I did not have a homework policy, I will implement a homework policy in every class in the future.	AR, M, SC
Joyce	3	11	Research indicates that homework will increase students' retention and understanding of the material. It can also help study skills and attitudes toward school and teach students that learning can take place outside of the school. Homework also teaches students self-discipline, time organization, inquisitiveness, and independent problem solving (CAREI, 1994).	SC, M

Joyce	4	13	In the second group of studies, researchers compared the assigning of homework with in-class supervised studies. The benefits of homework were about half of what they were when compared with no homework. Homework's advantage was the greatest, again, for high school. And finally, in 50 studies, researchers correlated the time students spent on homework with achievement. Forty-three correlations showed that students that did more homework had better achievement. Only 7 correlations showed the opposite (Plato, 2000).	AR
Joyce	5	29	In order to get input from the students to determine what they think about homework collection I put a reflection (a writing prompt) on the AP Calculus website and had the students respond to it.	AR, M
Joyce	6	35	Homework is an important part of AP calculus AB because this is where skills are practiced. Currently homework is collected on Tuesdays, but this does not seem to encourage the completion of homework on a daily basis.	AR

Joyce	7	45	I decided to base the homework policy on what the majority of the class seemed to want. In second period I implemented homework quizzes, in third period I implemented random collection, and sixth period had no homework policy at all. Some of the brightest students in the senior class are in this sixth period group. They believe that they can be responsible for their own learning and that their test averages will not change. I also have some extremely lazy students in this group and they told me in their reflections that they wanted to choose how much homework they wanted to do. These students felt that homework was bringing down their grade. I think that they will do less work and their test averages will go down as a result of doing less homework. I really hope I am wrong on my feeling about my lazy students.	AR, SE, M
Joyce	8	75	I could have worked harder to find that type of information.	M
Joyce	9	86	What I realized is that it doesn't really matter how I implement homework or if I collect homework at all.	M
Joyce	10	97	Research indicates that homework will increase students' retention and understanding of the material. It can also help study skills and attitudes toward school and teach students that learning can take place outside of the school. Homework also teaches students self-discipline, time organization, inquisitiveness, and independent problem solving (CAREI, 1994).	AR, SC, M, SE

Joyce	11	116	How has the treatment of homework during the last six weeks affected your nightly homework habits? Do you do more, less, or about the same amount of homework as before? Do you think your test average was affected in any way by this treatment of homework? What can I do next year to promote homework completion on a nightly basis (if you don't think that this treatment did)? Other suggestions? Do you think that counting homework more than one daily grade each six weeks would make students more likely to complete it?	M, AR, SC
Joyce	12	126	In the past, the daily part of their grade was 30%, with the homework only counting one daily grade each six weeks. It was not much and the students are smart enough to know that. I will use what I gained in the last action research in terms of homework. I will give the students homework quizzes several times a week. They may use their homework on the quizzes. I think that allowing the use of homework on these quizzes will encourage them to do more homework, especially if this grade will be 10% of their overall grade.	AR, M, SC
Joyce	13	132	Although their were many variables left unchecked in this non-scientific study, the evidence seems to indicate that it is better to have some form of homework implementation, since the averages went down the most in the class period where homework was left unchecked. I do not think it matters what type of homework implementation there is, as long is there is a plan. It also seems that some students are going to do the homework and some students are not, regardless of the plan.	SE, AR, SC, M

Joyce	14	5B	At the time of this writing, this calculus teacher has not yet been named, however it is certain that next year will be the first time this teacher will be teaching calculus at Parkview. My reasons for wanting this partnership are two-fold. First, I would like to assist this teacher while transitioning her into our calculus program which has the reputation of commanding the best from our students. Second, I believe that is important that groups of teachers collaborate in order to monitor classroom activities and to work toward student success.	M, AR, SC
Joyce	15	14B	Directive informational should be used when the teachers developmental level, in terms of calculus, is low and the teacher does not possess the knowledge about calculus that a mentor clearly possesses or if the teacher feels confused, inexperienced, and clearly at a loss about how to begin. Here, the supervising teacher may need to suggest data collection and analysis methods, and action plans.	AR, SC, M
Joyce	16	30B	As you begin, you need to explore data sources to help study and clarify the problem. These resources may be existing literature. The literature may help you determine what others have learned about the same issue. Teachers, administrators, university personnel, and people in the community may also be good data sources.	AR
Joyce	17	72B	Using the steps of action research listed below, you need to think about your next action research plan. This next plan should grow out of the action research that was just completed and evaluated.	AR, M, SC

Joyce	18	92B	This project reminded me of what I learned from National Board Certification. From my large group video, I learned that I need to act more as a facilitator and expect the students to do more. This project has again showed me that I need to relinquish the control and guide someone else to her own problem solutions.	M, AR, SC
Jacob	1	11B	An ongoing concern in my professional career has been formatively assessing students' knowledge.	M
Jacob	2	13B	Creswell (2001) found, "Action research is a useful design to address specific classroom problems and (empowers) individuals to improve their work situations"	AR,M, SE
Jacob	3	21B	The quality of work for traditional research is determined by peer review of methods and results, and action research is measured simply by observing a desired change in practice.	AR, M, SC
Jacob	4	23B	The audiences for traditional research and action research are completely different as well. Other researchers, the profession, government or private agencies view traditional research, and other practitioners in the school community study Action Research (p. 429).	AR, M, SC
Jacob	5	27B	Determine if action research is the best design to use. Collaboration with a colleague as an advisor or even a co-researcher can be valuable in evaluating a plan of action and the types of data collection, either quantitative or qualitative.	AR, CL
Jacob	6	41B	Implement and reflect on the plan. This step puts the plan to work, monitors it, and observes any differences. At this step, the researcher can reflect on what he/she has learned (Creswell).	AR, M, SC

Jacob	7	46B	In completing the last step of doing your action research, you must be able to evaluate it.	AR, M, SC
Jacob	8	56B	there evidence that your plan of action contributed to your reflection as a professional?	M, AR
Jacob	9	84B	The first purpose of assessment is to monitor students' progress and ensure that the students are moving toward learning goals. In monitoring students' progress, "evidence should be collected to provide each student and the teacher with feedback about progress toward those goals"	SC, M
Jacob	10	85B	The second purpose of mathematics assessment is to making instructional decisions. The teachers take evidence from students' mathematical understanding and modify their instruction to better facilitate learning. The question that should be answered for this purpose is, "How can I use evidence about my students' progress to make instructional decisions?" We should be able to understand from this purpose of assessment that learning and teaching are not static, but instead they are dynamic and working together in a symbiotic relationship (p. 26).	AR, M, SC
Jacob	11	87B	The fourth purpose of mathematics assessment is to evaluate the program of assessment is the identifying if the program working properly. Student performance is used to make decisions about instructional programs to promote high expectations in mathematics	AR, M

Jacob	12	101B	We need to consider what methods of formative assessment we have tried in the past and decide the various strengths and weaknesses of each format demonstrated. We can alter these methods to suit our needs, try these methods again without change, or we can discount them completely.	AR, SC, M
Jacob	13	8	Based on the findings from my needs assessment, the first stage of data collection in the action research, I came to believe that I could make a significant difference in the mathematical proficiency of all my students.	M
Jacob	14	36	Coach Melvin (girls' soccer) stated, "the same determination (athletes possess) to succeed on the field or court seems to carry over to the classroom" and "a healthy competition takes place where they want to beat their teammate on tests who sits next to them in AP Calc or whatever." He added, "A 'good' type of peer pressure is created where if (athletes) make mediocre grades then (the athlete) will be the outcast or different." Coach Melvin's response shows that there exists an intrinsic motivation in his female players that make his players special students. His comments state that girls take the fears of failure and embarrassment from the field and transfer those fears in a positive manner into the classroom.	AR, SC, SE
Jacob	15	39	He also mentions a factor in the girls' success in academics is tied to the parental support they receive.	AR, CL
Jacob	16	41	These statements also indicate that these student-athletes understand athletics' place in their lives and know that learning is the most important aspect of their educational experiences.	AR, CL, M, SC, SE

Jacob	17	51	At the end of this action research plan, I will hopefully be able to determine whether the parental influence, time-management skills, and peer encouragement are factors in student-athletes' academic success.	AR, M, SC
Jacob	18	55	Near the end of the semester, it will be necessary to compare the grades of each student with her journal entry from the respective time frames of the assessments to be able to chart academic progress. At this point, I will be able to begin the evaluation process.	AR, M
Jacob	19	65	I have informally asked them questions similar to the ones I had on the questionnaires, and their responses have included comments about how student-athletes are not afraid to come to the board and give responses to group questions, and how they typically are the students who are the first to come in before or after school in order to get extra help. These comments indicate that the student athletes are leaders in their respective classes, and they are willing to do more in order to be successful mathematics students.	AR, M, SC
Jacob	20	74	Having knowledge of what motivates our female student-athletes is going to have a positive influence on my communications with these students both inside the classroom and on the court. From gaining insight from other coaches, teachers, and the student-athletes, I hopefully will be able to communicate better with the student athletes, have a better gauge of what motivational techniques I can use on them and accurately assess them.	SC, M, SE

Jacob	21	75	Any good teacher or coach is always looking for what is most successful for the group and for the individuals, and I intend to use these results to help my non-athletic female students reach their academic potential.	AR, M, SC
Rachel	1	3	I have been teaching at the high school level for 19 years and I am constantly perplexed by the concept of assessment.	SE, M
Rachel	2	4	The information I learned from this study opened my eyes to what my students think about assessment and how they prefer to be assessed versus how they actually perform on various types of assessments.	M
Rachel	3	8	The problem is that I do not really know if my students know what they are supposed to know. a) How can I best assess what my students learn in relation to what I've taught them? I began to explore this question by reading types of assessments and finding research supporting one type of assessment over another in measuring my students' understanding of mathematics.	AR, SC, M
Rachel	4	12	Data collected from the literature included several types of alternative assessments including portfolios, group tests, and projects. I gathered important information from my students through a questionnaire that I created to gain insight on what and how they felt about assessments.	AR, SC
Rachel	5	16	They were asked if my assessments actually measured what they knew. I wanted to know how they preferred to be assessed.	M

Rachel	6	20	The problem is that I do not really know if my students know what they are supposed to know. a) How can I best assess what my students learn in relation to what I've taught them? I began to explore this question by reading types of assessments and finding research supporting one type of assessment over another in measuring my students' understanding of mathematics.	AR, SC, M
Rachel	7	22	Dorr-Bremme, Herman, Stiggins, Brookhart's study (as cited in Loadman & Thomas,2003). Experts say that alternative assessment strategies, such as teacher observation, personal communication, and student performances, demonstrations, and portfolios have a great usefulness for evaluating students and informing classroom instruction Yet, I find these incredibly hard to do, and I have had little, if any, instruction in these types of assessment tools.	SE, M
Rachel	8	26	Journaling in mathematics has also been shown to provide a vent for math–anxiety. I have used journals on occasion, but again I was faced with the time issue and how to fit them into the curriculum.	AR, M, SC
Rachel	9	28	Also, they stressed the importance of student involvement in their own learning.	CL, SC

Rachel	10	29	One very interesting question was about my students' preference of hand written tests versus typed tests. The results were surprising. In my sample of 23 Pre-Calculus students, 14 reported doing better on hand-written tests, 6 reported preferring typed tests, and 3 did not think it made a difference. The reason for liking the typed test was the obvious one; easier to read. The reasons for preferring the hand-written test were that they seemed less formal and because the handwriting was familiar to them, putting them more at ease.	AR, M, SC
Rachel	11	29	Educators are given the task of taking a curriculum that is designed for them, and presenting it to their students in a way they think the students will best learn it. Then, they are asked to assess the learning that took place. This is a great challenge.	SC, M

Rachel	12	30	When asked to describe their favorite type of assessment, most of my students preferred traditional written math tests (ranging from multiple-choice to free response questions) rather than projects, or other forms of alternative assessments. However, when asked to choose a form of assessment for my class, answers such as teacher-made tests, multiple choice tests, take-home tests, essays, and projects were given. Reasons for these choices were familiarity, aided in understanding, ability to work with others, and the ability to show your work for partial credit. When asked the best way to find out what my students actually had learned, answers were; more quizzes, writing a journal, application problems, classroom activities, and essay questions. Students seemed to prefer more quizzes because they felt like it measured their progress better than larger tests that covered more material. The students that preferred essay questions wanted a chance to write more about their thought processes. These tended to be my stronger writers and weaker math students. The student who prefers journaling stated that it would help her to write down what she had learned that particular week.	SE, SC, M,
Rachel	13	33	Because the data I collected from my sources were overwhelmingly supportive of alternate assessment, I realized that I should design an action plan that would require me to give my students several types of assessment to see which allowed them to show that they had learned the mathematics I taught.	M, SC, AR

Rachel	14	36	They were also asked to reflect on assessments I had given them earlier in the course. From the information I gained from my students' survey, I chose tests to fit the results of my students....I found that by giving my students assessments that fit their style, they were better able to show what they know.	M, SC, AR
Rachel	15	46	If I were to do this study again, I would collect my data more systematically and record more of my data.	AR, M
Rachel	16	52	**As a professional development tool, action research was helpful in giving me a more structured way of analyzing my problem and finding solutions.**	M
Rachel	17	56	The results showed that some students performed better when given assessments that fit their learning styles. In my next action research, I will study portfolios and see how their use will impact student achievement. The information I gained from this action research reinforced my opinion that alternative assessments are valuable forms of measuring student achievement and understanding.	AR, Sc, M

Appendix E

The following data were excerpts from the NBC and EdS reflections of four out of six participants. The two remaining participants were not able to provide her capstone project due to computer problems.

Each excerpt is listed with the name, quote number, paragraph number from their capstone papers, the excerpt, and then the constructs that were seen in each. Complete data sets are available by request to qualified researchers.

Name	Quote #	Paragraph	Quote
Abigail	1	4-RC	"Some of my students think that I am actually smart. They feel free to ask real life questions, sometimes personal, and want to know about anything I am willing to share. Was all this due to NBC? No, I think it is my personality, but I do know that NBC has made me more aware of the teaching and learning going on in my classroom for students and me (teacher)."
Abigail	2	1 - RC	"I learned a lot about myself, and my dedication to not only teaching mathematics, but also teaching the tools of how to be successful in life. I did not realize the amount of time that I spent in teaching and community service alone. I taught the students how to be a better human being by helping others and listening to others...I had to show them how to make a difference in others lives while at the same time it was making a difference in each of our lives."
Abigail	3	2 - RC	"NBC made me not only look as my accomplishments, but also explain why it was an accomplishment and how it impacted the students, parents and community around me. I am still learning that it is okay to let others know what I have attained, and how difficult it was."
Abigail	4	2 - RC	"I have had a hard time sharing my accomplishments because I feel that I am boasting or bragging. I thought anyone could achieve what I have achieved, so it is not worth discussing or sharing."

Abigail	5	3 - E1	"I have allowed the students to take responsibility for their own learning and share that experience with the other students, and the students are liking it. They feel confident and free to ask questions on what they don't understand and volunteer to answer questions when other students do not understand. My test scores have never been higher."
Abigail	6	1 - E1	"I learned to become the student and allow the students to teach me what they actually knew."
Abigail	7	2 - RC	"I have learned how to express my opinion and myself, whether on paper or to a group of people, and be able to listen and accept someone else's opinion as just that."
Abigail	8	4 - E3&4	"I now have my students more involved in their learning process. I have them engage in more student-to-student dialogue, and through this there is more peer-coaching going on in the classroom. My students have gotten very good at helping each other and I am teaching them how to help someone without giving them the answer. They know how to discuss thought processes and lead their peers through this process."
Abigail	9	2 - E1	"I incorporated puzzles and group games, some were racing against time and others were racing against others, that allowed every member to have the marker and a voice in class."
Abigail	10	3 - E3	"The students feel more comfortable asking each other questions on daily work or homework than asking me. I am now the last resort if the students around them do not know."

Abigail	11	1 - RC	"I even spent countless hours thinking up community service projects that would keep my students in touch with their society. I had to show them how to make a difference in others lives while a the same time it was making a difference in each of our lives."
Abigail	12	2 - RC	"I can share and help others learn how to achieve their goals."
Abigail	13	3 - E4	"I will continue to take part in the textbook adoption and curriculum change workshops because I think my opinion is important and hearing others might help me improve. We learn from each other and if we don't share our opinion as a diverse group of people, someone might be left out or neglected, so I must help change education instead of complain without a solution."
Abigail	14	1 - E1	"The National Board Certification process has made me analyze delivery and evaluation of my teaching and the students learning."
Abigail	15	2 - RC	"I have also learned to reflect over past experiences to see if I could have done things differently for a better outcome."
Jacob	1	2 - RC	"The National Board process has made me a more sophisticated learner in that I am constantly searching for the best approach to reaching out to my students for their learning benefit."
Jacob	2	1 - E2	"My classroom teaching has changed in that I am now much more conscientious of what the children are saying in their questions and in their comments. I feel like I rely much more on what the students are thinking, and I allow them to carry the flow of the class much more than I did in the past."
Jacob	3	1 - E1	"I felt like analyzing student work was something new to me, and after looking for prior work in this area, I felt as if it were something new to math education at-large."

Jacob	4	5 - E2	"Watching video has not really change my teaching as much as I thought it would. I'm still very concerned with the comments I make and the questions I ask, and I found on the videotape that my thought processes and analysis after watching the tape didn't change as dramatically as I thought. I feel that I'm very introspective in the middle of class – almost to a fault."
Jacob	5	4 - E3	"The student-to-student communication is much greater than before because I put the seats in clusters, and the kids are naturally going to be more apt to work together. Starting from the beginning of the semester is much easier than trying to change on the fly in the middle of the semester. The kids enjoy this level of discourse, and it has renewed my energy in teaching."
Jacob	6	2 - E2	"I have implemented much more group work than I did in the past, and my students have enjoyed the opportunity to do more than having just my teaching from the board."
Jacob	7	4 - E3	"The student-to-student communication is much greater than before because I put the seats in clusters, and the kids are naturally going to be more apt to work together."
Joyce	1	6 - E4	"As teachers, it really is all about the students and how we can better ourselves to serve them."
Joyce	2	3-RC	"I had to change my "old school" ideas about how a class should operate. I worked hard to make sure I was including every student in every class period, so they would feel actively involved."
Joyce	3	4 - E1	"We also started giving reflection assignments where the students had to compare and contrast different, but related concepts."

Joyce	4	6 - RC	"The whole process has been very enlightening and I believe I am a better teacher because of this process. I also think that reflecting on it has also been useful!"
Joyce	5	1 - E1	"I feel that I have learned so much based on large group videos and Entry 2.... I guess I was taken by surprise by what the National Board really wanted to see, communications with me and also communications amongst the students."
Joyce	6	4 - E4	"Collaboration with other teachers has always been a strength of mine. I was able to use that in my Entry 4 along with the creation of the Precalculus and Calculus web pages that I did with colleagues. I will always continue to collaborate with other teachers. It is better for the students and makes me a better teacher."
Joyce	7	6 - RC	"The whole process has been very enlightening and I believe I am a better teacher because of this process."
Joyce	8	2 - RC	"Just seeing a completed list of accomplishments with the documentation of letters and pictures made me realize that I have made a difference! This entry has given me more confidence in myself and my teaching. I think all teachers need to feel that what they do is important and that they made a difference in many peoples lives. It is this feeling that makes me want to go to work another day, another week, another year!"

Joyce	9	3 - RC	"I had to change my 'old school' ideas about how a class should operate. I worked hard to make sure I was including every student in every class period, so they would feel actively involved. I started sending more kids to the board to display their work…For years, I felt that students moving around created a disturbance. I also wanted them to see correct notation as I worked a homework problem. Now, I can talk with a class about the correct notation while we look at a students work. It really is more effective that way and I'm surprised it took me so long to see it!"
Joyce	10	4 - E1	"We also started giving reflection assignments where the students had to compare and contrast different, but related concepts. And the last reason, I believe, was trying to help students to conceptualize topics related to Entry 1."
Joyce	11	3- E3	"Sometimes students would rather ask me than to ask a classmate. What I do now, is to ask if the group has questions, and to encourage a group member to answer the questions for the other student."
Joyce	12	4 - E4	"Collaboration with other teachers has always been a strength of mine. I was able to use that in my Entry 4 along with the creation of the Precalculus and Calculus web pages that I did with colleagues. I will always continue to collaborate with other teachers. It is better for the students and makes me a better teacher."
Joyce	13	5 - E4	"Since Entry 4, I have felt more like a leader in the professional community."
Rachel	1	2 - NBCR	"The overall National Board Certification process has made me grow as a professional. It gave me more self confidence as a teacher and a leader."

Rachel	2	3 - E1&2	"Just the process of reflection has helped me with the other subjects that I have taught. I try to take the time grading their assignments and analyzing why they may have made the mistakes they made. I think it has made me a better assessor."
Rachel	3	3 - E1&2	"Just the process of reflection has helped me with the other subjects that I have taught. I try to take the time grading their assignments and analyzing why they may have made the mistakes they made. I think it has made me a better assessor."
Rachel	4	2 - NBC	"The overall National Board Certification process has made me grow as a professional. It gave me more self-confidence as a teacher and a leader. I realized that there were areas where I was very strong and some where I was weak. I have worked to become better at the weak areas. I continue to grow as a teacher and as a learner. The process made me aware of the importance of community and family involvement in the education of a child. It made me aware that when I grade a student's work, I need to analyze each paper and find the mistakes and understand what they did wrong and discuss it with them."
Rachel	5	1- RC	"National Board hasn't really changed how I see myself, but it has given me more confidence in myself. This added confidence has made me a stronger teacher."
Rachel	6	2 - NBC	"The overall National Board Certification process has made me grow as a professional. It gave me more self-confidence as a teacher and a leader. I realized that there were areas where I was very strong and some where I was weak. I have worked to become better at the weak areas. I continue to grow as a teacher and as a learner."

Rachel	7	2 - NBC	"It made me aware that when I grade my student's work, I need to analyze each paper and find the mistakes and understand what they did wrong and discuss it with them. I have tried to do this more since the NBC process."
Rachel	8	1 - RC	"This reflection allowed me to improve my instruction."
Rachel	9	4 - E3&4	"They know how to discuss their own thought processes and lead their peers through this process."
Rachel	10	6 - E3&4	"I am much more cognizant of involving all of my students."
Rachel	11	2 - RC	"I know that as a teacher and a professional, more is required of me than just what goes on in my classroom. I know that I have a responsibility to my students, my school, and to the community in which I teach."