SECONDARY MATHEMATICS TEACHERS' CURRICULUM PHILOSOPHIES AND EXPERIENCE

DISSERTATION

Presented to the Graduate Council of
Texas State University-San Marcos
in Partial Fulfillment
of the Requirements

for the Degree

Doctor of PHILOSOPHY

by

Jill Ashdown Cochran, B.S.

San Marcos, Texas
August 2010

SECONDARY MATHEMATICS TEACHERS' CURRICULUM

PHILOSOPHIES AND EXPERIENCE

Committee Members Approved:

_____
Gilbert Cuevas, Co-Chair

_____
Nathaniel Dean, Co-Chair

_____
Joyce Fischer

_____
Larry R. Price

_____
Alexander White

Approved:

_____
J. Michael Willoughby
Dean of the Graduate College

To the one who is beside me for every journey, knowing my capabilities

and talents better than I do…

Zane

ACKNOWLEDGEMENTS

I had a great deal of support throughout the whirlwind process of completing this dissertation and I would like to acknowledge those people who were most instrumental. I appreciate the willingness of both Dr. Nate Dean and Dr. Gilbert Cuevas to serve as my co-chairs. They provided me with two vastly different perspectives on my research and my future aspirations. They were advocates and guides for me as I navigated through becoming the first doctoral graduate from the Mathematics department at Texas State University-San Marcos. Dr. Dean was truly a mentor as he introduced me to the wider world of mathematics in the years we worked together. Dr. Cuevas not only taught me from his perspective of mathematics education, but listened to my experience and ideas and helped me mold them. I am grateful to both of these advisors.

My other committee members were also great sources of support and encouragement. Dr. Fischer helped guide my understanding of the theory that became the foundation for this dissertation. She provided friendly encouragement and professional support in addition to her detailed reading of the entire document. Dr. Price was responsible for expanding my understanding of psychometrics, the development of an instrument, and advanced methods for analyzing complex data. Even though many of the techniques we discussed did not make it to the final version, I learned a significant amount through the process. Dr. White was helpful as he took the time to fully understand the structure of the theory involved and talk through representations,

visualizations and manipulations of the information. His overall knowledge aided in organizing my ideas and fitting the different components together.

Of course, none of this research would have been possible without the support from many school districts across Texas and the teachers who chose to share their philosophies and experience.

Before this dissertation was even conceived, my family was vitally influential in getting me to the point where I could even fathom taking on such a project. My parents, Greg and Robyn Ashdown, were there from the beginning as I am sure they will continue to be, supporting and loving me. I also appreciate the support from my other parents, Don and Mentie Cochran, who believed in me and the importance of what I wanted to accomplish. My four brothers are greater examples to me than they will ever know and I am exceedingly proud of each of them. My two sisters inspire me to achieve all that I can. I especially appreciate Marcia who took over some of my responsibilities during the summers of my doctoral program.

The one person that I could not even begin to acknowledge all of his contribution would be my husband, Zane Cochran. From designing and managing the online survey to providing a soundboard for all ideas and editing everything many times, he made it possible to even attempt this project. He picked up my responsibilities at home and provided the encouragement and motivation to persevere. I appreciate him and my son, Asher, for all of their understanding and support.

This manuscript was submitted on July 8, 2010.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

LIST OF TABLES x

LIST OF FIGURES xiv

ABSTRACT xvi

CHAPTER

1. INTRODUCTION 1

    Retaining Quality Teachers 1
    Reform Movements 2

2. LITERATURE REVIEW 5

    Defining Curriculum Philosophies 5
    Curriculum Theory 7
        Competing ideals 7
        Curriculum ideologies 8
        Philosophy maturation 11
        The "middle ground" 12
    Characteristics of Relationships Between Beginning and Experienced Teachers 15
    Changes in Philosophies 17
    Theoretical Framework 20
    Summary 24

3. METHODS 26

    Population and Sample 27
        Sampling 27
        Sample size 29
    Procedures 29
    Instrumentation 31
        Attribute survey of teaching experience 31

Curriculum philosophy inventory 32
Forced-choice format 34
Initial development 36
Review 37
Revised instrument 39
Validity and reliability 39
Pilot study 40
Sampling and procedures 41
Item analysis 43
Qualitative analysis 44
Structure of ideologies 48
Conclusions from pilot test 49
Visualization Model 51
Developed visualizations 51
Coordinate systems 54
Theoretically possible scores 57
Transformation to Cartesian coordinates 57
Creation of meaningful regions 58
Visualizing theoretical points within the regions 61
Data Analysis 63
MTPI validity and reliability 65
Relating teachers' philosophies and experience 71
Summary 75

4. RESULTS 77

Sample 78
Did Any Questions Show Signs of Particularly Favorable or Negative Wording? 82
How Representative Was Each Item of the Aspect of Teachers' Philosophies to Which It Belonged? 83
How Well Do the Teachers Think That the Analysis Represented Their Philosophy? 84
How Well is the Model and Structure Established in the Theoretical Framework Represented in the Data? 92
What is the Relationship Between the Four Ideologies? 102
What is the Test-Retest Stability of the MTPI? 103
Can the Number of Questions for Each Aspect be Reduced? 105
How is the Data Distributed Across the Different Regions? 107
How Do Teacher Attributes Vary Between the Different Regions? 114
What Model of Prediction Can Teacher Attributes Give for the Region of a Teacher's Philosophy? 118
What Model of Prediction Can Teacher Attributes Give for the Distance of a Teacher's Philosophy from a Balanced Philosophy? 122
Summary 126

5. DISCUSSION AND CONCLUSIONS 129

Instrumentation 130
Reliability and validity 130
Inventory improvements 132
Limitations of the MTPI 135
Visualization Tool 136
Discussion of the Relationship Between Teachers' Experience and Philosophies 137
Overall philosophies 137
Purpose of education 141
View of mathematics 143
Purpose of mathematics 145
Teaching 147
Learning 150
Nature of knowledge 152
Nature of childhood 154
Evaluation 156
Summary and Conclusions to Research Question 157
Limitations of the Study 159
Implications for Future Research 160

APPENDICES 162

A. Experience Questions Portion of Survey 162
B. Review Instrument of Math Teacher Philosophies 164
C. Sample of Revised Mathematics Teacher Philosophy Inventory 165
D. Initial Email to Teachers 166
E. Additional Pilot Test Results 167
F. Description of Each Ideology Given to Participants After Completion of the MTPI 169
G. Inequalities that Defined the 15 Regions within the Tetrahedron 171
H. Additional Reliability and Validity Results 172
I. Logistic Regression Equations for Each Aspect 175
J. Component Loading Pattern and Structure Matrices After Rotation 183
K. Averages and Proportions by Region for Each Significant Experience Attribute 189

REFERENCES 190

LIST OF TABLES

Table **Page**

1. Comparison of Three Curriculum Theory Classifications 9
2. Comparison of Schiro's (2008) and Ernest's (1991) Curriculum Theories 21
3. Eight Constructs of Teachers' Philosophies from Each of the Four Orientations 23
4. Percentages of Texas Secondary Mathematics Teachers by Community Type 28
5. Examples of Classifications of Reviewers' Responses and Totals for Each Category 38
6. Descriptive Statistics for Pilot Study Sample 42
7. Qualitative Analysis Themes from Teachers' Reactions to the Pilot Survey and Results 45
8. Correlations Between the Totals for the Four Ideologies in the Pilot Study 49
9. Distribution of Possible Scores in Each of the 15 Theoretical Regions 62
10. Attribute Variables 72
11. Summary of Analysis 76
12. Comparison of Sample to Population Proportions by Community Type 78
13. Counts and Percentages of Teachers in the Sample by Gender and School Level 80
14. Descriptive Statistics for Responses to the Experience Questions 81
15. Themes from Qualitative Analysis of Teachers' Reactions to the Survey and Results 84
16. Eigenvalues and Cumulative Percentages of Variation Explained for All Components with an Eigenvalue Greater than One When All Aspect Totals were Included in PCA 97

17. Component Groupings by Color and Communalities with 11 and Eight Components 98

18. Eigenvalues, Component Loadings and Variance Accounted For in PCA for Each Ideology using Aspect Totals....101

19. Correlations Between the Four Ideologies in the Total Scores....102

20. Change in Total Scores for Each Aspect Measuring Test-Retest Reliability 104

21. Minimum Squared Correlations Between Reduced Inventories with the Given Number of Items per Aspect and the Full Inventory 107

22. Expected and Actual Counts for Regions with χ^2 Statistics Testing for Goodness of Fit....110

23. Visual and Analytic Description of the Distribution of Points 111

24. Averages and Proportions of Each Attribute in Each Region for Overall Philosophies 115

25. F-Statistics from ANOVA Tests for Independence Between Region Classifications and Numerical Attribute Variables....116

26. Results from Chi-Squared Tests for Independence Between Region Classifications and Categorical Attribute Variables 117

27. Logistic Regression Equations for Overall Philosophies Being Located in a Region 119

28. Summary of Attribute Variables used in Logistic Regression Equations for Each Aspect of Teachers' Philosophies 121

29. Multiple Linear Regression Equation for Weighted Distance of Overall Teachers' Philosophies from the Center....123

30. Multiple Linear Regression Equation for Weighted Distance of Philosophies for Each Aspect from the Center 124

A. Correlation Between the Reasons Given by Schiro (2008) for Teacher Philosophy Changes and the Survey Questions About Teaching Experience 163

E1. Counts for the Number of Teachers that Chose Each Response in Pilot Study 167

E2. Correlations Between Items and Totals for the Corresponding Aspect of Philosophies in Pilot Study....168

G. Inequalities that Defined the 15 Regions within the Tetrahedron 171

H1. Counts for the Number of Teachers that Chose Each Response....172

H2. Correlations Between Items and Totals for the Corresponding Aspect....173

H3. Order of Item Removal for Reduced Inventories....174

I1. Logistic Regression Equations for Log Odds of Philosophies about the Purpose of Education Being Located in a Region 175

I2. Logistic Regression Equations for Log Odds of Philosophies about the View of Mathematics Being Located in a Region 176

I3. Logistic Regression Equations for Log Odds of Philosophies about the Purpose of Mathematics Being Located in a Region 177

I4. Logistic Regression Equations for Log Odds of Philosophies about Teaching Being Located in a Region....178

I5. Logistic Regression Equations for Log Odds of Philosophies about Learning Being Located in a Region....179

I6. Logistic Regression Equations for Log Odds of Philosophies about the Nature of Knowledge Being Located in a Region 180

I7. Logistic Regression Equations for Log Odds of Philosophies about the Nature of Childhood Being Located in a Region....181

I8. Logistic Regression Equations for Log Odds of Philosophies about Evaluation Being Located in a Region....182

J1. Pattern Matrix for PCA with 32 Aspect Totals Reduced to 13 Components....183

J2. Structure Matrix for PCA with 32 Aspect Totals Reduced to 13 Components 184

J3. Pattern Matrix for PCA with 32 Aspect Totals Reduced to 11 Components....185

J4. Structure Matrix for PCA with 32 Aspect Totals Reduced to 11 Components 186

J5. Pattern Matrix for PCA with 32 Aspect Totals Reduced to Eight Components 187

J6. Structure Matrix for PCA with 32 Aspect Totals Reduced to Eight Components 188

K. Averages and Proportions by Region for Each Significant Experience Attribute 189

LIST OF FIGURES

Figure **Page**

1. Life History as a Trip 52
2. Life History as a Vector Analysis 52
3. Life History as a Portrayal of Internal Change 53
4. Life History as a Set of Influences 54
5. Life History as a Composite of Ideologies 54
6. Tetrahedral Space Representing Curriculum Philosophies as a Composition 56
7. Two Views of the Relationship of a Cuboctahedron to the Vertices, Edges and Faces of a Tetrahedron 60
8. Visual Representation of the Four Types of Regions 60
9. Proportion of Theoretical Points at Given Distances from the Origin 61
10. Theoretical Points Within the Tetrahedron and Cuboctahedron 63
11. Flow of Participants 82
12. Theoretical Hierarchical Structure for Curriculum Philosophies 93
13. Scree Plots for Each Aspect Using Principal Component Analysis 95
14. Minimum Correlations Between Reduced and Full Inventory Scores 106
15. Proportion of Responses by Region 108
16. Averages and Proportions for Experience Attributes that Failed to Show Independence with Overall Philosophies 139

17. Proportions of Teachers who Currently Taught High School with Philosophies About the Purpose of Education 142

18. Averages of Years Taught with Philosophies About the Purpose of Mathematics 145

19. Averages and Proportions for Experience Attributes that Failed to Show Independence with Philosophies About Teaching 148

20. Averages for Experience Attributes that Failed to Show Independence with Philosophies About Learning 151

21. Proportions of Teachers with Administrative Experience with Philosophies About the Nature of Knowledge 153

22. Averages of Years Taught with Philosophies About the Nature of Childhood ... 155

ABSTRACT

SECONDARY MATHEMATICS TEACHERS' CURRICULUM PHILOSOPHIES AND EXPERIENCE

by

Jill Ashdown Cochran, B.S.

Texas State University-San Marcos

August 2010

SUPERVISING PROFESSORS: GILBERT CUEVAS AND NATHANIEL DEAN

Teachers' beliefs about education greatly influence what they teach students. In light of current reform movements in mathematics education and the critical shortage of qualified mathematics teachers, it is important to understand teachers' curriculum philosophies as well as how those philosophies change. This study examined relationships between teachers' curriculum philosophies and their teaching experience. Using Michael Schiro's (2008) and Paul Ernest's (1991) curriculum ideologies as the framework, secondary mathematics teachers in Texas responded to a researcher-designed inventory with an ipsative format, which was used to identify the composition of

teachers' philosophies. The development of the Mathematics Teacher Philosophy Inventory included many measures of reliability and validity, each analyzed using various statistical methods and qualitative analysis of teachers' reactions to the survey.

An advanced visualization tool was developed to represent the composition of teachers' philosophies in a three-dimensional space, which aided in the exploration and analysis of teachers' philosophies and how those philosophies relate to their experience. This visualization tool relied on a compositional coordinate system, classification of philosophies into regions defined by combinations of ideologies, and a detailed understanding of the distribution of possible scores for the inventory. It was useful in recognizing patterns, understanding similarities between attributes of teachers with similar philosophies, and presenting results.

Analysis of relationships between teachers' curriculum philosophies and teaching experience was performed using a combination of statistical methods including chi-squared and ANOVA tests of independence and multiple regression techniques. The analysis was performed for the overall philosophies as well as philosophies about each of the following aspects: Purpose of Education, View of Mathematics, Purpose of Mathematics, Teaching, Learning, Nature of Knowledge, Nature of Childhood, and Evaluation. General trends for the population of secondary mathematics teachers showed definite agreement with one ideology over others, which varied among the different aspects of teachers' philosophies. The following attributes of teachers regarding their teaching experience were conclusively related to their curriculum philosophies: years of teaching experience, years at their current school, whether they taught middle school or high school, administrative experience, and formal mentoring experience. The

relationships of each of the attributes also varied among the different aspects of teachers' philosophies.

CHAPTER 1

INTRODUCTION

There are two attributes of teachers that greatly influence pedagogy: teachers' beliefs and knowledge structures (Frykholm, 2004). Teachers' beliefs is an important area of study because each teacher's beliefs influence his or her teaching, which in turn affects student achievement (Barrett Paterson, 2009; Benken, 2004; Cheung & Wong, 2002; Cooney, Shealy & Arvold, 1998; Pajares, 1992; Wayne & Youngs, 2003). In a review of current research about secondary mathematics teaching, two major topics were particularly relevant to teachers' beliefs: retaining quality teachers in schools and reforming practices to meet current national standards, especially those of the National Council of Teachers of Mathematics (NCTM, 2000).

Retaining Quality Teachers

According to Smith and Ingersoll (2004) there is a critical shortage of qualified mathematics teachers in the United States. They found that there is a significant link between high rates of beginning teacher attrition and teacher shortages. In fact, the rate at which mathematics teachers leave the profession within the first five years of teaching is increasing, which leads to school staffing problems and decreased school performance (Smith & Ingersoll, 2004). Many studies have addressed this problem by surveying beginning teachers about their challenges, support structures and induction programs (Friedrichsen, Chval, & Teuscher, 2007; Kardos, 2004; Miller, 2001). One common

conclusion in these studies is that part of the beginning teacher's struggle is related to unrealistic ideals about teaching. However, none of these studies defined exactly what those ideals were.

Reform Movements

All teachers, new and experienced, are facing the challenge of shifting ideals in response to the reform movement largely started in 1989 by NCTM with the Standards (revised in 2000) (Barrett Paterson, 2009; Frykholm, 2004). According to Frykholm (2004), the Standards were partially created in answer to results from the Third International Mathematics and Science Study (TIMMS) from 1995, recently known as the Trends in International Mathematics and Science Study (TIMSS), which showed the United States performing much lower than many other countries at every level. The TIMMS results and subsequent studies unleashed concern about the curriculum and teaching practices in the United States. In the context of the reform movement: "It is clear that those who wish to modify teacher behavior must take into account the belief systems of the teachers that they are trying to change" (Gallagher, 1994, p. 187). Frykholm showed in his four case studies of teachers, that reform often causes teachers to have uncertainty and doubt, which ultimately leads to what he terms *pedagogical paralysis*, which is the inability to progress as an educator due to confusion and doubt. He claimed that teachers often feel conflicted about how their beliefs about teaching and learning fit with the new curriculum and it causes a "discord".

This discord affects teaching practice (Frykholm, 2004). According to Cheung and Wong (2002), "If the teacher does not believe that a particular curriculum ideology is valuable he or she will not be willing to implement a curriculum designed on the basis of

that orientation" (p. 227). Therefore, the first step toward changing curriculum and practice is to first understand the beliefs and philosophies that teachers hold. Many studies, including Benken (2004) and Blake (2002), discuss the critical role that teachers' beliefs hold in determining their practice. Schiro (1992) further claimed that by understanding teachers' beliefs and how they change, staff development might become more beneficial for teachers and help them capitalize on the transitions that they naturally make. Adler, Ball, Krainer, Lin, and Novotna (2005) noted that while research in teacher education and development was underdeveloped until recently, it has blossomed during the past five years as it has been recognized as an important area of research in mathematics education. They recorded five significant gaps in the literature. One of these gaps was teachers' learning from experience. Understanding teachers' beliefs and philosophies is a critical component in addressing teacher shortages and attrition rate as well as reform-related change. The purpose of this study was to develop a suitable model for identifying and analyzing teachers' curriculum philosophies and use it to examine relationships that might exist between those philosophies and experience. The model included two major aspects: a more accurate way of collecting information about teachers' curriculum philosophies that can be used with a large number of teachers (a survey) and a visualization tool to aid in the analysis of results. Thus, part of this study involved creating an inventory based on Schiro's (2008) and Ernest's (1991) theories designed to measure mathematics teachers' curriculum philosophies and a visual representation to aid in the investigation and display of teacher's curriculum philosophies. This model was used to collect and analyze data, from secondary mathematics teachers, with appropriate exploratory and predictive data analysis methods.

The results were used to investigate the question: What relationships exist between mathematics teachers' curriculum philosophies and their experience?

CHAPTER 2

LITERATURE REVIEW

Defining Curriculum Philosophies

A review of the literature shows that many terms have been used in research related to curriculum philosophies. Curriculum ideologies, curriculum beliefs, educational value ideologies, curriculum ideologies and conceptions of curriculum are similar terms in research to describe curriculum philosophies. While these terms are sometimes used interchangeably there are small differences between the different terms, which are necessary to define in order to clarify exactly what is to be measured. Both Eisner (1992) and Schiro (2008) agreed on the term *curriculum ideologies*, which they used to describe "beliefs about what schools should teach, for what ends and for what reasons" (Eisner, 1992, p. 302) and "people's endeavors while they engage in curriculum activity or think about curriculum issues" (Schiro, 2008, p. 10). Both Eisner and Schiro specifically stated that they chose *ideologies* over *philosophies* because in their studies, they were concerned with the beliefs that directly influence practical decisions (ideologies) rather than articulated beliefs (philosophies). This is an important distinction because practical decisions and articulated beliefs often do not match. The seeming inconsistency can be a frustration for those who seek to change teachers' practices (Barrett Paterson, 2009).

Cheung and Wong (2002) opposed the viewpoint of Eisner and Schiro stating that "measurement of teachers' beliefs about curriculum design is different from measurement of curriculum implementation" (p. 230). Cheung and Wong's justification for looking at curriculum ideologies from articulated beliefs was that "limitations in time, space and personnel may limit the ability of the teacher to operationalize his or her belief about curriculum design" (p. 230). Cheung and Wong used *curriculum orientation*, which they defined as "a collective set of beliefs about curriculum elements such as curriculum intent (aims, goals and objectives), content, teaching strategies and instructional assessment" (p. 226). The concentration is on the strong beliefs that teachers have, which consistently affect their educational decisions, but are not always observed in practice due to contextual restraints. This study has the same focus as Cheung and Wong's study of teacher orientations.

In this study the focus will be on teachers' *philosophies*, which are the collection of deeply entrenched beliefs that teachers hold that might not always be evident in practice. Philosophies was chosen over orientations, which has a similar definition according to Cheung and Wong (2002) as stated previously, because orientation often also has the connotation of being directional or of magnitude. The focus of this study will be a snapshot of teachers' current beliefs rather than where they are headed or how strongly they will defend their particular position.

Teachers may hold different beliefs about many different topics, but in order to clarify which philosophies that are of interest to this study the term *curriculum philosophies* will be used. "A person often behaves differently when acting on (or thinking about) curriculum issues from how he or she acts (or thinks) as a psychologist,

parent, philosopher or epistemologist" (Schiro, 2008, p. 9). Schiro defined curriculum as consisting of the following six areas: the purpose of education, teaching, learning, the nature of knowledge, the nature of childhood, and evaluation. These aspects will be incorporated into this study along with an additional focus on mathematics. Thus, curriculum philosophies will be used in this study to mean the personal, core beliefs that teachers have about the purpose of education, mathematics, teaching, learning, knowledge, childhood, and evaluation.

The theoretical positions that were referred to by Schiro (2008) will remain under the term *curriculum ideologies*. These ideologies each represent a collection of society's ideals as they define distinct extremes in curriculum belief systems and will be specifically characterized in the Theoretical Framework.

Curriculum Theory

Competing ideals. Although many teachers may not know the names of different curriculum ideologies they have felt the force of the battle between them (Schiro, 1992, 2008). In mathematics education they are often referred to as the ‚math wars,' which ask teachers to take sides in the conflict between skill knowledge and conceptual knowledge (Goldin, 2008). "Educators find themselves immersed in constant debate and disharmony over critical philosophical and ideological issues" (Schiro, 1992, p. 252). Many authors have written about this constant debate that buffets the American school system including Eisner (1992) and Jackson (1992). Historically, this battle has taken place between a handful of philosophies about curriculum with similar themes repeating themselves under new names (Kliebard, 1992). Teachers and schools are under constant pressure to conform to one ideal or another. Political groups, parents, administrators and

curriculum developers are just a few of the sources for this pressure, making curricular and instructional issues the foremost concern for teachers (Brandell, 2005). Unfortunately, as will be discussed in subsequent sections, many theorists cannot agree on characteristics or even names for the different curriculum philosophies. This adds to the confusion that teachers often feel about the conflicting ideals that surround them (Schiro, 1992).

Curriculum ideologies. In the research literature there exist many documented sets of curriculum theories. According to Jackson (1992), there are between two and six distinct curriculum ideologies based on developed theories and historical trends. The focus of this review is the comparison of three major theories: Eisner and Vallance (1974), McNeil (2006) and Schiro (2008) with five, four and four ideologies, respectively. Table 1 gives a comparison of these authors' classifications of curriculum ideologies and a brief description of each ideology. Similar ideologies from different authors appear on the same row to facilitate comparisons. More complete comparisons including these authors and many others were done by Cheung and Wong (2002), Jackson (1992) and Schiro (2008) along with descriptions of their historical development. None of these curriculum theories are specific to math. A review of the literature shows that few attempts have been made to create or modify a theory specific to mathematics education.

The most common reference to ideologically separate curriculums in mathematics is dichotomous. The „math wars,' which have been discussed for decades, are usually presented as traditional (skill knowledge) versus progressive (conceptual knowledge).

According to Goldin (2008), there was an emphasis on memorization, skill building and routine problem solving in the 1940s and 1950s.

Table 1

Comparison of Three Curriculum Theory Classifications

Eisner (1974)	McNeil (2006)	Schiro (2008)
Academic Rationalism Enable students to use and appreciate the ideas and works that constitute the various intellectual and artistic disciplines (p. 161)	**Academic** Equip learners to enter the world of knowledge with the basic concepts and methods for observing, noting relationships, analyzing data and drawing conclusions (p. 83)	**Scholar Academic** Help children learn the accumulated knowledge of our culture: that of the academic disciplines (p. 4)
Technology Schooling is a complex system that can be analyzed into its constituent components (p. 49)	**Systematic** The importance of having a goal and then…determining what would it take to reach the goal together with continually assessing to ensure that the parts are contributing to the desired outcome or to make modifications if necessary (p. 57)	**Social Efficiency** Efficiently meet the needs of society by training youth to function as future mature contributing members of society (p. 4)
Cognitive Processes Develop a repertoire of cognitive skills that are applicable to a wide range of intellectual problems (p. 19)		
Self Actualization Means of personal fulfillment, to provide a context in which individuals discover and develop their unique identities (p. 105)	**Humanist** Listening, self-evaluation, creativity, openness to new experiences and goal setting (p. 21)	**Learner Centered** Schools should be enjoyable places where people develop naturally according to their own innate natures (p. 5)
Social Reconstructionism Schooling is an agency of social change (p. 135)	**Social Reconstructionist** Relation of the curriculum to society as it *should* be as opposed to society as it *is* (p. 41)	**Social Reconstruction** Facilitate the construction of a new and more just society that offers maximum satisfaction to all (p. 6)

The 1960s brought the New Math movement, which focused on concepts rather than procedures, but was done away with in the 1970s with a "back to basics" movement. Non-routine problem solving became important again in the 1980s and 1990s with emphasis on "exploration and discovery, group activities, open-ended questions, alternate solution methods, contextualized understandings, and uses of technology" (Goldin, 2008, p. 192). This was followed again by another back to basics movement with an increase in the importance of standardized testing around the turn of the 21st century. This pendulum

swinging in society's ideals can be seen in the area of mathematics education trying to influence educational practices (Goldin, 2008). Definitions for each of the two classifications vary by source and it is difficult to find an unbiased examination of both viewpoints considering how heated this debate has become within the reform movement (Ostler, Grandgenett, McGlamery, & Topp, 1998).

One classification of mathematical curriculum ideologies that goes beyond the two-ideology model is the following theory originally proposed by Kuhs and Ball (1986). English et al. (2008) gave the following summary of Kuhs and Ball's four ideologies:

> (a) *learner-focused* (mathematics teaching that focuses on the learner's personal construction of mathematics),
>
> (b) *content-focused with an emphasis on conceptual understanding* (mathematics teaching that is driven by the content itself but emphasizes conceptual understanding),
>
> (c) *content-focused with an emphasis on performance* (mathematics teaching that emphasizes student performance and mastery of mathematical rules and procedures), and
>
> (d) *classroom-focused* (mathematics teaching based on knowledge of effective classrooms) (p. 869).

These math-specific classifications can be easily matched to the general education classifications in Table 1. Ernest's (1991) ideologies also matched well as will be shown in the Theoretical Framework. Thus, it is reasonable to conclude that curriculum ideologies in mathematics education are not significantly different from the general education classifications, which are historically, more developed and researched.

Philosophy maturation. While curriculum philosophies are theoretical and abstract, they hold significant influence over teachers' beliefs and practices. Most teachers have never examined different philosophies from an unbiased perspective and thus will either (a) hold to one without considering any other or (b) not fully understand the advantages and disadvantages of each and will be "buffeted about" between them (Schiro, 2008). Thus, development of curriculum philosophies comes in two ways: teachers develop their own philosophies as well as posture toward other philosophies. Schiro (2008) documented four stages of development for posture toward other philosophies. These stages listed from most naive to most mature, include (a) *dualistic*, where teachers view each philosophy as either right or wrong; (b) *relativistic,* in which all philosophies are equal, but different; (c) *contextual,* where each philosophy has benefits based on context and (d) *hierarchical,* where teachers can use parts of each philosophy in a consistent manner to achieve their goals. These are comparable to the three stages of development for pre-service teachers reported by Perry (1999): dualistic, multiplicity and relativistic.

According to Schiro, teachers who are at relativistic or contextual levels of development sometimes cling to inconsistent combinations of the different philosophies. Wiegert (2002) disagreed with this idea, stating that teachers' level of development can depend on particular areas of curriculum or teaching and have characteristics of several stages simultaneously. One possible reason for the differences between these two authors' views about teachers' development is their definitions of curriculum philosophies or beliefs. As stated previously, Schiro was concerned with beliefs that influence day-to-day actions whereas Wiegert discussed deeper philosophies that are not

always in agreement with practices due to contextual variables. The latter position was also supported by Handal (2003) in his study, which specifically included mathematics teachers. Wiegert also suggested that teachers often hold their beliefs in isolated clusters, which explains some of the apparent discrepancies between the beliefs.

The research shows that discrepancies or inconsistencies in teachers' philosophies are difficult to understand (Barrett Paterson, 2009; Cheung & Wong, 2002; Handal, 2003; Perry, 1999; Schiro, 1992, 2008; Wiegert, 2002). This is a psychological area of research that is complicated by the lack of consistent definitions and measurement tools and teachers' general lack of experience with many different philosophies from an objective viewpoint (Schiro, 2008). Based on the nature of the research on teachers' philosophies, Pajares (1992) and Cooney, Shealy and Arvold (1998) agreed on the following: beliefs are best viewed as systems of beliefs with connections instead of as individual items or scenarios on a survey. They suggested that deeper understanding of teachers' philosophies and inconsistencies comes from studying both the overall effects of these philosophies in addition to each individual belief and its influence. Such an approach might yield the understanding that a teacher is not inconsistent at all, but rather beliefs are complicated to accommodate the many different situations teachers must make decisions about.

The "middle ground." One of the big debates about curriculum philosophies concerns how clearly teacher philosophies resemble the distinct theories posed by any of the curriculum theories. Schiro (2008) claimed that educators tend to cluster around the four ideal curriculum philosophies and deviate only in small ways. Jackson (1992) gives a similar perspective that teachers probably have orientation toward one, but do not take

the full abstract position because it is not sufficiently contextualized. The deviations from the ideal or abstract positions are seen as inconsistencies by these two authors because they state that teachers cannot hold positions from different ideologies simultaneously. However, neither of these authors gave evidence to support these claims. This opinion is inconsistent with the models of development explained earlier since the most mature level of development includes using parts of different ideologies to accomplish goals. The idea of one predominant curriculum ideology in every teacher's belief system is also inconsistent with the findings reported by Cheung (2000) who used McNeil's (1996) four curriculum ideology model, which is an earlier edition of the theory cited by McNeil in Table 1. In a later study done by Cheung and Wong (2002), they found that "although different curriculum orientations can be delineated separately on paper, they cannot be separated in a teacher's mind" (p. 228). Teacher philosophies tend to be more eclectic. In order to understand whether the philosophies are eclectic or inconsistent, researchers need to focus on the nuances within the philosophies rather than trying to fit them wholly into one of the predetermined categories (Cheung & Wong, 2002).

An example of such research is a case study performed by Blake (2002) who observed an experienced teacher named Donna. She had started teaching high school, then transferred to an elementary school teaching position and was teaching middle school science when Blake observed her classes for a year. He found that she used a wide variety of teaching techniques in her classroom. The following is a summary of the structure of her classes.

> The units generally begin with more of an emphasis on traditional practices, reviewing previous experiences and practicing the skills to be used in the new ones. Toward the end of the unit, especially in the evaluative stage, the class structure moves toward a progressive approach where Donna sets up the framework for learning and then allows the students the freedom to experiment and take chances within that framework. (p. 173)

Blake did not specifically research Donna's curriculum philosophies, but by observing her classes, he noticed that this balancing act between traditional (teacher-centered) curriculum and progressive (student-centered) curriculum was second nature to Donna after many years of teaching. Because her practice was a consistent blend between the two extremes, it is reasonable to conclude that her philosophies matched her practice. Donna found a middle ground between the traditional and progressive extremes and had justification for her position. While this example is of a science teacher, the results are still relevant to the questions that we have about mathematics teachers. The conflicts about traditional versus progressive teaching methods are prevalent in both subjects.

Since NCTM first released the Standards almost two decades ago, it has been seen as one of the leaders of the reform movement. However, "NCTM has modified the Standards somewhat, pointing out to the profession that the Standards did not imply basic computation skills should be ignored in favor of problem-solving" (Lewis, 2007, p. 72). This was an important revision after the reaction to the Standards. Ostler et al. (1998) claimed that the Standards caused a great divide in mathematics education when it was thought that NCTM was suggesting that teachers focus solely on conceptual understanding while ignoring skill development. These authors reported that the initial

reaction to the Standards was mostly positive, but some enthusiastic teachers and administrators who were willing to adopt the Standards overlooked the need to maintain traditional practices that were effective and continue the use of their textbook. The Standards recommended some improvements to mathematics education, but not the abandonment of sound practices for more exciting instruction and learning. "As is the case in so many areas of life, a careful blending of the best points from each end of the instructional spectrum leads to a more sound mathematical curriculum and ultimately a larger body of mathematically literate students" (Ostler et al., 1998, p. 64).

Some research, such as the last two examples from Blake (2002) and Ostler et al. (1998), suggest that a middle ground not only exists, but that some teachers already practice a balance of different ideals from society. Experienced teachers who have seen many reforms in curriculum and teaching philosophies may be doing this already like the teacher in Blake's study. Further research can help us understand specifically how math teachers use their experience to develop their curriculum philosophies, what can facilitate teacher growth and whether teachers can find a compromise of the many forces trying to influence their teaching.

Characteristics of Relationships Between Beginning and Experienced Teachers

In a review of educational research, many narratives were found relating transformations that occur as beginning teachers gain experience. One such study reported by Ross, Cornett and McCutcheon (1992) related the experience of a man who started teaching at a high school in a small town. He was completely ineffective and about halfway through the first year, he admitted this to his students. Each year he developed as a teacher, he got better and eventually became a teacher that some described

as “super-human.” As teachers become acclimated to a school and to the teaching profession, they often change and other teachers, particularly more experienced teachers, can have a major influence on those changes (Barrett et al., 2002; Bullough & Draper, 2004; Costigan, 2004; Melnick & Meister, 2008; Peterson & Williams, 1998). In a study of beginning high school mathematics teachers and their acculturation into a school, Gregg (1992) noted that one particular teacher was hired with certain expectations about her teaching philosophies based on her student teaching. Even though she held progressive ideals, the other teachers in the department reinforced more traditional practices and the new teacher was easily swayed. It is difficult to decipher whether this new teacher changed her curriculum philosophies or just her practice, but it is apparent that the school setting had a significant influence on her teaching.

The relationship between new and experienced teachers is important because research shows that one way that schools often try to encourage new teachers is by assigning an experienced teacher as a mentor. In a study of 3,235 first year teachers, Smith and Ingersoll (2004) discovered that mentoring programs are the most widely utilized induction system and 91.6% of the teachers found their mentor to be helpful. However, only 47.9% of the teachers had a mentor in the same field out of the 65.5% that had a mentor. Many studies have shown that mentors, especially those who teach the same subject, were extremely helpful to new teachers (Friedrichsen et al., 2007; Kardos, 2004; Miller, 2001). Research shows that mentoring programs bring experienced and new teachers together in ways that can help the new teachers become effective educators.

Brandell (2005) studied a high school mentoring program, which gave insight into characteristics of beginning and experienced teachers and their relationships, especially

the relationships between mentors and new teachers. In this study, Brandell found that although curricular and instructional issues were the most prevalent concerns for all teachers, there were differences in the level of concern related to experience. Most of the new teachers struggled to possess a clear or consistent philosophy their first year or two. After that, they began to understand what was important to them as a teacher (Brandell, 2005). On the other hand, "experienced teachers tend to have concerns that deal with higher-order instructional issues like differentiated instruction, brain research and the role of the teacher in the classroom" (Brandell, 2005, p. 142). Ultimately this program witnessed a significant increase in the number of new teachers teaching with higher-order teaching skills and best practices that only experienced teachers usually demonstrate. Brandell cited deep personal reflection as the key element in the program that fostered this growth. This reflection could be alone or with a mentor teacher. Brandell concluded that one reason that the first few years of teaching are difficult is because beginning teachers have relatively weak philosophies. In addition, this study suggested that relationships with experienced teachers can be helpful for beginning teachers if through the relationship the beginning teachers are exposed to different philosophies without bias, but harmful if the experienced teachers try to convince the new teachers of the correctness of their own personal philosophies. Schiro (2008) claimed that experienced teachers are ineffective in this task if they are not stable in understanding their own philosophies and knowledgeable about how philosophies can change.

Changes in Philosophies

Philosophies can change for many reasons, but relatively little research explains how transformations happen. One key element that is well documented is teacher

reflection. Both Cooney et al. (1998) and Wiegert (2002) agree that only reflective teachers can purposely change their philosophies. Cooney et al. and Kagan (1992) both cite hearing and integrating other teachers' beliefs as a major method of reflection that leads to philosophy changes. Kagan specifically worked with pre-service teachers who were able to critically evaluate and change their beliefs after working with practicing teachers who modeled self-reflection. Cooney et al. claimed that by critically reflecting on others' articulated beliefs and their own, teachers can become more knowledgeable about differing philosophies and can initiate changes in their practices and belief systems.

A summary of the literature shows that teachers' philosophies can be molded, but all beliefs in a teacher's philosophy are not equal. Wiegert (2002) stated two observations. She claimed that primary beliefs are more difficult to change than peripheral beliefs and psychological beliefs are more difficult to change than logical ones. To illustrate the former observation, Cooney et al. (1998) related the following experience with two student teachers. Both student teachers were highly resistant to the use of technology in their lessons as they began student teaching. The first cited a strong desire to "prepare students for the future" and felt that including technology only distracted the lessons from the larger goal. He did not believe that technology should be included in his lessons, but after discussing the matter with many other teachers he came to realize that helping his students to become technologically knowledgeable was an important part of preparing them for the future. On the other hand, the other student teacher never changed his belief about technology despite discussions with other teachers who tried to convince him of its usefulness and importance. For the first student teacher, helping prepare students for the future was a primary belief and the unimportance of

technology was peripheral, which he changed after reflecting on other teachers' philosophies. This shows a more mature level of development according to Schiro's (2008) stages cited earlier. The second student teacher could not see the use of technology from any other viewpoint and, therefore, could not be convinced to change this belief. These student teachers were on different levels of development in their philosophies concerning technology and it affected their practice.

For many teachers technology would probably be considered a peripheral belief that affects day-to-day decisions. Schiro (2008), whose interest was in these beliefs, claimed, "Flexible educators usually alter their curriculum beliefs in response to changing social trends and the changing school populations that they serve" (p. 206). In fact, in a large qualitative study involving 76 of his graduate students who were also teachers and administrators he found that they changed curriculum ideologies about every four years with the first major change after about three years of teaching (Schiro, 1992). This first change tended to be away from a Scholar Academic Ideology. The most frequently cited events that spurred the changes by these teachers and administrators were associated with "changing the school or grade in which an educator works, noting and responding to previously unknown needs of the children or community and changing jobs from teaching to administration" (Schiro, 1992, p. 251). Interestingly, the participants did not include significant curriculum changes such as new textbook adoptions, professional development or pressure from curriculum consultants (Schiro, 1992). This last statement is somewhat outdated since the data for this study was collected in 1989, the same year as the Standards were first published. In a review of the literature, however, no current

study of American teachers existed that measured the effect of the current reform movement on teachers' philosophies.

In a study similar in purpose to Schiro's (1992) study, Cheung and Wong (2002) researched 648 teachers in Hong Kong in 2002. Since research has suggested that teachers beliefs are usually firm and highly resistant to change (Pajares, 1992), Cheung and Wong were skeptical of Schiro's (1992) result that teachers change their ideologies every four years. They claimed that biases formed in Schiro's study because change was expected. In their results, Cheung and Wong claimed that the only relationship between the number of years of teaching experience and their curriculum ideology was that teachers with more than twenty years of teaching experience tended to agree more with the Scholar Academic Ideology. This is interesting because Schiro claimed that the first move that teachers made was away from the Scholar Academic Ideology. One possible reason for the lack of consistent results is that Schiro and Cheung and Wong defined what they were studying differently. Schiro observed teaching ideologies that affected day-to-day decisions whereas Cheung and Wong studied the firm foundational beliefs that teachers held. In both studies the results with regard to teacher experience were mostly not significant. This can be attributed to both studies lacking a suitable method for defining teachers who did not fit nicely within one ideology.

Theoretical Framework

In this study, the framework outlined in this section was used to develop the inventory of teachers' philosophies, create the visual model and aid in the analysis of teachers' curriculum philosophies. It can be concluded from the preceding review of the literature that teachers are often faced with the extremes of curricular theory, which call

for drastic changes in thought and action. Some teachers' philosophies agree with these extremes; however, many more teachers' philosophies agree with portions of one and portions of another. In the interest of not restricting teachers' philosophies to a small number of categories, the foundation for this study is based on Schiro's (2008) curriculum ideologies with additions from (Ernest, 1991). A matching of their ideologies can be found in Table 2.

Table 2

Comparison of Schiro's (2008) and Ernest's (1991) Curriculum Theories

Schiro	Scholar Academic	Social Efficiency	Learner-Centered	Social Reconstruction
Ernest	Old Humanist	Industrial Trainer and Technological Pragmatist	Progressive Educator	Public Educator

Ernest's theory has five ideologies, but he stated that "the [technological pragmatist] „descended' from the industrial trainers" (Ernest, 1991, p. 129). Additionally, both ideologies have significant similarities to Schiro's Social Efficiency Ideology. Since the ideologies in this study represent the extremes of teachers' philosophies, independent from each other, four ideologies will be observed instead of five and ideas from Ernest's Industrial Trainer and Technological Pragmatist will be combined.

Together, the theories are dynamic enough to allow for analysis of teachers' philosophies in a multidimensional spectrum. Schiro's (2008) four abstract categories of Scholar Academic, Social Efficiency, Learner-Centered and Social Reconstruction

represent the extremes of the space where teachers' philosophies lay. Schiro further subdivided each ideology using six aspects of teachers' curriculum philosophies: Purpose of Education, Teaching, Learning, Nature of Knowledge, Nature of Childhood, and Evaluation. These categories are on a level of concreteness that reflective teachers think about, unlike the general, abstract ideologies. Schiro's theory was not math specific and two additional categories from Ernest (1991) will be added to the framework for this study: View of Mathematics and Mathematical Aims. Thus teachers will be asked about each of the aspects, or subcategories, of their philosophy as they relate to math.

The responses to each aspect of a teacher's philosophy allow for a deeper understanding of the entire curriculum philosophy. Using this combination of smaller sets of beliefs, this study examined teacher philosophies as a system of beliefs rather than a similarity measure of closeness to abstract ideologies. Each aspect will be defined by relative agreement with each of the four curriculum ideologies: Scholar Academic, Social Efficiency, Learner Centered, and Social Reconstruction. A summary of the eight aspects for each ideology can be found in Table 3, in which the first six statements are derived from Schiro's (2008) inventory of these constructs. The final two are based on Ernest's (1991) work with mathematics teacher philosophies.

The construction of the Mathematics Teacher Philosophy Inventory (MTPI) developed during this study was similar in organization to Table 3 with four ideologies and eight aspects of teacher philosophies. Teachers were asked to respond to a series of items for each aspect of their philosophy based on comparisons between the ideologies and which phrase fit their philosophies the best.

Table 3

Eight Constructs of Teachers' Philosophies from Each of the Four Orientations

	Scholar Academic Ideology	Social Efficiency Ideology	Learner-Centered Ideology	Social Reconstruction Ideology
Purpose of Education	Schools should be communities where the accumulated knowledge of the culture is transmitted to the youth.	Schools should fulfill the needs of society by efficiently training youth to function as mature constructive members of society.	Schools should be enjoyable, stimulating, child-centered environments organized around the developmental needs and interests of children as those needs and interests present themselves from day to day.	Schools should provide children with the ability to perceive problems in society, envision a better society, and act to change society so that there is social justice and a better life for all people.
Teaching	Teachers should be knowledgeable people, transmitting that which is known to those who do not know it.	Teachers should be supervisors of student learning, utilizing instructional strategies that will optimize student learning.	Teachers should be aids to children, helping them learn by presenting them with experiences from which they can make meaning.	Teachers should be companions to students, using the environment within which the student lives to help the student learn.
Learning	Learning best occurs when the teacher clearly and accurately presents to the student that knowledge which the student is to acquire.	Learning best occurs when the student is presented with the appropriate stimulus materials and positive reinforcement.	Learning best occurs when children are motivated to actively engage in experiences which allow them to create their own knowledge and understanding of the world.	Learning best occurs when a student confronts a real social crisis and participates in the construction of a solution to that crisis.
Nature of Knowledge	The knowledge of most worth is the structured knowledge and ways of thinking that have come to be valued by the mathematicians over time.	The knowledge of most worth is the specific skills and capabilities for action that allow an individual to live a constructive life.	The knowledge of most worth is the personal meaning of oneself and of one's world that comes from one's direct experience in the world and one's personal response to such experience.	The knowledge of most worth is a set of social ideals, a commitment to those ideals, and an understanding of how to implement those ideals.

Table 3 (*continued*)
Eight Constructs of Teachers' Philosophies from Each of the Four Orientations

Nature of Childhood	Childhood is essentially a period of intellectual development highlighted by growing reasoning ability and capacity for memory that results in an even greater absorption of mathematical knowledge.	Childhood is essentially a time of learning in preparation for adulthood, when one will be a constructive, contributing member of society.	Childhood is essentially a time when children unfold according to their own innate natures, felt needs, organic impulses, and internal timetables. The focus is on children as they are during childhood rather than as they might be as adults.	Childhood is essentially a time for practice in and preparation for acting upon society to improve both oneself and the nature of society.
Evaluation	Mathematical evaluation should objectively determine the amount of knowledge students have acquired. It allows students to be ranked from those with the greatest intellectual gain to those with the least.	Mathematical evaluation should objectively indicate to others whether or not students can or cannot perform specific skills. Its purpose is to certify students' competence to perform specific tasks.	Mathematical evaluation should continuously diagnose children's needs and growth so that further growth can be promoted by appropriate adjustment of their learning environment. It is primarily for the children's benefit, not for comparing children with each other or measuring them against predetermined standards.	Mathematical evaluation should be a subjective comparison of students' performance with their capabilities. Its purpose is to indicate to both the students and others the extent to which they are living up to their capabilities.
View of Mathematics	Mathematics is a body of structured pure knowledge.	Mathematics is a set of truths and rules, which are useful.	Mathematics is a personalized process of investigation.	Mathematics is a tool for analyzing society and constructing changes.
Purpose of Mathematics	The aim of mathematics classes is to transmit mathematical knowledge.	The aim of mathematics classes is numerical fluency and training in useful mathematics to appropriate levels.	The aim of mathematics classes is creativity and self-realization through mathematics.	The aim of mathematics classes is promoting critical awareness and democratic citizenship through mathematics.

Note. Ernest, 1991, p. 138-139; Schiro, 2008, p. 214-215

Summary

In this review of the literature, the researcher found that teachers' curriculum philosophies are a complex and poorly defined construct with inconsistent definitions and

theories. These definitions and theories varied widely and sometimes were conflicting, but with a historical perspective it became easier to see similarities between the different theories. Most of the well developed theories for both general education and specific to mathematics had either four or five ideologies. By looking at commonalities in the variety of theories it was possible to find a general four or five ideologies encompassing the ideas from the many different theories.

Some theorists believed that individual teacher's curriculum philosophies should closely resemble the ideologies of society, but there is also a significant body of research that supported the idea that teachers' curriculum philosophies are more eclectic. Few teachers know the names of the different theories and their personal philosophies do not align themselves completely with any one theory or ideology. Those that proscribe to the first theory claimed that differences in teachers' philosophies were due to inconsistencies and that these philosophies are not fully mature. The theories of philosophy maturation claimed that teachers begin with a black and white perspective of the different ideals in education, but as they mature they broaden their scope to see the benefits of different ideologies and use that knowledge to their advantage. This was one major difference between new and experienced teachers, but some research has shown that the maturation of a teacher's curriculum philosophy can be sped up by the teacher reflecting on his or her philosophies and the philosophies of other teachers. Thus, the difference that experience makes in a teacher's philosophy is worth investigating. Once teachers' curriculum philosophies are better understood, attempts to change teachers' teaching style, new teacher mentoring programs, teacher retention, and professional development can be improved.

CHAPTER 3

METHODS

In this study, teachers' curriculum philosophies were explored in order to provide information to teachers, teacher educators and policy makers about the development of philosophies and the role of experience as it relates to teachers' philosophies. The review of the literature revealed a lack of quantitative studies about teachers' philosophies and mostly anecdotal evidence of a connection between experience and teachers' beliefs. The research question guiding this study was: What relationships exist between secondary mathematics teachers' curriculum philosophies and their teaching experience? There were three main tasks for this study, which were designed to help answer this research question. First, the theories of Schiro (2008) and Ernest (1991) were used to create an inventory of mathematics teachers' curriculum philosophies that was demonstrated to be both valid and reliable. Since the inventory covered many different dimensions it was advantageous to have a visualization tool to accurately represent the comparisons gathered in the inventory. The creation of this visualization tool was the second task. The third task was to distribute the inventory along with questions about each teacher's experience to a representative sample of secondary mathematics teachers in Texas. Information gathered from the survey was used to identify and describe relationships that exist between teachers' curriculum philosophies and their teaching experience using the visualization model as a tool to guide data analysis. The data were analyzed using

principal component analysis and other statistical tests to gather information about the structure, reliability and validity of the inventory. Qualitative analysis methods were also utilized to gather evidence of the validity of the instrumentation. Finally, a variety of statistical tests and prediction models gave evidence of patterns in responses between experience and curriculum philosophies in order to answer the research question.

Population and Sample

The population from which the sample was drawn for this study consisted of middle and high school mathematics teachers at public schools in Texas, excluding charter schools. According to the response from a public information request to the Texas Education Agency (TEA), there are 59,650 teachers that fit these criteria in the state of Texas for the 2009-2010 school year. Secondary teachers were chosen because they are usually more specialized to mathematics and focused on educational issues related to mathematics. Teachers at specialty schools such as disciplinary schools, private schools and charter schools will not be included for this study since they may not accurately represent the general population of secondary mathematics teachers in Texas. Additionally, the teachers were randomly selected first from the list of districts in the state and these specialty schools are not always included in public school districts in Texas.

Sampling. A two-stage sampling was used to collect a random stratified proportionate sample of teachers from the population. According to Whittemore (1997), "if it costs little to determine the attributes that are necessary to classify the units, it can be cost efficient to stratify a large sample in stage 1, and then in stage 2 to subsample the strata at different rates" (p. 589). This sampling technique was appropriate in this

situation since it was a case where it would take significant time and resources to compile a list of all of the secondary mathematics teachers in Texas, but acquiring a list of school districts was more easily obtained. The stratification of school districts in stage 1 was based on their classification of community type according to the Texas Education Agency (2008). The 1,022 Texas school districts were divided into the eight categories listed in Table 4.

Table 4

Percentages of Texas Secondary Mathematics Teachers by Community Type

Classification	Percentage	Classification	Percentage
Major Urban	20.7	Non-Metro Stable	8.6
Major Suburban	34.9	Other Central City	11.3
Independent Town	6.1	Other Central City Suburban	13.3
Non-Metro Fast Growing	1.4	Rural	5.3

Then school districts were randomly selected from each community type and contacted in order of selection to request permission to survey their secondary math teachers. District approval was followed by a request to each principal, which was sometimes delegated to an assistant principal or math department head. If approved by all necessary administrators, a list of secondary math teachers and their contact information was obtained.

One concern with this two-stage sampling method was that if a large district was selected, then it had the possibility of overwhelming the sample with teachers mostly from one district, whose curriculum philosophies might have been influenced by similar curriculum or administration. Thus for school districts with more than 100 math

teachers, a random sample of 100 teachers from that district was selected and invited to participate.

Sample size. Sample size for complex and interdependent data such as that obtained from this survey is difficult to determine (DeVillis, 2003). Determining the sample size relies on what types of conclusions are desired and what methods are being used to analyze the data. In scale development and factor analysis DeVillis (2003) suggests that 300 is an adequate number of participants. Based on the response rate of 39.2% from the pilot study described later in this chapter, the goal for this study was to invite 800 secondary math teachers to participate. This was based on the estimate that if about 800 teachers were contacted then at least 300 would respond. Even with the information from the pilot test, the distribution of teachers' philosophies was difficult to estimate before actually collecting data. This study was exploratory in nature and a goal of 300 was chosen because it was realistic and provided enough data to at least examine general trends.

Procedures

After obtaining administrator approval, the researcher sent initial e-mail invitations (Appendix D) to the teachers who were selected using the criteria stated previously explaining the purpose of the survey and how to access the survey online. The e-mail addresses for each teacher were obtained from either the district or school offices. The initial e-mail included a unique access code for each individual. This is a precaution suggested by Dillman, Smyth and Christian (2009). The access codes served two purposes: (a) tracking those who had taken the survey for follow-up purposes and (b)

protecting the integrity of the sample by ensuring that only sample participants took the survey and that they only took it once (Dillman et al., 2009).

Both the pilot survey and the main survey were to be administered online. It was assumed that the middle school and high school teachers would have access to the Internet and e-mail. While some might have been more comfortable than others with the technology, the survey was designed to be very easy to access and take. The guidelines for web surveys set by Dillman et al. (2009) were followed to ensure that the online survey was secure, included a representative sample, and was user-friendly. These guidelines were set to increase the response rate and maximize the benefits of this type of administration. The main benefit of an online distribution is that the sample was not restricted by geographical location. Since acquiring a large enough sample of secondary mathematics teachers to perform the statistical tests was a concern for both a pilot study and this main study, a larger pool from which to sample was a definite benefit. Other suggestions that Dillman et al. recommended that were used in this study include reminders sent to invited participants and giving participants a deadline by which to complete the survey. Reminder e-mails were sent one week and again two weeks after the initial e-mail to all teachers who had not responded.

Once teachers completed the survey they were thanked for their participation and asked to volunteer to take a portion of the survey again two weeks later. The purpose of the second administration was to measure test-retest reliability. The number of teachers that volunteered to take a portion of the survey again allowed the researcher to divide the inventory, which was the only part needing to be retested, into three sections with the goal that each of the three sections would be completed by 50 people, but participants

would not have to take the entire survey again. Similar to the first administration the teachers received an initial e-mail with a URL and the same access code. They also received two e-mail reminders about three days and one week after the initial e-mail request.

Instrumentation

Two instruments were used in this study: an attribute survey about teaching experience and a curriculum philosophies inventory. Items from both sections were derived from current literature, but curriculum philosophies were measured while information about teachers' experience was not. The responses to questions about teacher experience were treated as demographic or attribute data for the teachers rather than as an actual measure of their experience.

Attribute survey of teaching experience. Schiro (2008) reported twelve main reasons related to teaching experience for teachers to change their curriculum philosophies based on his qualitative study of 200 educators enrolled in his graduate course. The twelve reasons listed in order of frequency of occurrence are:

1. A change in the school in which an educator works
2. A change in the grade level with which an educator works
3. Addressing or responding to the needs of the children or community served
4. A change from one type of administrative job to another
5. Attending graduate school
6. Significant life events
7. A change in occupation from teaching to administration
8. Confrontation of the realities of teaching or administration

9. Temporary interruptions of one's career
10. Responding to social trends or sociopolitical occurrences
11. A change from one type of teaching job to another
12. Working with an influential mentor (pp. 207-208)

Based on these observations by Schiro, the researcher formulated questions about teachers' experience and relevant demographics (Appendix A). Appendix Table A1 illustrates the intended correlation between these reasons summarized by Schiro and the survey questions for this study regarding teaching experience. The responses to these questions were then used separately and in combinations to describe relationships between attributes of teachers' experience and the measured philosophies that were obtained from the Mathematics Teacher Philosophy Inventory (MTPI).

Curriculum philosophy inventory. Curriculum philosophy inventories have historically fallen into two categories. One type of inventory and analysis uses a „bottom-top' approach. These inventories have used a large number of questions analyzed through factor analysis to determine a reasonable number of orientations or ideologies. Many examples of this approach exist including a 90-item inventory (Ennis & Hooper, 1988), which was later shortened to a 75-item inventory and applied to physical education teachers (Ennis, Mueller, & Hooper, 1990). Andrews and Hatch (2000) also took this „bottom-top' approach with an inventory designed specifically for secondary mathematics teachers. They compared British teachers' beliefs to Hungarian teachers' beliefs after research had shown that Hungarian teachers' pedagogy was vastly different from British teachers' and the former had done remarkably well on the TIMMS test. The factor analysis of their inventory showed that British teachers could be

classified into five conceptions of mathematics and five conceptions of teaching mathematics (Andrews & Hatch, 1999). The Hungarian teachers' inventories revealed only four conceptions of mathematics and five conceptions of teaching mathematics, but were otherwise remarkably similar to the conceptions of British teachers (Andrews & Hatch, 2000). Since this „bottom-top' approach has consistently shown four to five curriculum orientations, they have helped validate the inventories with a „top-bottom' approach that use orientations similar to those described by curriculum theorists such as Schiro (2008) and Ernest (1991).

The studies that use a „top-bottom' approach assume a particular curriculum theory and design the questions in relation to its ideologies. Cheung (2000) created a 32-item inventory based on meta-orientations of his own design and McNeil's (1996) model of four orientations, but found through hierarchical confirmatory factor analysis that the data did not fit the model well. He tried again in 2002 with a 30-item inventory based on the five orientations of Eisner et al. (1974) curriculum theory with much better results. Although there is no record of the implementation or validity of Schiro's (2008) inventory it is similarly designed around his four curriculum orientations.

The organization of Schiro's (2008) inventory was based on the six aspects of curriculum philosophies stated in the Theoretical Framework: Purpose of Education, Teaching, Learning, Knowledge, Childhood, and Evaluation. It asked respondents to rank four statements, one from each of the orientations, for each aspect. Ennis et al. (1990) also used this type of ranking method. Cheung and Wong (2002) argued that a ranking method is not appropriate since it limits teachers' responses significantly and produces an arbitrary ranking that may not accurately reflect the teachers' philosophies.

Strictly ranking the statements reflects the idea that teachers can have only one orientation at a time. Teachers are also forced to evaluate subtle differences in the feelings in a discrete fashion.

Forced-choice format. The format of the philosophy inventory for this study, the MTPI, is forced-choice with ipsative scoring, which is a scoring method where "a test taker's responses, as well as the presumed strength of measured traits, are interpreted relative to the strength of measured traits for that same individual" (Cohen & Swerdlik, 2005, p. 353). Participants were asked to choose the phrase that most fits their beliefs and the one that least fits their beliefs from a list of four options. The scoring attached a value of 2 to the one selected as the "most" and 0 to the one selected as the "least". The two remaining options are given a value of 1. This gives a constant total for not only the test, but each "quad" of four choices as well.

The use of this format is significantly debated in the current research. Some of the controversy focuses on whether ranking pre-selected items is appropriate for personality tests, which are related to philosophy inventories. Cheung and Wong (2002) argued that ranking is arbitrary and may not be accurate if participants feel equally inclined toward two options while Ennis et al. (1990) disagreed. Ennis et al. felt no person would feel exactly equally about two different options and even small distinctions would be evident if enough questions about any latent variable were included. The forced-choice format used for this inventory, while not a strict ranking, does involve some ranking using the latter argument that more questions will decrease the disadvantages of ranking.

An alternative format involves a normative scale, such as Likert scales. Saville and Wilson (1991) found that normative and ipsative formatted tests that were designed to measure the same latent variables correlated well with each other and with external criteria. This is supported by a larger study done by Bowen, Martin and Hunt (2002). Thus one is not generally better than the other, but they have different purposes. The major concern with ipsative formatting is that it cannot give normative strength measurements (Cattell, 1944; Cohen & Swerdlik, 2005). For example with personality tests, results can be used to determine whether a person agrees with traits inherent to one personality over another, but cannot compare the strength of that agreement with another person who shows the same preference. This is a limitation of the MTPI also. Those who use the results must account for the fact that conclusions can only be drawn about intrapersonal belief systems.

The ipsative format has several strengths over a normative format. As Bowen et al. (2002) state, the ipsative format is designed to significantly reduce issues with social desirability, which is the tendency of the participant to choose responses that will make others view them favorably. Since all of the responses are favorably worded, this type of ipsative instrument does not share this common problem with normative instruments. This is a significant advantage as Likert scales can have an overall inflation of half of a standard deviation due to social desirability (Bowen et al., 2002). As there are advantages to each, it seems that normative and ipsative scales have strengths, but ipsative is more appropriate for measuring teacher philosophies. As a closing comment on the format, Saville and Wilson (1991) state that "inadequate constructs or the use of poor items are far greater sources of bias in personality questionnaires than issues of

normative versus ipsative presentation of items" (p. 236). For this study, great care was taken to ensure quality items and well-theorized constructs.

Initial development. According to DeVillis (2003), the following steps are necessary for developing a measurement instrument such as the MTPI. The first step is to determine clearly what construct should be measured. For the MTPI, the latent variables and constructs were outlined in Table 3 of the Theoretical Framework with their respective theories. DeVillis stated that the second step is to generate an item pool. Schiro (2008) and Ernest (1991) both wrote extensively about their respective theories and the item pool was generated by selecting phrases from their writings about each aspect of teacher philosophies for each of the ideologies. Some phrases were modified to be math specific and the comparison in Table 2 (see Chapter 2) of Schiro's and Ernest's ideologies provided the foundation for linking the two theories. The first version of the inventory used these phrases in full sentences, but the format was cumbersome. So the phrases were grouped in quads and shortened to phrases as described previously in the forced-choice format section.

Step three, according to DeVillis (2003), involves determining the format for measurement. There were several options available including Likert scale and ipsative formats, but for reasons stated earlier the format for this inventory is an ipsative format. The fourth step in scale development is to have the initial item pool reviewed by experts. This was done in two parts. First, a teacher educator familiar with Schiro's theory and two current K-12 mathematics teachers were asked to review the items for wording bias. Both teachers teach in bilingual settings and were particularly looking for wording that might have cultural bias. All three generally evaluated the wording for possible negative

connotations or bias. Based on their suggestions and comments some items were revised before a second group of reviewers was given the instrument.

*Review***.** The format of the instrument for this review (sample in Appendix B) was different from the format of the actual instrument because instead of the purpose being to compare the phrases from each ideology to each other, the purpose was to classify them individually as representative of one of the ideologies. All of the phrases for each aspect of curriculum philosophies in the inventory were listed in a random order to limit comparisons between them. Next to each phrase was a checkbox for each of the four ideologies: Scholar Academic (SAI), Social Efficiency (SEI), Learner Centered (LCI), and Social Reconstruction (SRI) with an extra checkbox to mark if the phrase was particularly difficult to classify into one of the four ideologies followed by a space to make comments or wording suggestions.

Five reviewers familiar with Schiro's (2008) theory were recruited for the purpose of this review. These five mathematics education graduate students had studied Schiro's theory in depth as it applies to mathematics education. They agreed to review the phrases that had been selected and classify them according to their understanding of Schiro's (2008) theory on curriculum philosophies. About one week after receiving a copy of the instrument, the researcher followed up with a reminder. All five returned completed surveys to the researcher within two weeks and the responses were immediately reviewed and followed up on for any that were left undone or comments that needed clarification. The researcher then classified each of the phrases into one of the following four categories:

- more than 75% of reviewer responses matched the researcher's classification
- between 50 and 75% of reviewer responses matched the researcher's classification
- less than 50% of reviewer responses agreed with the researcher's classification, but the majority selected one other classification
- less than 50% of reviewer responses agreed with the researcher's classification and there was no other classification that received a majority

The results with examples are summarized in Table 5. Additionally, 58 phrases were marked as difficult to classify by at least one of the reviewers, but only three of the phrases were selected by a majority of the reviewers to be difficult. Based on these results, the original instrument was revised.

Table 5

Examples of Classifications of Reviewers' Responses and Totals for Each Category

Classification		**Inventory Statement**	SAI	SEI	LCI	SRI	**Number of Items**
Majority agreed with researcher's classification	**More than 75% agreement**	Schools should be child-centered.			1111		**126**
	50-75% agreement	Mathematics is structured.	111	11			**22**
Majority disagreed with researcher's classification	**Majority chose one ideology**	The knowledge of most worth represents sensory data.	1		1111		**32**
	No ideology selected by majority	Childhood is a time of improving oneself.	1		11	11	**12**
						Total	**192**

Note. Each tally mark represents a response from a reviewer. Shading represents the researcher's intended classification.

Revised instrument. The revised instrument (sample in Appendix C) included many changes that improved its validity. After seeing the classifications of the reviewers, the researcher evaluated each of the items and, for clarity, reworded the ones in the categories with 50-75% agreement and no majority for any one ideology. For the items that the majority of responses indicated a different classification from the one that was expected, the researcher either reworded the item to be clearer or switched the classification that was expected. This review showed evidence of the inventory being a valid measurement tool, but these changes addressed evident issues and improved the validity of the inventory as it relates to the framing theory. The suggestions from the reviewers also reduced wording bias and confirmed that the format of the inventory is appropriate and easy for participants to take. Further assessment of reliability and validity continued in a pilot study.

Validity and reliability. According to the American Psychological Association (APA), the American Educational Research Association (AERA) and the National Council on Measurement in Education, (NCME) (1999), "validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests" (p. 9). According to DeVillis (2003), there are three different categories of validity evidence and each has its own tests and methods for assessing validity. The first is content validity, which relates to coverage of important aspects of the domain being measured. The second category of validity is criterion-related validity, or predictive validity, which is related to how successfully the instrument can estimate or predict other variables with known relations to the construct being measured. This was not addressed in this study. The third category of validity is construct validity, which is concerned with

how related the items that comprise the measurement tool are in relation to the underlying and latent variable or constructs.

While validity of an instrument is important to conclusions for all studies that use that instrument, reliability is also a central concern (DeVillis, 2003). Reliability refers to the consistency of the scores from a measurement instrument (APA, AREA & NCME, 1999). Given a population, measurement reliability indexes how stable or internally accurate the scores obtained from the survey are likely to be with different samples. Two measures of reliability that were used in this study were internal consistency and temporal stability. Internal consistency is a measure of how related items are to each other that are purported to measure the same latent variable. For example, the responses that are intended to represent the Scholar Academic Ideology should be highly related to one another. Temporal stability, or test-retest stability, measures how constant the scores from the inventory were from one administration to another (DeVillis, 2003). Evaluation of temporal stability was reserved for the main study with a larger sample, but the other types of validity and reliability mentioned in this section were assessed using data from the pilot study as well, in order to understand the strength of the inventory and inform revisions for the main study.

Pilot study. The purpose of this pilot study was two-fold. The first reason was to test the online instrumentation for problems and estimate the response rate. This survey was administered in a web-based format. Typically, online surveys have a poor response rate of between 30 and 50% according to Dillman et al. (2009). This pilot study gave insight into the number of survey invitations that needed to be sent out to get a large enough sample for the main study. The second reason for this pilot study was to address

issues of reliability and validity from a statistical perspective. Based on the results and conclusions from this pilot test, the MTPI was revised again before administering it to a larger sample of teachers.

Sampling and procedures. To get a large enough sample to make the statistical tests meaningful, 130 middle and high school math teachers were invited to take the survey during this pilot study with an anticipated response rate between 30 and 50%. Five of the in-service teachers that participated were recruited through a graduate mathematics course at Texas State University-San Marcos. School districts were then randomly selected from the list of 1,022 school districts in Texas without regard for the community type until the researcher had a list of 125 additional potential participants. This gave a total of 10 school districts. Administrative approval was received as outlined in the description of the main sample at both the district and school levels. The procedures for contacting the teachers were the same as in the main study except with the graduate students who received the initial contact through their instructor. The teachers received reminder e-mails as in the main study, but were not asked to participate a second time.

From the 130 teachers invited to take the survey, 51 chose to participate giving a response rate of 39.2%. Table 6 includes some descriptive statistics of the sample. The community type was based on teacher opinions of the community, not official classifications. The proportion of male teachers in this sample is higher than the state proportion of male secondary math teachers which is 19.7%. The reasons for this discrepancy were not clear and no alterations were made in procedures for the main study to try to correct it. The pilot study was designed to be similar to the main study for the

purpose of gathering information about any potential problems with implementation on a larger scale. No major problems were encountered during the pilot testing to change the procedures for the main study. However, the MTPI was revised again after examining the reliability and validity results from the pilot test.

Table 6

Descriptive Statistics for Pilot Study Sample

	Mean	Standard Deviation
Number of Years Taught	13.9	11.4
	Values	Percentage of Sample
Gender	Female	58.8
	Male	41.2
Community Type	Urban	17.6
	Suburban	41.2
	Rural	41.2
Current Level of Teaching	Middle School	56.9
	High School	43.1
Past Levels of Teaching Experience	Only Middle School	21.6
	Only High School	25.5
	Elementary and Middle School	13.7
	Middle and High School	29.4
	All Levels	9.8

As previously mentioned, the initial development of the MTPI had a foundation in theory and was revised several times based on review feedback prior to the pilot study to ensure its validity. Additional measures of validity were assessed using data gathered during the pilot administration. As all of the measures of reliability and validity were repeated with the larger sample, only a brief description of the analysis procedures will be given here saving the details and justification for the Data Analysis section later in this

chapter and the Results from the main study in Chapter 4. Item analysis, qualitative analysis of teacher reactions to the inventory and results, and confirmatory factor analysis all contributed to the evidence of validity and reliability.

Item analysis. One enduring threat on the validity of results from the MTPI was wording bias. This is a concern because if an item choice was worded in a particularly favorable way, then teachers might have been more inclined to choose that response than what would accurately represent their philosophy. The reverse is true with negative wording or connotations.

To check for wording bias among responses the researcher computed the number of teachers who selected each response. The results can be found in Table E1 (Appendix E). Most items showed diversity in the responses, but the items that had almost all or very few responses were examined individually again for wording bias and revised if necessary. A relatively even spread between the different choices was not expected due to influences of current trends and ideals that could affect all teachers, but diversity is important because each of these ideologies should be represented at least minimally.

Another item analysis tool related to the internal consistency, or reliability, of this inventory was correlations between each item and the totals for the aspect that it was designed to measure. For example, the first question in the inventory was related to the Purpose of Education. To examine the relationship between responses to this question and the totals for the six questions related to the Purpose of Education, the researcher computed four Pearson correlations. If A1SAI, A1SEI, A1LCI and A1SRI represent the four ideology scores for the first question and edSAI, edSEI, edLCI and edSRI represent

the total ideology scores for each participant for the Purpose of Education aspect then the four computed correlations were:

A1SAI~ edSAI A1SEI~ edSEI A1LCI~ edLCI A1SRI~ edSRI

For these variables, the correlations should have been positive and relatively high showing that each item belongs to that aspect. A table of these correlations can be found in Appendix E (Table E2). In a two-tailed t-test of whether each correlation was significantly different from zero, or no correlation, 155 were significantly different at the 0.01 level, 25 were significant at the 0.05 level and 12 were not significantly different. The questions that had a response in this last category and the one correlation that was slightly negative were particularly examined and revised if necessary. These correlations and the counts that were computed for each response showed evidence of validity and reliability for the MTPI, but also gave specific information about each item, which informed further revisions before use with the larger sample.

Qualitative analysis. The qualitative question following the administration of the inventory was designed specifically to gather information about the content validity of the inventory. Since the inventory was administered online, it was possible to give immediate feedback to participants about their results. Therefore, at the end of the inventory, after their responses were all submitted, each participant was shown their total overall score as percentages for each ideology along with a short description of each ideology (Appendix F). For example, if a participant's total for each ideology was SAI: 96, SEI: 48, LCI: 48 and SRI: 0 for a total of 192 then they would be shown the following percentages:

Scholar Academic 50%

Social Efficiency 25%

Learner Centered 25%

Social Reconstruction 0%

Then they were asked, "If you would, take the time to write a few comments about what surprised you about this analysis of your beliefs and how well you thought that it suited you."

The responses were enlightening as a measure of the content validity of the instrument and also as a view of how teachers perceive their own philosophy. Of the 51 participants, 23 chose to answer this question and themes were developed during analysis based on their responses. These themes are summarized in Table 7 along with counts of the number of responses that reflected each theme.

Table 7

Qualitative Analysis Themes from Teachers' Reactions to the Pilot Survey and Results

Themes	**Counts**
Subthemes	
Survey was difficult	**7**
Difficult because the intent was unclear or too broad	4
Difficult because participant agreed with all of the choices	3
Results were an accurate analysis	**5**
Balance is important	1
Justified results with statements about background	2
Results were surprising, but no judgment about their accuracy	**5**
Surprised by how balanced the results were	2
Philosophies about testing	**3**
Conjectures about survey	**1**
"The questions were very interesting. Are they indicative of how math is changing to meet social needs rather than academic needs? How will that compare to other nations and how they view math?"	

*Total counts in this table in addition to the two responses that were not related to the results or survey do not equal the total number of responses because some responses reflected more than one theme.

The fact that many teachers found the inventory difficult was not surprising. This has been documented previously in literature about the forced-choice format. Bowen et al. (2002) reported that participants felt more discomfort with ipsative scales than the more common normative scales because they were forced to choose a "most" and "least" response when perhaps they did not agree with any of them or perhaps agreed will all of them. The comments about the clarity of the questions were more concerning for the validity of the inventory. However, no specific items were mentioned making it impossible to make revisions based on their comments.

The comments about the accuracy of the analysis were important to the evaluation of the content validity of the MTPI. These comments were generally further expanded on such as in the following: "I think that this is pretty accurate. I do think that it is our job to prepare the students for life outside of school. I realize that there are many social problems, but I don't feel that it is my job as a math teacher to focus on them. I hope that I show by example a Godly, Christian way to live and want to demonstrate my beliefs through the way I live." These comments gave insight into what some teachers thought about their beliefs and gave evidence of some validity related to the inventory.

Since one of the main ideas of this study is whether there is a "balanced" philosophy, it was interesting to see that idea emerge in some of the comments. The following comment was illustrative: "I think that the analysis suits me well. I do think that learning has to be a balance. We should be teaching what kids need in their stage of development and also what they will need for the future. But, overall these kids need to become productive members of society and have the tools to do so because of what we teach them." Even though this teacher specifically mentioned a balance in learning, but

gave examples about the purposes of education it reveals the importance this teacher places on a balanced philosophy.

The idea of testing is a current important topic in education and it was therefore not surprising that it was something that a few teachers chose to include in their comments, especially since this inventory was administered a few months before the Texas Assessment of Knowledge and Skills (TAKS) testing, the standardized test in Texas given to all students in grades 3 through 11. The following comment was representative of the three comments on testing as they relate to teacher philosophies. "Learning should be an experience that benefits every child. All children can learn. However, not all students have the same abilities or capabilities; and yet we are forced into giving a test at the end of the year that ALL students must pass. We are asked as teachers to provide individualized instruction and yet they are all tested on the exact same thing. What message are we sending to our students? I think there certainly needs to be some expectation for student growth, but a standardized test is not the answer." Specific comments about the other aspects of a teacher's philosophy were rare or nonexistent in the responses to this inventory, but it was evident that beliefs about evaluation were especially important to at least a few of the participants.

The qualitative analysis provided a different perspective on the validity of the MTPI. The responses demonstrated that the inventory addressed issues that these teachers considered important and had beliefs about. It also confirmed the previously reported result that a forced-choice format can be uncomfortable for participants. Specific themes of a balanced philosophy and testing were witnessed suggesting ideas

that were then looked for in the larger sample as they might be particularly important topics related to teachers' philosophies.

Structure of ideologies. One of the most important ideas concerning this inventory is construct validity. Assuming evidence of construct validity, the researcher could then draw conclusions about the existence of proof in actual teacher responses for Schiro's (2008) and Ernest's (1991) theories. It also shows evidence that the inventory measures what it was intended to measure. Construct validity is an evaluation of the strength of the relationship between the theory and responses to the inventory. When that relationship is strong, it helps validate both the theory and the instrument measuring it.

A model of the intended relationships between the items in the inventory and the constructs of teachers' curriculum philosophies was developed in the Theoretical Framework and was thoroughly explored with the larger data set for the main study. The model was too complex and involved too many latent variables to extensively investigate with the small sample size for this pilot study.

One measurement tool was used for this pilot study to gain a general idea of the structure of responses in relation to the intended structure established in the Theoretical Framework. The correlations between the four ideologies (SAI, SEI, LCI, and SRI) were examined. This was done by computing the pair-wise Pearson correlations between the total scores for each of the ideologies. These correlations are presented in Table 8.

The theoretical correlations were also calculated between each pair of the four ideologies for comparison. As mentioned previously, the ipsative format of the items created dependencies between the scores for each ideology. Thus, when teachers' rank one ideology higher, the rank(s) of one or more of the other ideologies must decrease.

Using a uniform distribution of all possible scores, the theoretical correlation between each pair of ideologies was calculated as -0.333 and significance calculations were based on this value instead of the usual zero. The collected data fit well with the theory behind the ideologies. These correlations suggested that these are four distinct ideologies since none of the correlations were significant.

Table 8

Correlations Between the Totals for the Four Ideologies in the Pilot Study

	SAI	**SEI**	**LCI**	**SRI**
SAI	1.000			
SEI	0.188	1.000		
LCI	-0.590	-0.587	1.000	
SRI	-0.647	-0.537	0.176	1.000

Note. Correlations between different ideologies were tested for significance against the value -0.333.

Conclusions from pilot test. Throughout the initial development and refinement of this inventory, the researcher followed the Standards for Educational and Psychological Testing (APA, AREA & NCME, 1999). The results from this pilot test showed that because of the initial work put into the development of this inventory, the very complex, latent variables associated with teachers' curriculum philosophies can be observed and measured with a valid and reliable instrument. The item analysis using counts for each response and correlations between each item and the corresponding aspect total revealed room to improve some of the questions, but generally showed diversity in responses and significant correlations between each item and the totals for that aspect.

The qualitative analysis provided another perspective on the validity of the MTPI. It showed that while the format was uncomfortable for some teachers, several were pleased with the analysis of their responses. Additionally, two specific themes emerged related to teachers' philosophies, namely a balanced philosophy and testing, which gave areas to look for in results from the main study. The qualitative analysis revealed evidence that this inventory was indeed collecting information about teachers' philosophies without any noticeable gaps or discrepancies.

Finally, the confirmatory factor analysis and correlations between ideology totals confirmed the structure and relationships intended between the responses to the inventory and the constructs developed in theory. This suggested that no major structural changes were necessary before expanding the administration to a larger sample.

Gathering evidence about the reliability and validity of the MTPI was the main purpose for the pilot test, but there were other reasons as well. It was advantageous before the main study to test the web-based survey format, which required no changes, and to gain a better idea of the response rate for an estimate of the number of teachers that needed to be contacted in the main study to reach the desired sample size. Both of these purposes were met. Upon completion of the pilot test analysis, the first task of this study to develop an inventory was almost complete. Since the structure of the inventory and supporting theories was validated in the results of the pilot test, the next task was to create a visualization model to represent this structure.

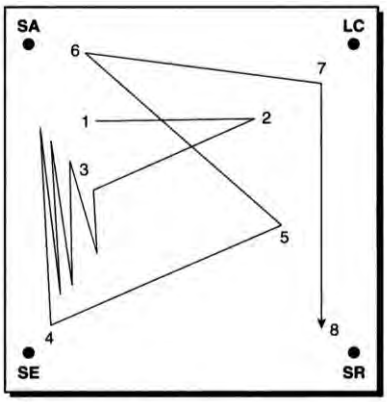
Visualization Model

In order to better understand the comparisons between each teachers' curriculum philosophies and look for patterns in the relationships between teacher experience and

teachers' curriculum philosophies it was important to have a method of visualization. Knoke and Yang (2008) claimed that visualizations are useful to "develop structural insights and to communicate those insights to others" (p. 79). These were both valid reasons to create a visualization tool for teachers' philosophies. The first was important since this was an exploratory study with the research goal to better understand the complex relationships between teachers' philosophies and their experience. Being able to communicate the results to others, particularly teachers, administrators and policy makers is also very important. A geometric interpretation was logical because the topics of similarity and dissimilarity are naturally connected to the idea of distance in geometry.

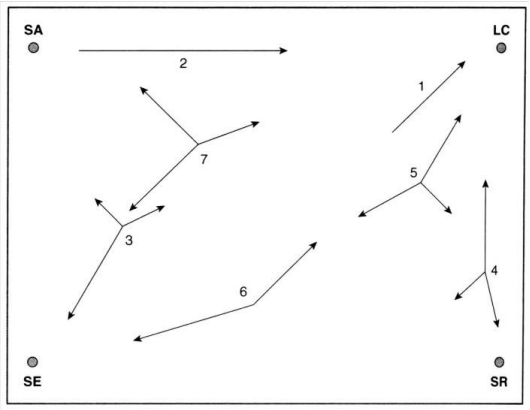
Developed visualizations. In Schiro's (1992) study of 76 graduate students, he requested that they visually represent the history of their curriculum ideologies. He reported five distinct visualization tools. Examples of these visualizations are given in Figures 1-5. Figures 1 and 2 demonstrate the assumption that some ideologies are "closer" to each other than they are to other ideologies. One way that Schiro positioned the ideologies, which is reflected in these two figures, was based on two aspects of children. The vertical axis represents whether educators were worried about the external or internal processes of children. The horizontal axis represents the worth of children according to the ideologies (Schiro, 2008). There are many choices for the axes and each is dependent on what question the researcher would like to answer. Since this study used information from all of the aspects of a teacher's curriculum philosophy simultaneously it was important to have each of the orientations equidistance from each other assuming that the four ideologies are all distinct and independent. Figures 1 and 2 allow for a

teacher's philosophy to be placed between ideals assuming that philosophies can be a mixture of ideals.



1. First three years teaching first grade
2. Fourth to seventh years teaching first grade
3. Three years teaching fifth grade
4. Four years teaching junior high in a large urban school
5. Five years teaching junior high in a small rural school
6. Five years as principal in an affluent suburban junior high
7. First year as principal at the Native American reservation
8. Second to fifth years as principal at the Native American reservation

Figure 1. Life History as a Trip. SOURCE: From *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael S. Schiro, copyright © 2008. Reprinted with permission from Sage Publications.



1. 1962–1966: Kindergarten teacher
2. 1966–1968: High school teacher
3. 1968–1971: Special education teacher
4. 1971–1972: University study
5. 1972–1977: Special education teacher
6. 1977–1985: Special education director
7. 1985–1989: Assistant superintendent

Figure 2. Life History as a Vector Analysis. SOURCE: From *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael S. Schiro, copyright © 2008. Reprinted with permission from Sage Publications.

This principle was also reflected in the visualization in Figure 3. In this visualization, each ideology can only have 3 positions: internal, external and on the boundary. It does not reflect levels of influence between the internal points, which limits the usefulness of the visualization since each ideology has a small finite number of possible positions.

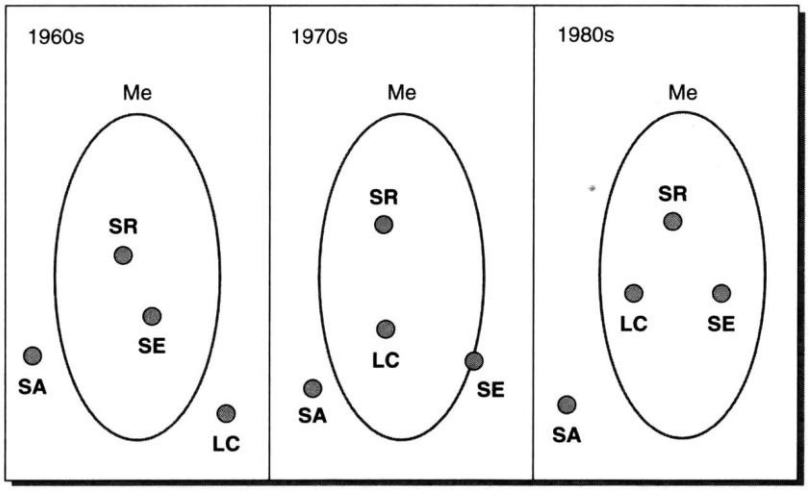


Figure 3. Life History as a Portrayal of Internal Change. SOURCE: From *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael S. Schiro, copyright © 2008. Reprinted with permission from Sage Publications.

Figure 4 represents a visualization that has the opposite critique. It shows the influence of each ideology on a continuous scale. The scale in Figures 4 and 5 is still somewhat arbitrary since each was based on a graduate student's memory of his or her career. It was not based on any quantitative test or inventory. They are useful because relationships between the individual ideologies are obvious, but it is difficult to compare them to other teachers' philosophies. These five visualization models each serve a purpose and all attempt to show the changes in philosophies over time, which was not done in this study, but in order to answer broad questions about more than one teacher's philosophy, a new visualization model is needed.

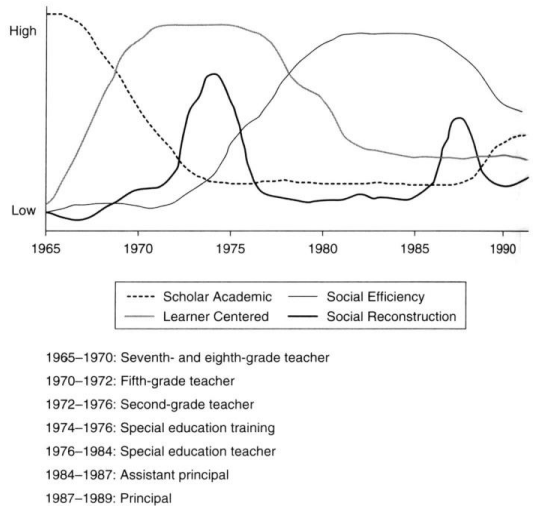


Figure 4. Life History as a Set of Influences. SOURCE: From *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael S. Schiro, copyright © 2008. Reprinted with permission from Sage Publications.

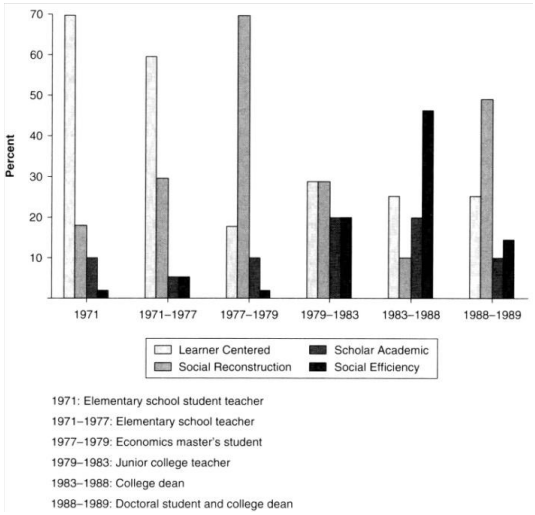


Figure 5. Life History as a Composition of Ideologies. SOURCE: From *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael S. Schiro, copyright © 2008. Reprinted with permission from Sage Publications.

In a situation related to the one in this study, Black (1978) proposed a multidimensional view of political party identification. By considering the party affiliation in multiple dimensions he was able to visualize the *intensity* with which people liked their own party, the *extremity* of a person's like for their party more than others, and a person's attitude toward political *independence* (Black, 1978). Independence was defined as an equal dependence on each political orientation. This study relied on a similar definition assuming that Schiro's (2008) ideologies covered the extremes based on historical patterns.

Coordinate systems. Following this assumption, we can imagine each philosophy as having four dimensions, one for each of the ideologies. The information that is gathered from the inventory is special because the sum of the scores for each ideology is always constant. As mentioned earlier when the forced-choice format was discussed, the response selected as the most receives a score of 2, the response selected as

the least receives a score of 0 and the other two responses are scored with a 1. This results in the scores for each quad of responses having a total of 4. So in the case where there are six quads for one aspect of the teachers' philosophies, the total is 24. Therefore the scores for each ideology can be thought of as ratios of this total with none of them being negative and when three are known the fourth can be determined by subtracting the three known scores from the total. In the literature, these are known as barycentric coordinates (Berger, Pansu, Berry, & Saint-Raymond, 1982; Pamfilos, 2008) or compositional coordinates (Aitchison, 1982; Hijazi, 2003). In this study, they will be referred to as compositional coordinates.

This coordinate system has the following properties: in n dimensions n+1 variables of positive data are represented by a point $(\lambda_1, \lambda_2, \ldots, \lambda_{n+1})$. If $s = \sum_{i=1}^{n+1} \lambda_i$ then the point can be normalized as $(\lambda_1/s, \lambda_2/s, \ldots, \lambda_{n+1}/s)$ so that the sum of the components is equal to one, or 100 percent, for each data point; and the center is $(1,1,\ldots,1)/n+1$ (Berger et al., 1982, chap. 3). Thus for n=3, four variables can be represented by points of the form: $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$; four scalars can be used to normalize the points so that $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 = 1$ for each teacher's philosophy; and the center of the space or where all of the axes join is an exact balance of all of the philosophies with the coordinate (¼, ¼, ¼, ¼). Each of the four components in the coordinates represents one of the ideologies listed in the order of (SAI, SEI, LCI, SRI) and each ideology is also represented by one of the axes as in Figure 6.

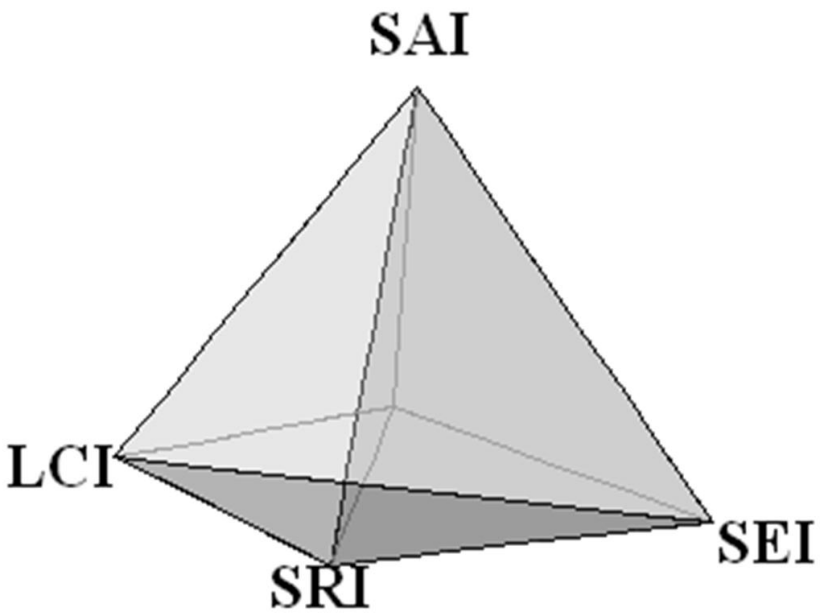


Figure 6. Tetrahedral Space Representing Curriculum Philosophies as a Composition.

The extreme cases of this space occur when one ideology receives all of the points while the other ideologies have a score of zero. This creates a tetrahedron of possible coordinates. The vertices of the tetrahedron are (24,0,0,0), (0,24,0,0), (0,0,24,0) and (0,0,0,24) and all other combinations of points whose components sum to 24 lie within this tetrahedron. The vertices are also equidistant from each other eliminating arguments about which ones are more similar to each other. However, the scoring of the inventory will never result in a point at one of the vertices. This is because participants only pick a response for the most which receives 2 points and a response for the least, which receives 0 points. The two remaining options receive a score of 1 making it impossible with this inventory to achieve three components with a score of 0.

Theoretically possible scores. In order to better understand the range of possible scores and the space that they filled in this tetrahedron, the researcher created a list of all possible coordinates. For each quad of responses, the twelve possible scores are:

(0,1,1,2)	(0,1,2,1)	(0,2,1,1)	(1,0,1,2)	(1,0,2,1)	(1,1,0,2)
(1,1,2,0)	(1,2,1,0)	(1,2,0,1)	(2,0,1,1)	(2,1,0,1)	(2,1,1,0)

Then for each of the six questions that are part of an aspect, any one of these 12 scores could apply giving a total of 12^6 combinations of scores. When these scores are totaled to create a score for the aspect there are 923 unique scores with different frequencies. The differences in frequencies are difficult to understand without a visual representation. Since none of the standard visualization tools can deal with compositional coordinates, it was necessary to transform these coordinates to Cartesian coordinates.

Transformation to Cartesian coordinates. The compositional coordinates are useful for seeing the relative strengths of each ideology within a teacher's philosophy, but it is also necessary to know the corresponding Cartesian coordinate for each data point. Cartesian coordinates are necessary to utilize available visualization software packages and to compute distances between the data points. This conversion is a linear transformation and thus preserves the relative distances between data points. If $r_i = (x_i,y_i,z_i)$ for i= 1, 2, 3, 4 are the coordinates of the vertices of the tetrahedron mentioned earlier and $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$ is a normalized compositional coordinate (the sum of the four components is 1) that will be converted then the corresponding Cartesian coordinate is $r = T\cdot\lambda + r_4$ where

$$T=\begin{bmatrix} x_1 - x_4 & x_2 - x_4 & x_3 - x_4 \\ y_1 - y_4 & y_2 - y_4 & y_3 - y_4 \\ z_1 - z_4 & z_2 - z_4 & z_3 - z_4 \end{bmatrix}$$

and $\lambda = (\lambda_1, \lambda_2, \lambda_3)$ (Pamfilos, 2008). The vertices of the tetrahedron were chosen to be:

$$r_1=\left(\frac{\sqrt{3}}{3},\frac{\sqrt{3}}{3},\frac{\sqrt{3}}{3}\right) \quad r_2=\left(\frac{-\sqrt{3}}{3},\frac{-\sqrt{3}}{3},\frac{\sqrt{3}}{3}\right) \quad r_3=\left(\frac{-\sqrt{3}}{3},\frac{\sqrt{3}}{3},\frac{-\sqrt{3}}{3}\right) \quad r_4=\left(\frac{\sqrt{3}}{3},\frac{-\sqrt{3}}{3},\frac{-\sqrt{3}}{3}\right)$$

These coordinates are unit distances from the origin and the center of this tetrahedron is the origin. Thus

$$T=\begin{bmatrix} 0 & -2\sqrt{3}/3 & -2\sqrt{3}/3 \\ 2\sqrt{3}/3 & 0 & 2\sqrt{3}/3 \\ 2\sqrt{3}/3 & 2\sqrt{3}/3 & 0 \end{bmatrix}$$

This conversion served two purposes. First, this allowed use of standard visualization software packages and secondly, this provided a standard method for computing Euclidean distances between the data points, which are important not only for comparing how similar or dissimilar two philosophies are, but will also be used in the data analysis.

Creation of meaningful regions. Several data analysis methods were considered to explore these philosophies represented as compositions of beliefs. Cluster analysis was considered as a strong option as it would help organize the data into similar groups for interpretation. However, it was recognized early in the study that the teachers' philosophies did not naturally cluster and interpretation of the positions of clusters within the tetrahedral space was difficult.

For the benefit of the interpretation and conclusions, the researcher chose to divide the tetrahedral space into disjoint regions reflecting the structure already present in this space and the theory. From the perspective of a philosophy being a composition of the four tested ideologies, the researcher acknowledged four types of compositions.

1. If a philosophy is mainly in agreement with one of the ideologies and the other three are about equal, then the compositional coordinate for that philosophy will

represent a point near the axis for that ideology somewhere between the center and the vertex of the tetrahedron.

2. If a philosophy is a strong balance of two ideologies with the other two being less influential, then the point for that philosophy will be near the space defined by the center and the edge of the tetrahedron between the two vertices representing the two ideologies.
3. If a philosophy is a relatively equal balance of three ideologies with the four being significantly less than those three, then the point representing that philosophy will be near the line from the center of the tetrahedron to the center of the face of the tetrahedron opposite from the vertex of that fourth ideology.
4. If a philosophy is a balance of all four ideologies, then the point representing it will be near the center of the tetrahedron.

Since there are four vertices of the tetrahedron, representing four ideologies, there are four regions in the first category. There are six edges, representing six possible combinations of two ideologies, which make six regions for the second category. The third category corresponds to the four faces of the tetrahedron, which each represent a balance of three ideologies. The final category can simply be represented by a sphere around the center of the tetrahedron showing a balance of all four ideologies.

Excluding the sphere around the center, which does not reach the edges of the tetrahedron, there are 14 regions. Since the research was interested in making these regions disjoint, a 14-sided figure was sought to represent these regions. A cuboctahedron, which has 14 faces, is a very natural representation as shown in Figure 7. The 14 faces of this figure include eight congruent equilateral triangles and six congruent

squares. The angles and relative sizes align in such a way that four of the triangles correspond to the vertices of the tetrahedron, the other four triangles correspond to the faces and the squares correspond to the edges.

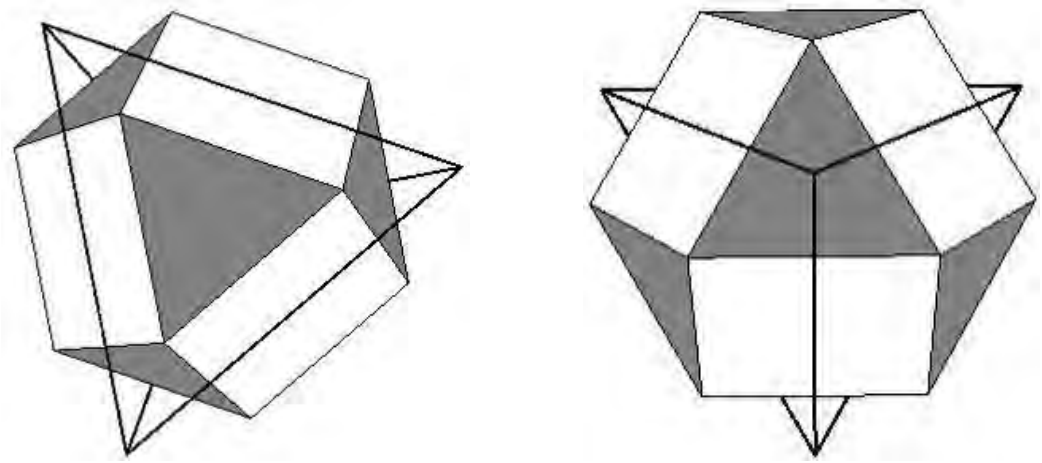
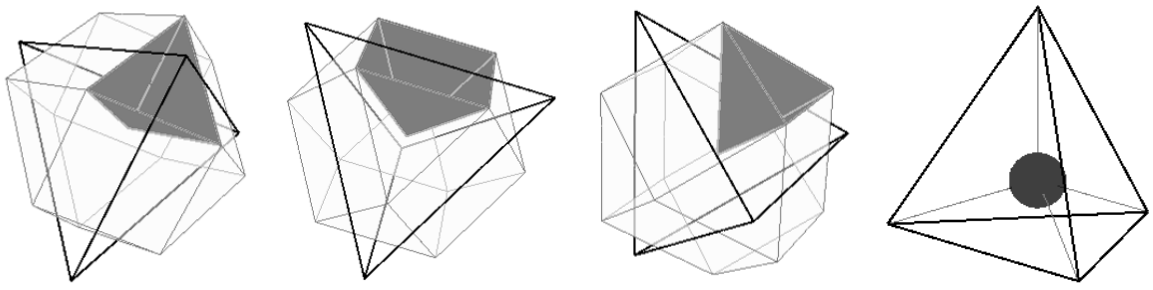


Figure 7. Two Views of the Relationship of a Cuboctahedron to the Vertices, Edges and Faces of a Tetrahedron.

Using the vertices of the cuboctahedron as a guide and the center, 14 disjoint regions were defined that matched the theoretical structure. These are triangular and rectangular pyramid-shaped regions as shown in the examples in Figure 8. There is a fifteenth region of interest around the center of the tetrahedron, which is also shown in Figure 8.



Vertex Regions (strong single ideologies)	Edge Regions (balance of two ideologies)	Face Regions (strong adversion to a single ideology)	Sphere Region (balance of all four ideologies)

Figure 8. Visual Representation of the Four Types of Regions.

These regions were defined with the center of the tetrahedron and the cuboctahedron as the origin. Then, for the first three categories corresponding to the vertices, edges and faces of the tetrahedron, inequalities were used to define each region as shown in Appendix G. In order to know how large to make the region representing the center of the tetrahedron, the researcher examined the distribution of theoretical points within this space.

Visualizing theoretical points within the regions. The first step in visualizing the list of theoretical points that was described earlier was to convert the compositional coordinates to Cartesian coordinates according to the linear transformation described previously. Then distances were computed for each of the points from the origin using Euclidean distance. By plotting the distances from the origin with the percentage of points at that distance, as in Figure 9, it was noticed that the distribution was skewed away from the origin. The researcher chose to define the radius of the sphere that enclosed the region around the center of the tetrahedron as 0.07 units.

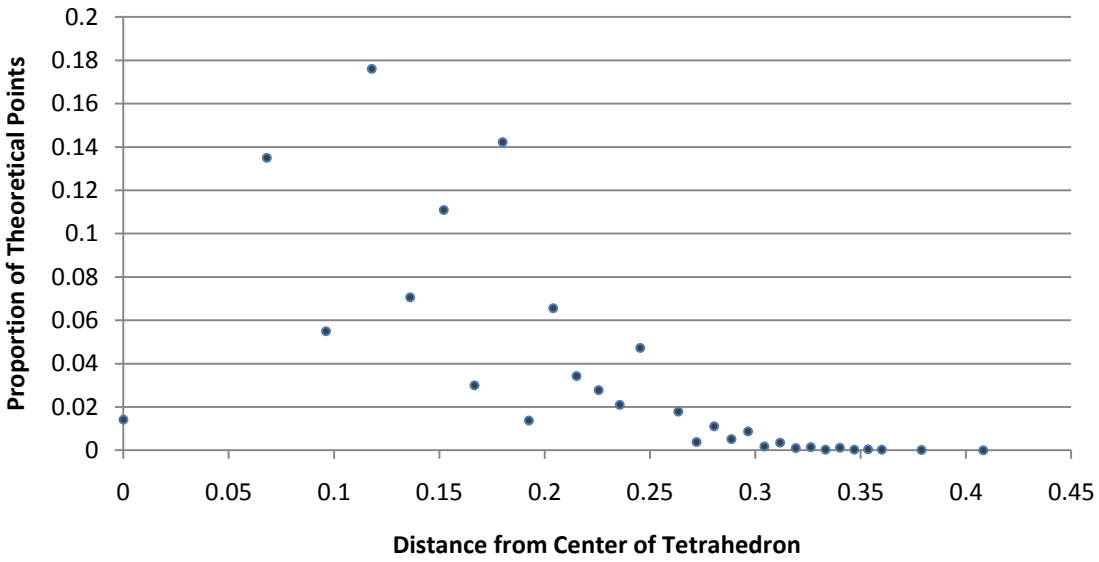


Figure 9. Proportion of Theoretical Points at Given Distances from the Origin.

This only includes the two smallest possible distances as seen in the graph in Figure 9, but it includes almost 15% of the possible points (including duplicates). After the points that lie within that sphere were removed, the remaining theoretical points were classified into one of the other 14 regions. Table 9 shows the distribution of those points.

Table 9

Distribution of Possible Scores in Each of the 15 Theoretical Regions

Region	**Number of distinct points**	**Number of possible scores including duplicates**	**Weighted Percentage***
Center	13	445,440	14.92
SAI	80	240,708	8.06
SEI	80	240,708	8.06
LCI	80	240,708	8.06
SRI	80	240,708	8.06
notSAI	65	168,522	5.64
notSEI	65	168,522	5.64
notLCI	65	168,522	5.64
notSRI	65	168,522	5.64
SAI/SEI	55	150,604	5.04
SAI/LCI	55	150,604	5.04
SAI/SRI	55	150,604	5.04
SEI/LCI	55	150,604	5.04
SEI/SRI	55	150,604	5.04
LCI/SRI	55	150,604	5.04

*Weighted percentage is the percentage based on the numbers of points including duplicates. The total number of possibilities is 12^6 based on 12 possibilities for each of 6 quads in an aspect.

Since the square pyramidal regions are slightly larger in volume than the triangle pyramidal regions, the researcher decided to classify any points directly on the plane between regions as belonging to the triangular regions. This method gave the most even distribution of points among the regions.

Plotting the theoretical points within the tetrahedron and cuboctahedron provided a surprising result. As shown in Figure 10, the mesh of theoretical points has a similar shape to the cuboctahedron and the faces of each are parallel.

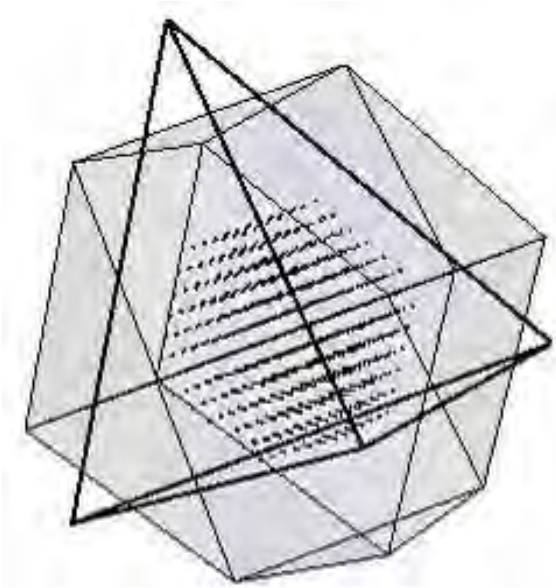


Figure 10. Theoretical Points Within the Tetrahedron and Cuboctahedron.

This visualization model served the original purpose of providing insight into the structure of teachers' philosophies and the connections between those philosophies and the MTPI, which was designed to measure those philosophies. The tools that were developed as part of the visualization were also valuable in the data analysis process, which required distances between points and from the origin and utilized the regions that dissected the space in an interpretable way.

Data Analysis

A combination of exploratory and predictive data analysis methods were used to answer the research question for this study, which was: In what ways are teachers' experience and their curriculum philosophies related? Exploratory data analysis is useful as a discovery tool when new ideas are generated and new insights are obtained about a relatively unknown phenomenon (Jain & Dubes, 1988), which was applicable to this study. Predictive analysis was used to test observed and anticipated patterns for

significance, which led to stronger conclusions about the likelihood of such patterns to be observed in other samples of the same population. The goals for the data analysis process were two-fold.

1. Significant analysis of the reliability and validity of the MTPI was necessary because it was the foundation for all conclusions about teachers' philosophies. Many of the methods used in the pilot study were repeated with a few additional tests that could only be performed with a larger sample.
2. Descriptive and predictive analysis of relationships between teachers' curriculum philosophies and their experience was done to answer the research question. The descriptive analysis was mainly exploratory and relied heavily on the visualization tool to reveal patterns and relationships. The predictive analysis statistically tested those relationships.

Each of these goals was broad and could have been approached using many different methods. To further define what results the data analysis would produce, the researcher specified the following problem questions, which all contributed to the overall research question about the relationships between teachers' experience and their philosophies.

1. Did any questions show signs of particularly favorable or negative wording? (Item bias)
2. How representative was each item of the aspect of teachers' philosophies to which it belonged? (Reliability-internal consistency)
3. How well do the teachers think that the analysis represented their philosophy? (Content validity)

4. How well is the model and structure established in the Theoretical Framework represented in the data? (Construct validity)
5. What is the relationship between the four ideologies? (Construct validity)
6. What is the test-retest stability of the MTPI? (Reliability-temporal stability)
7. Can the number of questions for each aspect be reduced? (Reliability)
8. How is the data distributed across the different regions?
9. How do teacher attributes vary between the different regions?
10. What model of prediction can teacher attributes give for the region of a teacher's philosophy?
11. What model of prediction can teacher attributes give for the distance of a teacher's philosophy from a balanced philosophy?

MTPI validity and reliability. The first two questions were related to analysis of the actual items on the MTPI. Computing counts of the number of teachers that responded to each answer choice was an efficient method for checking wording bias. As mentioned in the discussion about the results of the pilot test, the researcher was not looking for an even distribution of responses for every category. This method was implemented to identify phrases that received almost all or very few responses, suggesting a possible wording bias. Then the items were compared to the totals for each aspect. If all of the items in the Purpose of Education aspect measured that latent variable, for example, then the correlation between each of those six items and their total should be positive and high. If one of the questions measured something else then it was probable that there would be a low or negative correlation between that item and the totals for that aspect. Correlations were appropriate for this problem question because the

variables could be considered in pairs, which gave information about the statistical strength of the relationship between each pair of variables. Pearson correlations were used for these variables since they were relatively continuous.

In another approach to the question of validity, qualitative analysis provided valuable information about the teachers' reactions to the survey and areas for further analysis of teachers' philosophies. This additional perspective is often referred to in qualitative methods research as "triangulation" (Patton, 2002). By gaining multiple views of the same information and finding agreement, the results were validated. The qualitative portion of this study was minimal, but enhancing. After taking the survey, the researcher was able to provide immediate feedback to participants because of the online format. As described with the pilot study, participants were given their total scores as a percentage along with the descriptions of each ideology found in Appendix F. Then they were asked, "If you would, take the time to write a few comments about what surprised you about this analysis of your beliefs and how well you thought that it suited you."

The responses to this request were analyzed according to the following method described by LeCompte (2000). The first step was to sift through the responses to find relevant information through frequency, omission and declaration. Through organizing the responses many different ways, the researcher was able to discover patterns and develop themes for the responses. This method of building a model and patterns from the data was an opposite approach to the one taken for validating the model and structure that had already been developed in the Theoretical Framework.

A theoretically structured model of relationships between many variables associated with teachers' philosophies was previously developed in the Theoretical

Framework. Several data analysis tools were considered to analyze the validity of this model and structure including confirmatory factor analysis with structural equation modeling, but the combination of a complex model, interdependent variables and a relatively small sample size prevented this form of analysis. Principal component analysis (PCA) was used instead.

The goal of PCA in this study was to condense information in such a way that the total variation of a set of variables was explained with a smaller number of components. The number of components necessary to explain a set of variables and the ways in which those variables are grouped in each component gave information about the underlying structure of the latent variables related to teachers' philosophies. Since a theoretical structure was developed previously, this analysis was compared to that structure to assess the construct validity of the MTPI.

The two main classifications for teachers' philosophies used in the MTPI included the eight aspects (Purpose of Education, View of Mathematics, Purpose of Mathematics, Teaching, Learning, Nature of Knowledge, Nature of Childhood, and Evaluation) and the four ideologies: SAI, SEI, LCI, and SRI. The cross between these classifications was represented in the data by the 32 aspect totals. Within each classification, a relatively low level of variation would reflect that all variables, or aspect totals, within that classification measure a single latent construct. Thus, a confirmatory approach was taken for this analysis. For each aspect, the four ideology totals were analyzed for the number of components that were needed to explain most of the variation in the variables. Similarly, for each ideology, the eight aspect totals were analyzed. Finally, all 32 of the

totals were analyzed together to gather information about how the ideologies and aspects interacted.

Each analysis began with the correlation matrix of included variables. Using matrix algebra and eigenvalues, the first component was extracted. The residuals were then analyzed to extract another component. This continued until the number of components equaled the number of variables. Each additional component explained less of the variation than the previous one, but added to the total explained variation. According to DeVillis (2003) there are two rules to begin to understand how many of the components to retain. The eigenvalue rule states that all components with an eigenvalue greater than one should be retained. The reasoning behind this was that an eigenvalue of one corresponds to 1/k of the total variance with k variables and that eigenvalues greater than one represent more information than the original variables (Kaiser, 1960). The other method of evaluation involved looking at a plot of the eigenvalues, called a scree plot, to determine when a major drop in additional information occurs. This is called an "elbow" of the graph and, when present, can indicate that all factors above the elbow should be retained (Cattell, 1966). Using a combination of these two rules as a starting point, the researcher determined the number of factors needed to explain each set of variables.

The next step was to determine how each of the included variables loaded onto the components. This gave evidence about the similarities between each of the variables and the general structure of the aspect totals. For each analysis, unrotated component loading were computed, but not used in the analysis because rotation was necessary to find meaningful loadings. According to Agresti and Finlay (2009), "the purpose of rotation is to bring most loadings of a variable close to 0, so that each variable is highly

correlated with only one or two factors" (p. 534). The impact of rotation on the interpretation was important because rotations allow for similar variables to be loaded on the same component instead of on many components in an arbitrary way. Two main types of rotations were available resulting in either an orthogonal or oblique rotation. Orthogonal rotations represent independent factors. Oblique rotations are more complex taking into account the presumed correlation among the components (DeVillis, 2003). In this study, oblique rotations were used for all of the analyses since correlation between components was expected. These rotated component loadings were then examined for patterns that either supported or did not match the theoretical structure. The PCA with each ideology, each aspect and all of them together provided significant information about the structure supported by the data and construct validity.

During the PCA, the overall philosophies were not included. For these four variables pair-wise Pearson correlations were calculated similar to the analysis done on the pilot study data. This method also promoted comparison between the results of the pilot study and the results with the larger main study. It was expected that the correlations would not have strong positive correlations since they are supposed to be four distinct ideologies.

The reliability issue of temporal stability, or test-retest stability, was not addressed with the pilot test due to sample size restrictions, but it was determined during the main study. Teachers were asked after completing the survey to volunteer to take a portion of the inventory again. The goal was to have 50 retests of the entire survey. Based on the number of volunteers, the inventory was divided into three portions including either two or three aspects. The separate sections were administered to the

teachers who volunteered according to the procedures outlined previously. These results were matched with their previous responses on the same items. For each aspect, the score from the first administration was compared with the score from the second administration. The total change was calculated as the sum of the differences for all four ideologies. For example, if the first set of scores were (11,1,7,5) and the second set were (9,3,6,6), then the total change would be: $|11-9|+|1-3|+|7-6|+|5-6|=6$. No change would result in a total change score of 0. At the other extreme a "complete" change in scores would result in a total change score of 24, which was theoretically found by calculating the change in scores for all pairs of theoretical points. For example, if a participant's two sets of scores were (0,6,6,12) and (12,6,6,0) this would result in a total change score of 24 and shows a swap between the ideologies that the teacher agreed the most and least with. The reliability of the instrument is poor when significant changes occur from one administration to the next. Descriptive statistics such as the mean and standard deviation for these total change scores were used to gather information about the reliability of the scores in a test-retest situation.

One reason for dividing the second administration into smaller portions was because the inventory was long and several teachers commented in their feedback about the length of time that it took them to complete it. Thus some statistics were used to analyze whether the same amount of information could be obtained with fewer items. Pearson correlations were used again between the scores for each aspect and the scores for that aspect if one, two, three, four, or five strategically selected items were removed from that aspect. This completed the last step DeVillis (2003) suggested in the process of developing an instrument, which was to reduce the number of items as much as possible.

Relating teachers' philosophies and experience. After development of the visualization tool, significant information was known about the theoretical distribution of scores for the MTPI. It was not expected that the actual scores would be so evenly distributed among the regions defined in the Visualization Tool section. Current trends, administrative pressure, testing or other variables outside this study likely had an impact on the teachers' curriculum philosophies and their responses to the MTPI. A χ^2 Goodness of Fit test was appropriate in this situation to test how well the actual spread of the data matched the known theoretical proportion of responses for each region. The actual proportions were tested against the theoretical proportions in each of the 15 regions with the null hypothesis that the actual proportions fit the theoretical model. Particularly sparse or dense regions could indicate some general trend in teachers' philosophies.

Once the distribution of the actual philosophy points within the different regions for each aspect was tested, the next step was to test whether the attributes of teachers differed between the regions. The teachers whose philosophies were in the same region have similar philosophies. By testing whether the attributes are different among the different regions, conclusions were drawn about relationships between the composition of teachers' philosophies and attributes of their experience. The attribute variables were tested individually and included those variables listed in Table 10.

The numerical attribute variables were analyzed using an ANOVA F-test. This method is appropriate when comparing mean values in several groups (Agresti & Finlay, 2009). The null hypothesis for this test was H_0: $\mu_{Center} = \mu_{SAI} = \ldots = \mu_{Center}$ where the μ_i represents a population mean for a particular attribute in a given region. The alternative

hypothesis was that the means for at least two of the regions would be significantly different from each other.

Table 10

Attribute Variables

	Variable	
Numerical Variables	Number of Years Taught	
	Number of Years at Current School	
	Number of Schools Taught At	
	Variable	**Values**
Categorical Variables	Gender	Male Female
	Community Type	Major Urban (MU) Major Suburban (MS) Independent Town (Ind) Non-metro Fast Growing (NMFG) Non-metro Stable (NMS) Other Central City (OCC) Other Central City Suburban (OCCS) Rural
	Current Level	Middle School (MS) High School (HS)
	Past Elementary Experience	Yes / No
	Past Middle School Experience	Yes / No
	Past High School Experience	Yes / No
	Left Position Due to Differences in Philosophies	Yes / No
	Administration Experience	Yes / No
	Taken Graduate Education Courses	Yes / No
	Taken Graduate Math Courses	Yes / No
	Formally Mentored Another Teacher	Yes / No
	Initial Certification Obtained Through	University Alternative None

A χ^2 test of independence was used with the categorical variables to test whether the proportion of teachers with a particular attribute differs between the regions. The null hypothesis for each attribute was that the region where a teacher's philosophy occurs is

independent of that particular attribute. With both the ANOVA and χ^2 tests, regions were removed from analysis when the sample within a region was too small for an analysis.

The preceding tests to determine the distribution of scores and whether the attribute variables differ between regions were helpful in exploring the data and determining what to look for, but more advanced methods were necessary to better understand the relationships between experience and philosophies. Prediction of a variable such as curriculum philosophies requires more advanced statistics than "simple" multiple regression can provide. If the curriculum philosophies are considered in compositional form, then some research with similar compositional variables has utilized different approaches such as using a Dirichlet distribution or logratio analysis in order to produce regression-like analysis of compositional data (Hijazi, 2003). If the philosophies are considered a response variable based on the region that they are in then the response variable is categorical. Logistic regression is a method of examining pairs of regions and the log odds of being in one region over another (Agresti & Finlay, 2009). A logistical regression equation was found for every pair of regions, but not all regions were included due to the sample size of points within each region and some regions were collapsed as appropriate. Additionally, once an equation was found for each region and a reference region, Center, then the researcher found all other pairs using the properties of logs. For example,

$$\log\left(\frac{P(y=SAI)}{P(y=SEI)}\right)=\log\left(\frac{P(y=SAI)}{P(y=Center)}\right)-\log\left(\frac{P(y=SEI)}{P(y=Center)}\right)$$

The variables that were used to predict the region, or the log odds of being in the region, were the attribute variables in Table 10. The first step was to add all of the variables to the linear regression equation predicting the log odds of being in a particular region over

another. Then the variable with the lowest significance (or greatest p-value) was removed repeatedly until the best model equation was determined. The best model was determined using the F statistic. For two identical models except for a $\beta_i x$ term, an F statistic tests the null hypothesis, H_0: $\beta_i=0$. If the null hypothesis is rejected then the $\beta_i x$ term is significant and the more complex model including it is necessary. If the null hypothesis is not rejected, then the two models are similar enough that the simpler one should be used. The goal of any type of regression is to obtain the simplest model with the most power. This logistical regression was useful to determine approximate location in the space of philosophies.

Since one of the main ideas that the researcher wanted to explore was the idea of a balanced philosophy based on literature and qualitative responses in the pilot study, multiple regression was used to determine what predictions could be made about a teacher's distance from a balanced philosophy with their experience attributes as predictors. The predictor variables were the same as with the logistic regression, but the response variable was different. The response variable was a distance from the origin, which represents a balanced philosophy. However, as was shown in Figure 9, the percentage of possible points is significantly greater near the origin, which made regression difficult because a great number of points had only small distances between then while only a few represented the farther distances from the origin. Thus a weighted distance was used in the regression analysis. The same method of combining all attribute variables into one equation first and then removing them one at a time was used again to find a best model for predicting the distance of a philosophy from the origin based on teacher attributes. Both of these regression methods were used to better understand how

teachers' experience is related to the composition and balance of teachers' philosophies. Through the analysis described in this section, the researcher was able to explore many different views of these relationships and statistically describe them for the benefit of drawing significant conclusions.

Summary

Teachers' curriculum philosophies are an important area of mathematics education research that is relatively unexplored. The theories specific to math teachers are underdeveloped and methods for examining the belief systems are not robust enough to deeply examine the complex system of philosophies. For this study, the researcher (a) developed an inventory (MTPI) to measure mathematics teachers' curriculum philosophies, (b) created a visualization tool to aid in the investigation and display of teacher's curriculum philosophies and (c) used exploratory and predictive data analysis methods to investigate answers to the question: What relationships exist between mathematics teachers' experience and their curriculum philosophies?

The survey for teachers included questions about their experience as a teacher and an inventory of their curriculum philosophies. The inventory was developed using the theories of Schiro (2008) and Ernest (1991) and reviewed by experts. It was pilot tested with a small sample of teachers to assess potential problems, reliability and validity. After revision, the survey was administered to a larger sample of secondary mathematics teachers from Texas. Table 11 summarizes the analysis of responses to the survey for the purposes of gathering information about the validity and reliability of the inventory and understanding relationships between teachers' philosophies and their experience.

Table 11

Summary of Analysis

	Problem Questions	Variables	Method of Analysis
Reliability and Validity	Did any questions show signs of particularly favorable or negative wording?	"Most"/"Least" responses for each item	Counts
	How representative was each item of the aspect of teachers' philosophies to which it belonged?	Items (SAI,SEI,LCI,SRI) Aspect totals	Pearson Correlation
	How well do the teachers think that the analysis represented their philosophy?	Teacher comments	Qualitative
	How well is the model and structure established in the Theoretical Framework represented in the data?	Aspect totals (SAI,SEI,LCI,SRI)	Principal Component Analysis
	What is the relationship between the four ideologies?	Total scores (SAI,SEI,LCI,SRI)	Pearson Correlations
	Can the number of questions for each aspect be reduced?	Complete aspect totals and without 1,2,3,4 and 5 questions	Pearson Correlations
	What is the test-retest stability of the MTPI?	Matched aspect rankings from two administrations	Total change in score
Relating Teacher Philosophies to Experience	How is the data distributed across the different regions?	Region assignments Teacher attributes	χ^2-Goodness of Fit
	How do teacher attributes vary between the different regions?	Region assignments Teacher attributes	ANOVA χ^2-Independence
	What model of prediction can teacher attributes give for the region of a teacher's philosophy?	Region assignments Teacher attributes	Logistic regression
	What model of prediction can teacher attributes give for the distance of a teacher's philosophy from a balanced philosophy?	Weighted distances Teacher attributes	Linear regression

Through this study, the educational community can better understand the development of teacher philosophies. The results can inform professional development decisions regarding the differentiation of teacher education, research initiatives designed to help teachers change their views about educational practices and curriculum decisions focused on national standards. This study is also significant for its contribution to research methodology because of the unique approach to an educational research question through an ipsative formatted inventory and visually based analysis.

CHAPTER 4

RESULTS

An extant review of literature revealed that studies of teachers' philosophies about math education have generally lacked quantitative evidence to support their theoretical underpinnings. Exploring such a complex topic quantitatively required a number of statistical tools and exploratory techniques. The first task of this study involved creating an inventory to measure curriculum philosophies of mathematics teachers. The instrument development process included initial theorization, review and revision yielding the Mathematics Teacher Philosophy Inventory (MTPI). Evidence of measurement reliability and validity was gathered during this study and constitutes a significant portion of the results reported in this chapter.

The second task in this study involved the development of a visual tool to explore teachers' curriculum philosophies. Utilizing the structure developed for the MTPI, a four dimensional space, viewed in three dimensions, was created to aid in exploration and data analyses. The third and final task involved administering the survey, including the MTPI and questions about teachers' experience, to a representative sample of secondary math teachers in Texas. The primary research question of interest was: What relationship exists between teachers' philosophies and their experience?

Sample

Sampling of teachers in Texas involved a stratified random protocol by district within type of community. Table 12 provides a descriptive summary of the sample. In order to obtain permission to survey Texas teachers, administrators at both the district and school levels were contacted with requests. For most of the subpopulations of community types, acquiring permission posed no obstacle to the sampling procedure. For each community type, only one or two districts declined the offer to participate or did not respond to the phone call and e-mail requests. The one exception was the Major Urban category.

Table 12

Comparison of Sample to Population Proportions by Community Type

	Number of Districts	Number of Survey Invitations	Number of Responses *(Response Rate)*	Percentage of Responses	Texas Percentages
Major Urban	1	60	27 *(45.0%)*	8.4	20.7
Major Suburban	4	289	119 *(41.2%)*	37.0	34.9
Independent Town	3	68	38 *(55.9%)*	11.8	4.8
Non-metro Fast Growing	2	19	9 *(47.4%)*	2.8	1.1
Non-metro Stable	6	68	36 *(52.9%)*	11.2	8.6
Other Central City	3	81	33 *(40.7%)*	10.2	11.3
Other Central City Suburban	8	107	40 *(37.4%)*	12.4	13.3
Rural	14	43	20 *(46.5%)*	6.2	5.3
Total	**41**	**735**	**322 *(43.8)***		

There were only 10 school districts in Texas classified by the Texas Education Agency (TEA) as Major Urban. Of these 10 school districts, eight either declined the request to participate in this study or had a policy preventing this research study in their district. By the time the ninth selected district in this category agreed to participate, it was about one month before TAKS testing, the state mandated standardized testing, and a month after surveying had begun with the other participating school districts. Citing the imminent pressure of the TAKS testing, a greater percentage of principals in this Major Urban school district refused contact with their teachers compared to other school districts. These refusals resulted in fewer survey invitations in the Major Urban category than were necessary to reach the representative population proportions. Thus, this sample was slightly less representative of the Major Urban category than desired. The other community types had similar representation in the sample to the state proportions, except Independent Towns, which were overrepresented as shown in Table 12, partially due to the high response rate in that category.

One Major Suburban school district included more than 100 math teachers thus requiring a random sample to be chosen within the district. Subsequently, the only variable controlled for in this second stage of sampling of the Major Suburban school district was the school level. Approximately equal percentages of high school and middle school teachers were randomly selected from this district. In general, this was not a variable controlled for in this study, but as illustrated in Table 13, the sample contained almost equal proportions of teachers at the middle school and high school levels.

Table 13

Counts and Percentages of Teachers in the Sample by Gender and School Level

	Female	Male	**Total**
Middle School	137 *(42.5%)*	23 *(7.1%)*	**160** ***(49.7%)***
High School	95 *(29.5%)*	67 *(20.8%)*	**162** ***(50.3%)***
Total	**232** ***(72.0%)***	**90** ***(28.0%)***	**322** ***(100.0%)***

Table 13 illustrates the composition of the sample in relation to gender and current teaching level. Gender and teaching level were the two demographic variables used to help ensure that the sample was representative of the population and neither were controlled for during sampling, excluding the Major Suburban school district previously mentioned. As illustrated, 72% of the sample was female, which was slightly lower than the percentage of female secondary math teachers in the state (80.3%, according to a public information request from TEA). Another variable not controlled for was geographic location, but the school districts that chose to participate represented 15 of the 20 educational regions in Texas. These variables suggest that the proportions of teachers in the sample correspond to those of the population of secondary math teachers in the state of Texas. This was especially important to verify because of the relatively low response rate and volunteer nature of the survey, which eliminated true randomization.

It was important with the experience variables to have enough teachers representing each of the categories used in analysis or a wide range for the numerical variables. Table 14 provides descriptive statistics for the sample regarding the experience variables.

Table 14

Descriptive Statistics for Responses to the Experience Questions

	Mean	Standard Deviation
Number of Years Taught	14.3	10.2
Number of Years at Current School	7.7	7.5
Number of Schools Taught At	2.6	1.8
	Values	**Percentage of Sample**
Current Level	Middle School	50.3
	High School	49.7
Past Levels of Teaching Experience	Middle School	22.0
	High School	26.4
	Elementary and Middle School	13.7
	Elementary and High School	0.3
	Middle and High School	31.4
	All Levels	6.2
Left Position Due to Differences in Philosophies	Yes	18.7
	No	81.3
Administration Experience	Yes	2.8
	No	97.2
Taken Graduate Education Courses	Yes	50.6
	No	49.4
Taken Graduate Math Courses	Yes	30.7
	No	69.3
Formally Mentored Another Teacher	Yes	57.5
	No	42.5
Initial Certification Obtained Through	University Program	71.1
	Alternative Program	22.4
	None	6.5

Figure 11 shows the flow of participants through the study. The target number of teachers to contact was 800. Although the mark of 80 was not realized, but a higher response rate than anticipated was observed yielding more than 300 completed surveys. The only procedure that changed between the pilot study and this main study involved school administrators. Several principals during the pilot study volunteered to take a

more active role in the study and offered to contact their math teachers with the request. For the main study, this became part of the request to each school administrator. While the researcher still contacted the teachers directly through e-mail, the researcher asked principals or math department heads to also contact teachers with a small introduction and advisement to look for an e-mail from the researcher. The increased contact from school administrators may be responsible for part of the increase in the response rate for this study over the pilot study.

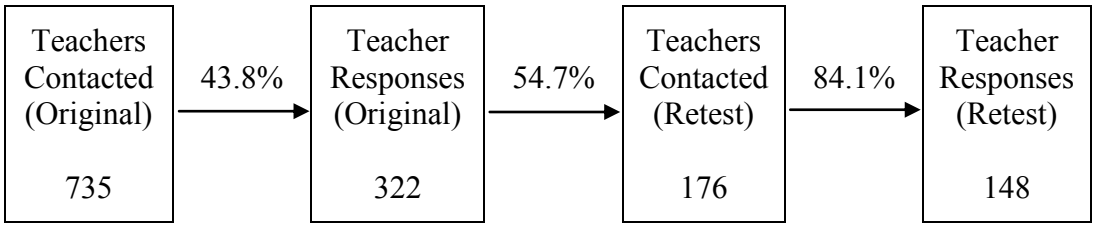


Figure 11. Flow of Participants.

The response rate for the retest was significantly higher than the original administration, but because those teachers specifically requested to participate in the retest, the likelihood that they would respond increased. The number and randomized selection of participants in this study allowed for significant results to the question of whether teachers' philosophies are linked to their experience, specifically related to the 11 problem questions outlined in Chapter 3.

Did Any Questions Show Signs of Particularly Favorable or Negative Wording?

This problem question and the following one specifically related to how well the inventory items fulfilled their purposes. The item bias was measured by the number of

teachers that chose each answer choice. If one phrase had been chosen significantly less than the other three choices or significantly more for any item then it would have suggested wording bias. This was evident in a few of the items during the pilot test, but as is shown in Table H1, the proportions for most responses changed after the revisions made to the pilot test inventory. No one choice stood out for any item even though there were sometimes two phrases chosen significantly more often than the other two. As was explained in the previous chapter, this was expected since not all of the ideologies are likely to be equally supported by any population at any given time. Some response to each of the items was evidence that the wording was not significantly biased and teachers were given four valid options to choose from with each item.

How Representative Was Each Item of the Aspect of Teachers' Philosophies to Which It Belonged?

From a psychometric perspective, the issues addressed included (a) content and construct validity and (b) the internal consistency, or reliability, of the items. Each item was designed to measure one aspect of a teacher's philosophy. Pearson correlations revealed the relationships between the four scores for each item and the four parts of the total scores for the aspect each item was intended to measure. Those results are provided in Appendix Table H2. All of the correlation coefficients displayed significance at the 0.01 level and ranged from 0.156 to 0.662. These correlation statistics improved in magnitude from the the pilot test (Table E1). These results suggest that the item revision exercise completed after the pilot testing improved the measurement reliability and content of the items relative to teachers' philosophies.

How Well Do the Teachers Think That the Analysis Represented Their Philosophy?

Another measurement of the content validity of the MTPI involved qualitative analysis of teachers' responses to the inventory. After teachers completed the survey they were asked to react to the overall results from their responses given a description of the four ideologies (Appendix F). At first, comments were identified for agreement, disagreement or no judgment of the analysis. The results are summarized in Table 15 along with other themes that emerged during analysis.

Table 15

Themes from Qualitative Analysis of Teachers' Reactions to the Survey and Results

Themes / **Subthemes**	**Counts**
Results were an accurate analysis	**15**
Specifically Learner Centered	7
Reiterated beliefs without judgment of the analysis	**5**
Surprised by part of analysis	**15**
Scholar Academic score was surprising	5
Social Efficiency score was surprising	2
Learner Centered score was surprising	7
Social Reconstruction score was surprising	5
It was difficult to choose responses	**10**
"Least" was the most difficult to choose	3
Mentioned a balance of philosophies	**3**
Balance was surprising	9
Balance was not surprising	5
Pleased with balance because it is important	9
Beliefs are situational	**5**
Survey does not reflect beliefs	**7**
Because correct answers were not clear to see	2
Because of biased questions	2
Because sometimes agreement was forced when none of the choices were agreed with	5
Survey was time-consuming	**4**
Comments on the format of the survey	**2**
Philosophies about testing	**2**
Conjectures about survey	**1**

*Some responses reflected more than one theme.

Teachers who responded through e-mail were also included in this analysis. Of the 74 teachers' comments, 15 specifically mentioned agreement with the analysis. The

following two responses from teachers showed that they could identify with the results and differentiate between the four ideologies, which are referred to in the psychometric literature as discriminant validity (Campbell & Fiske, 1959).

> I agree that these are my values…I'm all about the children and how they will become as adults, much more than whether they know how to use a box-and-whisker plot.

> I do run my classroom as an employer would a place of enterprise and am pleased to see that my survey confirms that fact.

The second comment reflected an attitude that also appeared in other comments, which suggested that some teachers seemed to seek confirmation about their philosophies from the inventory rather than the other way around with them confirming that the results from the inventory matched their beliefs. Another such comment was, "I don't really know what this says about me….This must mean I am very well rounded." Other teachers' comments reflected more conviction in their beliefs as is demonstrated in the following comment:

> I have always made it known that my classroom and my teaching philosophy is student centered. The day that I change is the day that I need to leave the classroom.

For causes unknown, many teachers specifically focused on the Learner Centered Ideology and being student centered. Almost half of the decisive agreements with the analysis further commented on how learner-centered they viewed their philosophies to be.

Many of the comments from teachers included a brief summary of what they believed regarding math education even when they did not make a judgment about the accuracy of the analysis. These phrases are particularly useful in evaluating the content validity of the survey because they covered a wide range of topics relevant to teachers' beliefs. Almost all were addressed in the MTPI, which showed strong evidence of content validity, but as one teacher pointed out, there are other topics that could be included or improved on.

> I was really surprised that there were not more questions about integrating technology or about how we reach those students who live in poverty or experience social turmoil.

Technology was not addressed specifically in the inventory, but is a topic of importance in mathematics education and one that is related to teachers' beliefs (Ertmer, 2005; Windschitl & Sahl, 2002). While this could be considered as an additional aspect of teachers' curriculum philosophies and added to the inventory, it would not represent a missing dimension of the aspects that were already present. It is not an overlooked ideology, but another aspect of teachers' philosophies that in addition to the eight already identified could be measured. The second suggestion concerning reaching students who live in poverty or experience social turmoil is a situational application of many of the more general questions in the inventory. This was noticed by another teacher who wrote that it "seems you have a lot of questions with social justice issues, lots of power theme issues." Many of the items related to social justice belonged to the Social Reconstruction Ideology. This ideology seemed to inspire a number of negative comments including one teacher who called it the "cumbaya" category and another who agreed that it should be

the least of the ideologies for his or her analysis since "I don't think students should be trying to change the world while they're still young. They'll be able to make a difference once they get out into the world, not by observing from the safety of a public school."

As mentioned before, many teachers commented on the Learner Centered Ideology, usually in a supportive or positive way, while many others commented on the Social Reconstruction Ideology with negative wording. These two ideologies were mentioned most frequently in teachers' comments about their scores. The significance of these two ideologies was also noticed in the quantitative analysis as will be shown later in this chapter.

One of the most interesting results of the qualitative analysis related to teachers' philosophies came from the comments that teachers wrote about a balance of the four ideologies. Since it is unclear from the literature whether a relatively even agreement with the four ideologies reflects a well-rounded philosophy and something to aspire to or just inconsistencies, it was enlightening to analyze teachers' opinions about this topic. Of the 18 teachers who perceived their score as balanced, nine mentioned that a balance was a good thing to have. Some of the following statements reflect that sentiment:

> Education has many ingredients. Too much of one would not be best for the students.

> I believe that schools should do it all.

> I have always seen value in all those areas of belief and feel they should be balanced within the classroom.

These comments reflected a belief that a balanced philosophy including all four ideologies was necessary in education to benefit all students. One teacher even described his or her efforts to become more balanced. The teacher related, "When I first began to teach, I was more of the scholar academic type, which actually fits more closely my own personality. Over the years, I have stretched to become more learner centered." This teacher saw a balance as something learned over time that made him or her more effective as a teacher. A balanced philosophy was something desirable to the teachers who wrote these comments, but it is unclear with some whether the teachers conscientiously worked for a balance of different ideals or whether it was desirable because that was what the analysis revealed them to be.

At least two experienced teachers disagreed about whether a teacher should have a more balanced philosophy as they gain experience. As shown in the last comment, one teacher felt that adopting other beliefs from the one that he or she started with was beneficial. Another teacher wrote that, "After teaching for so many years I would have thought my beliefs would be leaning towards one type." The thought was not conclusive, but showed doubt about whether a balanced philosophy is the clear objective. Another teacher mentioned, "I wouldn't be surprised if I contradicted myself at times in my answers because of different scenarios that come to mind." Even when teachers just reflected on their own beliefs, it was not clear whether they thought of a balance as including all of the important parts of education or being inconsistent. As was argued in the Literature Review, some of the controversy may be due to differences in the definitions of *beliefs* and *philosophies*. Certainly different situations call for different teacher or student actions, but the question of a balance in this study was focused on

teachers' overall goals and philosophies in teaching. However, most teachers do not think of their philosophy on an abstract level removed from any particular situation. One teacher very poignantly said,

> Your statements are wonderful conversation pieces but to put more value on one area than another is situational. The statements make one re-evaluate why they are in education and that is a good thing, as far as I am concerned.

Many instruments about philosophies or personalities, like the MTPI, instruct participants to think of particular situations to help in the process of deciding what is most important (Price, 2006). This is because it is difficult for people to generalize their beliefs and ways of thinking outside of specific situations.

Some of the teacher comments reflected an ability to see patterns in their responses about their beliefs and generalize those to express their overall philosophy. The following two comments from teachers showed opposite conclusions after taking the survey and reflecting on their answers.

> I was surprised at how difficult it was to select one "most applicable" statement, as they are all important to me, but as the survey went on, it became easier and the direction of how I teach and how I believe math teachers SHOULD teach match pretty well.

> This survey reminded [me] how much my beliefs differ from what really happens in my classroom. There are a lot of things I want to do, but I do not currently know how to implement [*sic*] them.

Both of these teachers acknowledged that what they believed should happen and what happens in daily practice can be different things. Their comments suggested that these realizations come from reflection on their responses to the inventory and that thinking about specific situations helped reveal patterns in their thoughts that might or might not match their daily actions. One teacher specifically mentioned that implemented beliefs, rather than ideals, were of most importance. "I feel the more we can share what we do on an everyday basis to make our students successful is what we should be answering an evaluation on." This response reflected an opinion that beliefs are situational and it is not beneficial to try to separate beliefs from the resulting actions to given situations.

The seven teachers that had negative responses to the inventory included three teachers who did not even see the results of their survey because they chose not to complete it and sent an e-mail to the researcher detailing their reasons for stopping. All three mentioned discomfort when forced to select most and least options when they did not feel that any should be selected. Two of these teachers mentioned a desire to have a conversation about the questions because they were "thought-provoking", but that the format of the survey made it difficult to express their beliefs. One of these teachers wrote,

> I got extremely frustrated with the choices. Sometimes I agreed with all 4…other times I agreed with none. Sometimes I felt that the answers were way too vague to know what a response really meant. I decided that you would in no way be able to really understand my beliefs about what I value in mathematics education from my responses to this survey. There seemed to be way too much educational

> jargon and not nearly enough specifics….I don't think that this instrument is going to give you much in the way of measurable responses.

This teacher did not actually see his or her results due to not finishing, but the format of the survey was discouraging enough that he or she did not complete it. While this could have potentially affected the sample of teachers due to discomfort with the format, it is not clear from the seven negative responses whether these teachers actually disagreed with the analysis of their responses or the method of getting them.

In addition to the three teachers who did not complete the survey, four others expressed a negative reaction to the survey. The two primary reasons mentioned for their dislike were question wording and the format of the survey. One teacher wrote that this was an "interesting and challenging way to do a survey" while another suggested that the "answer choices should have been ranked." In the analysis of the pilot study, the researcher mentioned that discomfort with the format was expected based on review of relevant literature, but that this format has its benefits to the study including a decrease in the effects of social desirability and increased simplicity.

Another theme that emerged during the pilot study was an issue with testing. Only two teachers specifically mentioned testing in comments from this main study. These comments were focused on standardized testing not being beneficial to education, which was confirmed in teacher comments made during the pilot study. However, based on the responses during the pilot study, the researcher expected more than two comments about testing with the larger sample, which was administered closer to TAKS testing. Testing might continue to be an area of interest, but it is not clear whether strong beliefs are held by many in the population.

The qualitative analysis provided rich information about how a small group of teachers felt about the survey and their results. Many expressed agreement with the results and even some that did not specifically mention the accuracy of the analysis reported that the survey was interesting and thought-provoking. The teachers that expressed a dislike of the survey gave reasons including an uncomfortable format and broad wording of the questions. Neither of these reasons gave any indication about the accuracy of the results, but revealed properties of the instrument that might discourage participation.

Content validity was the primary concern of this analysis. The diverse descriptions from teachers about their beliefs did not reveal any gaps in the theory and instrumentation used in this study, except for the possible inclusion of an aspect related to teachers' philosophies about technology. Teacher comments also supported theories about the development of philosophies, which showed a progression from concrete situations to generalized philosophies through reflection. These findings cannot be generalized to all teachers in the population or even sample, but they did give evidence of the content validity for the MTPI and provide themes for future investigation. Qualitative analysis is a method often used to gather rich information for building theory while the next step in the data analysis was used to test existing theory.

How Well is the Model and Structure Established in the Theoretical Framework Represented in the Data?

A hierarchical structure of latent variables was suggested as the foundation for teachers' philosophies in the Theoretical Framework. This structure is shown in Figure 12. Some of the theories noted in Chapter 2 were on the general level of curriculum philosophies, however a significant amount of research suggested that teachers'

philosophies vary on a more specific level, which has been classified in this study into eight different aspects according to Schiro's (2008) and Ernest's (1991) well documented theories about education and mathematics, respectively. The Scholar Academic (SAI), Social Efficiency (SEI), Learner Centered (LCI), and Social Reconstruction (SRI) ideologies can be applied to the overall curriculum philosophies for a general idea about teachers' philosophies or to each one of the aspects of a philosophy for more specific information. The goal of the principal component analysis was to evaluate how well the data supports these levels of classification for philosophies.

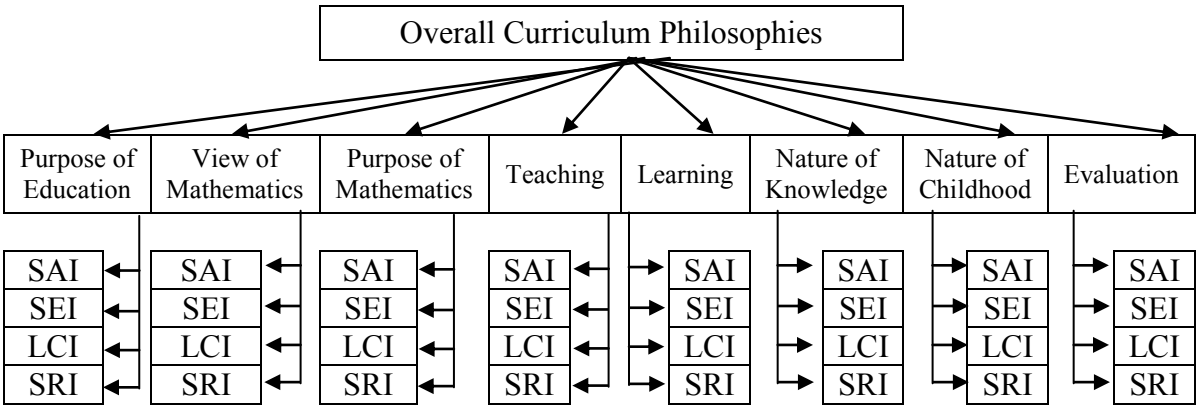


Figure 12 – Theoretical Hierarchical Structure for Curriculum Philosophies.

Since this problem question was concerned with the relationships of the eight different aspects and four ideologies, the researcher chose to use the aspect totals for all analyses instead of the item totals. This was not an analysis of the items, but of the structure of the data. Additionally, the aspect totals are more continuous with a greater range of values, 13 instead of three, and they included a more manageable number of variables. The goal of principal component analysis (PCA) was to determine whether a small number of components could reflect the variation and structure of a larger number

of variables. To assess this, one component at a time was extracted from the data and the residuals were examined to determine whether any additional components could be extracted. These successive extractions were reflected in the eigenvalues of the correlation matrix of variables. An eigenvalue of one corresponded to 1/k of the total variance when there were k variables included. Regarding the question of how many components to include, this was the reasoning behind the eigenvalue rule of retention, which claimed that all components with an eigenvalue greater than 1 should be retained because they represent a component with more information than the original items (Kaiser, 1960).

Another standard for component retention is the scree plot test (Cattell, 1966). For this procedure, a scree plot of the eigenvalues was examined by looking for an "elbow" in the graph. This occurs when the line connecting data points turns a relatively sharp corner from vertical to horizontal indicating a significant drop in relative information from each component to the right of the elbow. Both the eigenvalue rule and scree plot test aided in determining the number of components necessary to describe these variables.

The first step in PCA for this study was to examine the structure of each aspect. If one component could have sufficiently described each of the aspects, it would support the idea that all variables associated with each aspect were highly related and should be grouped together. A scree plot was generated for each aspect from the eigenvalues, which were calculated from the correlation matrices of each. These are shown in Figure 13 with an eigenvalue of one marked.

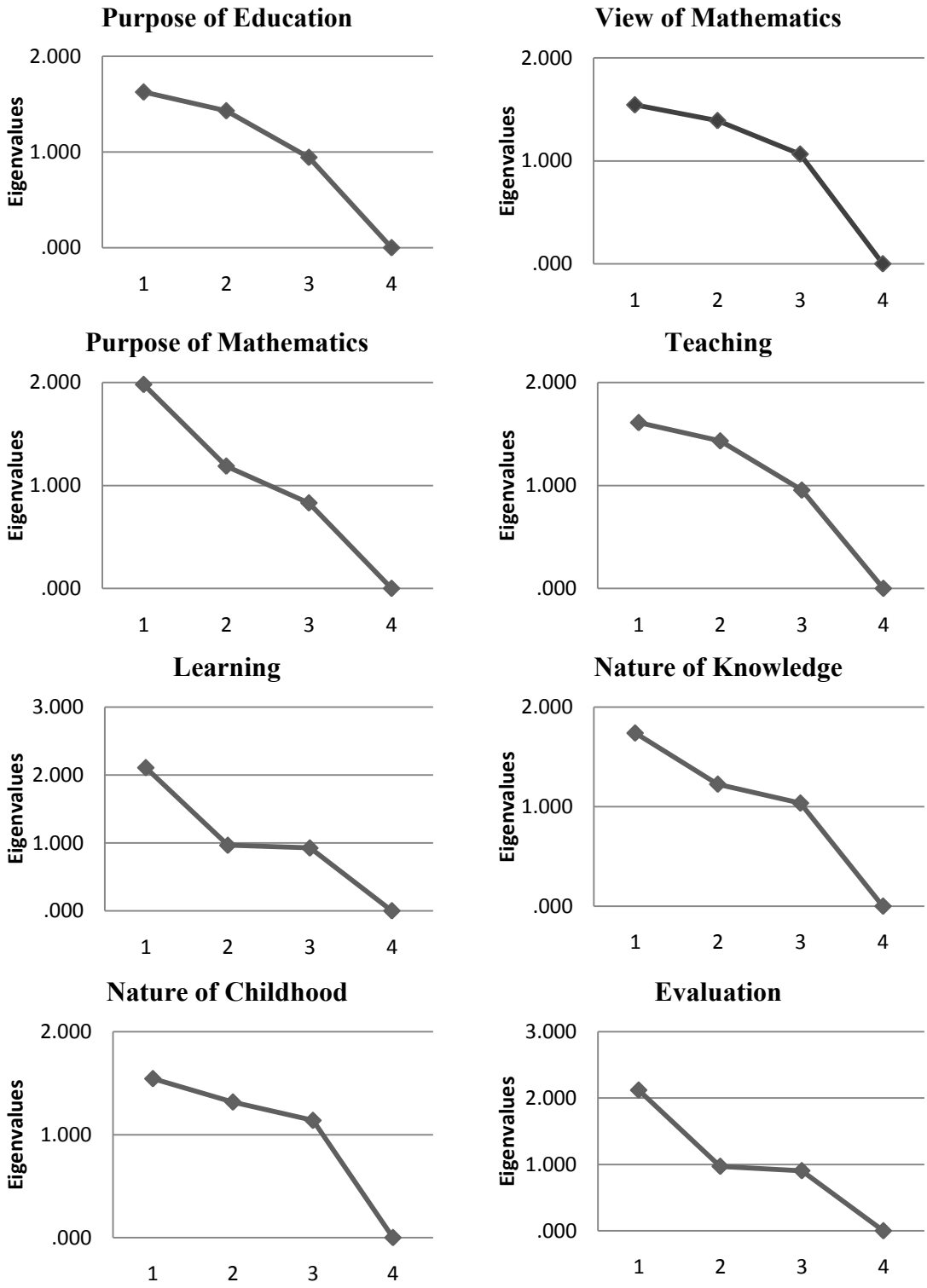


Figure 13. Scree Plots for Each Aspect Using Principal Component Analysis.

The number of points above this line indicated the number of components that the eigenvalue rule would suggest for retention. These ranged from one to three components. Only the aspects of Learning and Evaluation exhibited a pattern resembling the elbow of interest when using a scree plot, suggesting that a single component for each agreed with the eigenvalue rule. The scree test was difficult to apply to the other aspects. These plots revealed that there was a relatively large amount of variation within each of the aspects that necessitated more than one component to explain them. It was difficult to examine the source of this variation from these plots or even from continued analysis with each of the aspects separately. Therefore, the next step of PCA involved combining all of the 32 aspect total variables into one analysis.

When PCA was performed with all 32 of the aspect total variables, the results contained 13 components with an eigenvalue greater than one. A list of those first 13 components' eigenvalues is in Table 16. The eigenvalues are related to the percentage of variation explained by the components as mentioned earlier. Table 16 also includes the cumulative percentage of variation explained by all included components. By including 13 components, 73.3% of the total variation among the 32 variables was explained. It was also observed that not much of that information was lost by eliminating one or two components.

It was necessary to examine how each of the variables loaded onto the different components to determine whether the number of components could be reduced. For this process, rotation of the data was necessary (DeVillis, 2003). Unrotated components contain information about how each variable relates to some arbitrary axis that does not have meaning for the data.

Table 16

Eigenvalues and Cumulative Percentages of Variation Explained for All Components with an Eigenvalue Greater than One When All Aspect Totals were Included in PCA

Components	Eigenvalue	Cumulative Percentage
1	5.810	18.155
2	2.569	26.183
3	1.902	32.125
4	1.715	37.486
5	1.557	42.353
6	1.418	46.785
7	1.374	51.079
8	1.325	55.219
9	1.289	59.247
10	1.219	63.057
11	1.166	66.701
12	1.077	70.067
13	1.052	73.355

By rotating the solutions, patterns in the data determine the axis and create more meaningful loadings of each variable onto the components. Many of the available rotations restrict axes to be orthogonal to each other. Since most latent variables in the social sciences are not mutually independent, it is not appropriate to force them to be orthogonal (DeVillis, 2003). An oblique rotation accounts for correlation between the axes that define latent variables and allow a more realistic interpretation. For this study, oblique rotations were always used to find loadings for each component with the Promax rotation in SPSS 18.0.

While each variable did not load entirely on a single component in any of the analyses, there was generally one component that had a much higher loading value than the others using both the structure and proximity matrices from the output of SPSS

(Appendix J). Both types of matrices represent the component loadings after oblique rotation. Using a single component with the highest absolute value for each, the patterns of components were analyzed in relation to the ideologies and aspects with 13 components. Many of the components were contained within one aspect and few, only two of the 13, represented variables in more than one aspect. However, one component contained only one variable, which suggested that either this variable was independent of the others or that 13 components were more than the number needed to explain the variables.

PCA was repeated, forcing the number of components to be 12 and then 11 and similar structures were found in each with the analysis of 11 components not containing any components with single variables. This last analysis is shown in Table 17.

Table 17

Component Groupings by Color and Communalities with 11 and Eight Components

	11 Components				8 Components			
	LCI	SAI	SRI	SEI	LCI	SAI	SRI	SEI
Teaching	0.78	0.55	0.77	0.69	0.40	0.46	0.69	0.62
View of Mathematics	0.75	0.72	0.73	0.58	0.55	0.60	0.66	0.56
Purpose of Mathematics	0.83	0.56	0.59	0.64	0.55	0.54	0.57	0.40
Purpose of Education	0.62	0.69	0.76	0.71	0.59	0.47	0.60	0.61
Learning	0.52	0.65	0.55	0.63	0.43	0.57	0.53	0.53
Nature of Childhood	0.84	0.81	0.67	0.64	0.74	0.73	0.59	0.39
Nature of Knowledge	0.72	0.56	0.77	0.73	0.60	0.52	0.57	0.57
Evaluation	0.72	0.62	0.43	0.61	0.58	0.53	0.41	0.54

Note. Each color represents a different component. Underlined communalities represent a large negative factor loading. The order of the aspects and ideologies were rearranged to maximize the number of adjacent cells in the same component.

Each aspect is represented by a row and each ideology is represented by a column. Six of the 11 components are completely contained in a single aspect. Some of the other components that contained variables in more than one aspect still had a primary aspect and only contained one variable from another. These showed a tendency to group variables according to aspect rather than ideology. The same analysis was run with only eight components, the number of aspects, and resulted in a greater mixture of variables from different aspects within the same components, suggesting that fewer components pushed the analysis to favor ideology classifications more, as shown in Table 17.

Table 17 also contains the communalities for each variable given the analyses. The communalities are the squared component loadings representing the percentage of variation for each variable explained by the components. With 11 components, these range from 48.2 to 83.8% and drop to between 39.2 and 74.2% with eight components. Overall this was less than a 10 percent drop with four fewer components. Some variables decreased more than others, which reflected a greater impact on the power of the components to explain those variables, but no variable had an extremely low communality. This suggested that either 11 or eight components could represent the variables reasonably well and information about the structure of the data was gathered from both.

One observation about the information in Table 17 reflected additional structure. Namely, no one cell was alone in a component in both its row and column, meaning that variables in the same component were always in the same row or column. This suggested that between ideology variation and aspect variation, significant covariation was accounted for. These results also confirmed that neither the aspects nor ideologies alone

could explain the data, even though aspects seemed to have a higher influence over the classifications.

The final PCA involved each ideology individually. Similar to the analysis with individual aspects, the final PCA investigated whether all of the variables for a particular ideology would load on a single component signifying a single group. The results from this analysis are summarized in Table 18. Using the eigenvalue rule, SAI and SEI exhibited one factor and LCI and SRI exhibited two, but upon inspection of the scree plots it was determined that the additional amount of information gathered with each additional component diminished significantly after just one component in all four analyses. This can also be seen in the eigenvalues given in Table 18. This finding suggests that the model of reduction that was most powerful or received the most information for the fewest number of parameters included one component for each of the ideologies. The variation accounted for in each case was between 25 and 32% as reported in Table 18, which revealed the relative power of just one component to explain eight variables. Although these percentages are not high, many more components would have to be retained to increase the percentages.

Component loadings are also reflected in Table 18 along with their squared values. The squared value, or communality, represents the percentage of each variable explained by the single component. In each case, low values reflected that the component was not able to significantly explain the variation among those variables. The LCI View of Mathematics was the lowest of all of the communalities, which revealed that the component describing the other LCI philosophies was not as adept at explaining

the View of Mathematics. Thus, the aspect about the View of Mathematics from a LCI perspective was different in some way than the others in that ideology.

Table 18

Eigenvalues, Component Loadings and Variance Accounted For in PCA for Each Ideology using Aspect Totals

Factor Eigenvalues	**SAI**		**SEI**		**LCI**		**SRI**	
1	2.524		2.161		2.030		2.343	
2	0.986		0.990		1.089		1.160	
3	0.890		0.962		0.988		0.983	
4	0.824		0.886		0.878		0.841	
5	0.795		0.819		0.835		0.753	
6	0.719		0.768		0.758		0.698	
7	0.664		0.730		0.740		0.666	
8	0.598		0.684		0.681		0.556	
Component Loadings† (squared)								
Purpose of Education	0.599	(.359)	0.584	(.341)	0.570	(.325)	0.657	(.432)
View of Mathematics	0.474	(.225)	0.390	(.152)	0.291	(.085)	0.562	(.316)
Purpose of Mathematics	0.614	(.377)	0.582	(.339)	0.496	(.246)	0.657	(.432)
Teaching	0.631	(.398)	0.505	(.255)	0.342	(.117)	0.358	(.128)
Learning	0.608	(.370)	0.623	(.389)	0.517	(.267)	0.587	(.345)
Nature of Knowledge	0.648	(.420)	0.375	(.141)	0.574	(.329)	0.508	(.258)
Nature of Childhood	0.424	(.180)	0.547	(.299)	0.554	(.307)	0.553	(.306)
Evaluation	0.442	(.195)	0.496	(.246)	0.596	(.355)	0.356	(.127)
Variance Accounted For	31.553%		27.017%		25.380%		29.294%	

†Component loadings were for just one component in each case and the squared component loadings (communalities) were the variance of each variable accounted for by the component.

By examining each aspect and each ideology individually and collectively, the researcher was able to obtain a significant amount of information about the underlying structure of the data and its similarities to the intended structure provided in the Theoretical Framework. The results provided some variation among the different classifications for each variable, but in general showed strong evidence that aspect and

ideology classifications account for much of the variation observed in the aspect totals for teachers' philosophies. Furthermore, the hierarchy suspected with each aspect being a part of teachers' curriculum philosophies and each ideology present within every aspect was supported in the overall analysis with all aspect totals. In individual analyses, each ideology was adequately represented with one component, while analyses of the aspects required two or three components in most cases to explain four variables. These results from the PCA were vital to understanding the structure of the data and played a critical role in providing evidence of construct validity specific to the underlying structure of the MTPI.

What is the Relationship Between the Four Ideologies?

Another assumption inherent to this study was that the relationship between the structure of teachers' philosophies as represented by the four distinct ideologies. To test this, a correlation matrix was constructed between the total scores for each ideology. This matrix is shown in Table 19. These results were similar to those from the pilot test.

Table 19

Correlations Between the Four Ideologies in the Total Scores

	SAI	**SEI**	**LCI**	**SRI**
SAI	1.000			
SEI	0.283**	1.000		
LCI	-0.596	-0.627	1.000	
SRI	-0.711	-0.573	0.231*	1.000

* $p < 0.05$ **$p<0.01$

Note. Correlations between different ideologies were tested for significance against the value -0.333.

The only significant correlations were positive and observed between the pairs of ideologies that are theoretically considered traditional or progressive. The Scholar Academic and Social Efficiency Ideologies have been considered traditional for many of the aspects (Schiro, 2008). The Learner Centered and Social Reconstruction Ideologies generally are more progressive (Schiro, 2008). Even though the correlations are significant, they were still moderate and each of the four ideologies should be considered distinct ideologies consistent with the theoretical foundation. It is possible that there were other reasons for the significant negative correlations, but causation is not possible to evaluate with bivariate correlations analyses.

What is the Test-Retest Stability of the MTPI?

The reliability of the composition of the four different ideologies was measured by administering the inventory a second time to volunteers. As shown in Figure 11, 176 teachers volunteered to retake a portion of the inventory to measure test-retest reliability. The inventory was divided into three portions, two with three aspects and one with just two. Each teacher who volunteered was sent a link to one of the three portions. Responses were included for analysis if all items for an aspect were completed and between 49 and 51 usable responses were received for each aspect.

To measure the reliability of the scores for each aspect, responses from the retest were matched with corresponding responses from the original administration. The change was measured for each aspect by calculating the difference in aspect totals for each ideology for each participant. Thus if a participant had the following totals for one of the aspects from the first and second administrations, the total change score would be 2+1+2+0=5.

Example:	SAI	SEI	LCI	SRI
First administration	11	6	5	2
Second administration	9	7	7	2

The average, range and number of total change scores for each aspect are listed in Table 20. The maximum possible change was 24 for any one aspect as mentioned in Chapter 3.

Table 20

Change in Total Scores for Each Aspect Measuring Test-Retest Reliability

Aspect	Average Change	Min	Max	n
Purpose of Education	4.9	0	12	49
View of Mathematics	4.6	0	10	49
Purpose of Mathematics	5.4	0	14	49
Teaching	4.8	0	10	50
Learning	4.9	2	12	49
Nature of Knowledge	5.6	0	10	51
Nature of Childhood	5.7	0	12	49
Evaluation	6.1	0	14	49

The average change for each aspect was between 4.6 and 6.1 with the maximum observed change 14. This shows a low level of change in general, which provided evidence of acceptable stability reliability of scores.

The most change was seen with the Evaluation aspect. To comprehend the changes that occurred for this aspect, the researcher found the sum of all changes for each ideology within the Evaluation aspect. The following were the totals from those calculations:

SAI -11 SEI -7 LCI +14 SRI +4

It seemed that the two weeks between administrations for the 49 teachers who responded to this aspect made a slight difference overall away from the Scholar Academic and Social Efficiency Ideologies mainly toward Learner Centered. Overall, the changes were

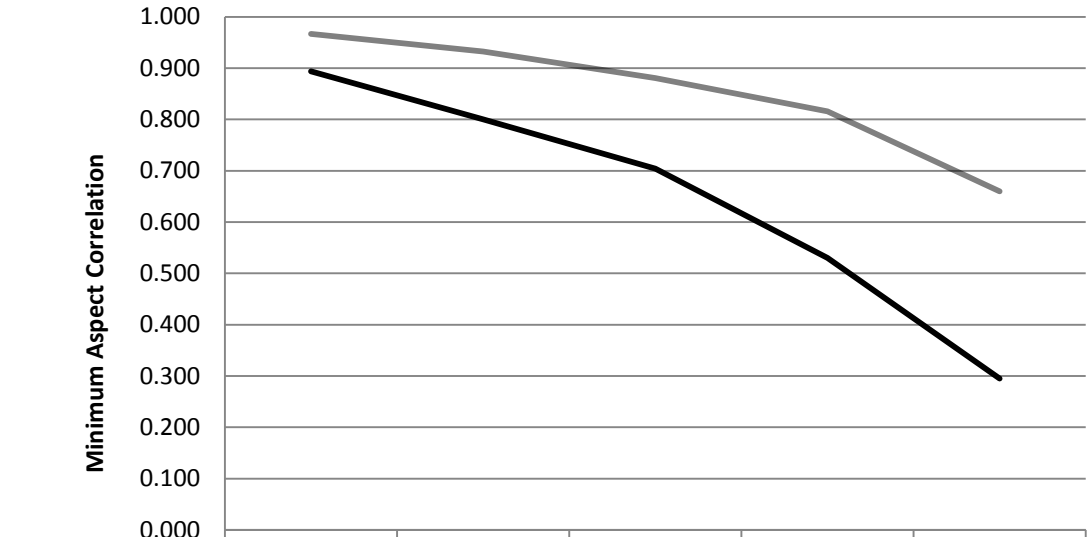
small, which provided evidence of score reliability or stability from one administration to another.

Can the Number of Questions for Each Aspect be Reduced?

Once the response structure, reliability and validity of the instrument were established, the researcher investigated whether the inventory could be shortened. Some teachers in their comments mentioned the survey taking a long time and DeVillis (2003) listed optimizing the length of a survey as the final step in the development of an instrument. The guiding principle in shortening the MTPI was to collect the same level of information from participants with fewer items. The amount of information gathered from a reduced inventory was measured in comparison to the information gathered with the full inventory. The correlations calculated for the first problem question provided the items to be eliminated from the survey. For each of the eight aspects, the item displaying the smallest correlation to the aspect total was removed from the data matrix and new aspect and overall totals were calculated for each participant with only five items instead of six for each aspect. Then the correlations were calculated between the original aspect totals and the new ones for the reduced inventory. The minimum of the 32 correlations for the aspect totals (four for each of the eight aspects) and minimum of the four correlations between overall totals is shown in Figure 14.

The inventory size was again reduced by choosing the item with the least average correlation to the aspect total to eliminate from the data and correlations were calculated again between the reduced inventory with four items for each aspect and the full inventory. This process was repeated until only one item remained for each aspect. The items in order of elimination for each aspect are listed in Appendix Table H3. The

minimum correlations among the aspects as well as the minimum correlations for the overall philosophy totals between the reduced and full data sets are shown in Figure 14.



	5 Questions	4 Questions	3 Questions	2 Questions	1 Question
Aspect Totals	0.894	0.800	0.704	0.530	0.295
Overall Totals	0.967	0.932	0.880	0.816	0.660

Figure 14 - Minimum Correlations Between Reduced and Full Inventory Scores.

These correlations revealed that, even with a reduced number of questions, a significant amount of information could be obtained from participants about their philosophies. For example, by eliminating one question from each aspect and calculating the squared correlation, the aspect totals still preserved at least 80% (0.894^2) of the original information. The overall totals shared 94% (0.967^2) of their variance with the original overall totals. The squared correlations that result from a reduced inventory with five, four, three, two or one items for each aspect are listed in Table 21. Less information was lost for the overall totals than aspect totals because the overall totals contained combined information.

Table 21

Minimum Squared Correlations Between Reduced Inventories with the Given Number of Items per Aspect and the Full Inventory

	5 Items	4 Items	3 Items	2 Items	1 Item
Aspect Totals	0.80	0.64	0.50	0.28	0.09
Overall Philosophy	0.94	0.87	0.77	0.67	0.45

How is the Data Distributed Across the Different Regions?

In order to better understand how related the different aspects were and how teacher philosophies were distributed among the 15 regions related to the four ideologies, the data from this study was compared with the theoretical distribution assuming the philosophies were randomly selected. In Figure 15, the first pie chart shows the percentages of the sample whose overall philosophies were classified in each of the 15 regions as described in the Data Analysis section of Chapter 3. If the philosophies were evenly distributed among the 15 regions as with the theoretically possible points, then the sections of these graphs would be relatively equal. Upon visual inspection, they were unequal in size. The region classifications for each aspect were also inspected and found not to be equal although some aspects had a more equal distribution than others as can be seen in Figure 15.

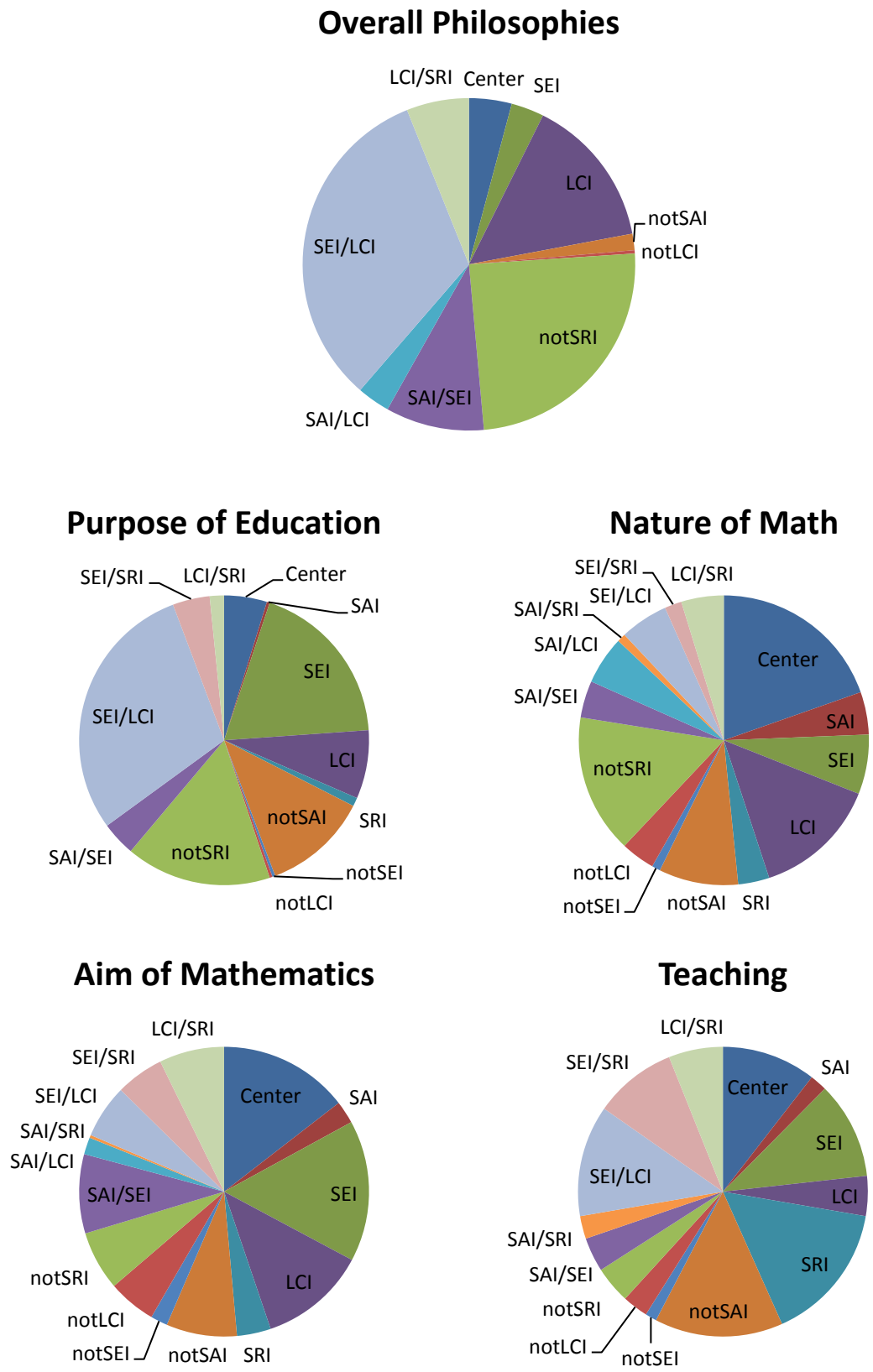


Figure 15. Proportion of Responses by Region.

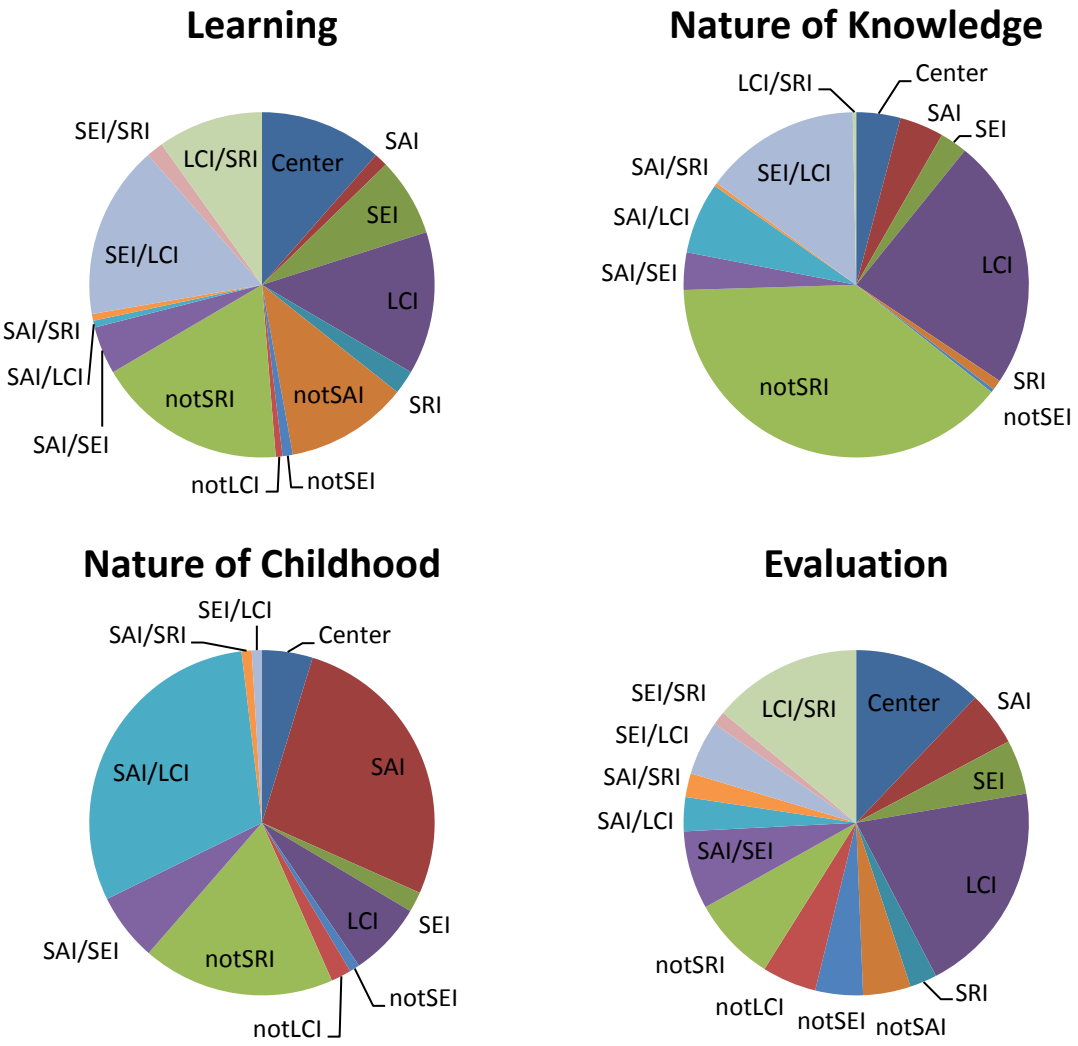


Figure 15 (*continued*). Proportion of Responses by Region.

The equal distribution of the philosophy scores for each aspect and overall were tested with a χ^2 - Goodness of Fit test using the theoretical distribution of scores as the expected proportions. The results from this test are shown in Table 22. The χ^2 statistic is significant at the 0.001 level for all aspects and the overall philosophies. This suggested two things about this classification. First, teachers' responses were not just random and

second, that there were significant general trends in the population of teachers regarding their curriculum philosophies.

Table 22

Expected and Actual Counts for Regions with χ^2 Statistics Testing for Goodness of Fit

	Center	**SAI**	**SEI**	**LCI**	**SRI**	**not SAI**	**not SEI**	**not LCI**	**not SRI**	**SAI/SEI**	**SAI/LCI**	**SAI/SRI**	**SEI/LCI**	**SEI/SRI**	**LCI/SRI**	**χ^2 (*df*) ******
Expected (based on N=322)	**48**	**26**	**26**	**26**	**26**	**18**	**18**	**18**	**18**	**16**	**16**	**16**	**16**	**16**	**16**	
Purpose of Education	15	1	59	24	3	37	1	1	51	12	0	0	92	13	5	550.415 (12)
View of Mathematics	62	15	21	44	11	28	3	12	49	13	17	3	17	6	15	125.048 (14)
Purpose of Mathematics	46	8	50	38	12	25	6	17	21	28	6	1	19	17	23	96.024 (14)
Teaching	33	6	34	14	49	45	4	9	13	12	0	8	39	29	19	155.578 (13)
Learning	36	4	23	42	7	36	3	2	56	14	2	2	51	5	31	313.326 (14)
Nature of Knowledge	13	13	8	74	0	3	1	0	122	11	21	1	46	0	1	697.804 (11)
Nature of Childhood	15	85	6	22	0	0	3	6	57	20	96	3	3	0	0	526.618 (10)
Evaluation	38	16	16	63	8	14	14	16	25	23	10	7	16	4	44	169.116 (14)
Overall Philosophy	**13**	**0**	**10**	**46**	**0**	**5**	**0**	**1**	**77**	**30**	**10**	**0**	**102**	**0**	**19**	**410.774 (8)**

****All χ^2 statistics were significant at the 0.001 level

Note. Underlined entries were too small to be included in further calculations with attribute information.

The χ^2 - Goodness of Fit test would have been significant even if only one region contained a proportion significantly different from the expected. In order to gain a better perspective of which regions were significantly different and any general trends of teachers' philosophies, the researcher used the visualization tool described in Chapter 3 to view the number of teachers in each region. Snapshots of these visualizations can be

found in Table 23 with calculated estimates of the number of teacher philosophies near each ideology.

Table 23

Visual and Analytic Description of the Distribution of Points

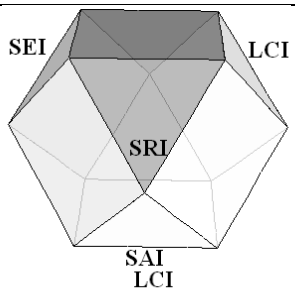
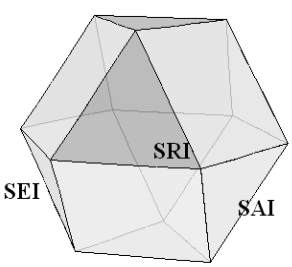
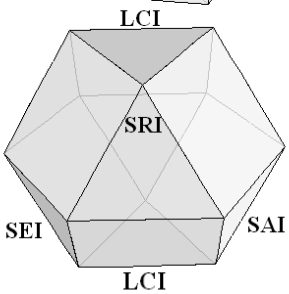
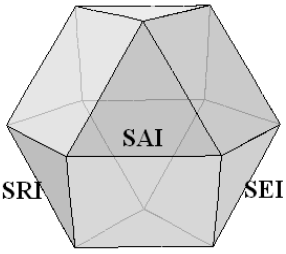
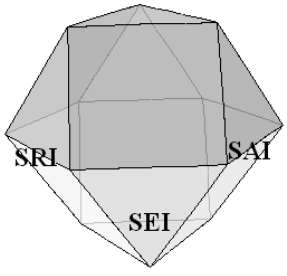
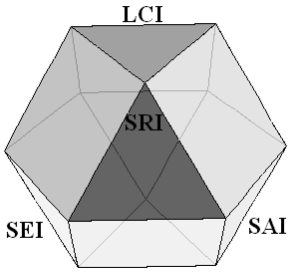
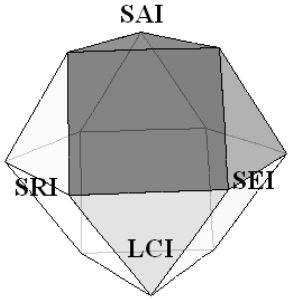
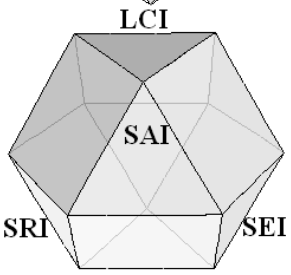
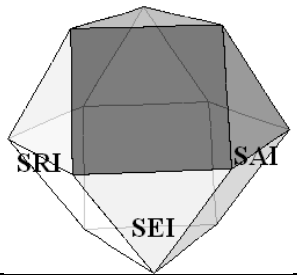
Aspect/Total	Visual Snapshot	SAI	SEI	LCI	SRI
Purpose of Education		25	147	102	25
View of Mathematics		53	69	95	37
Purpose of Mathematics		40	103	79	49
Teaching		25	96	64	96
Learning		33	89	116	40

Table 23 (*continued*)

Visual and Analytic Description of the Distribution of Points

Aspect/Total	Visual Snapshot	SAI	SEI	LCI	SRI
Nature of Knowledge		71	78	150	2
Nature of Childhood		167	39	92	5
Evaluation		54	56	116	50
Overall Philosophy		**46**	**104**	**139**	**12**

Note. Darkest (most dense) regions are shown forward in the visual snapshot.

These estimates were found by calculating the sum of the number of teachers in the vertex region specific to an ideology, half of all edge regions adjacent to that ideology and one third of all face regions including that ideology. For example, to calculate the SAI estimate, the following calculation was used:

$$SAI = SAI + \frac{SAI/SEI + SAI/LCI + SAI/SRI}{2} + \frac{notSEI + notLCI + notSRI}{3}$$

Philosophies classified in the center region were excluded from these estimates because they would not be considered "near" any one ideology.

The visualizations and estimates suggested general preferences in the sample, which varied between the different aspects. The View of Mathematics, Purpose of Mathematics, and Teaching aspects were approximately equal between the four ideologies with no significant pull toward or away from any one ideology. Learning, Nature of Knowledge, and Evaluation showed a general preference for the Learner Centered Ideology, which was consistent with the Overall Philosophies that also showed a preference for LCI. The Social Efficiency Ideology was also strong in the Overall Philosophies and this was reflected in the Purpose of Education aspect with LCI as a secondary preference. The aspect that had the most unique results was the Nature of Childhood, which had a strong preference for the Scholar Academic Ideology. For this ideology Schiro (2008) states, "Childhood is essentially a period of intellectual development highlighted by growing reasoning ability and capacity for memory that results in an even greater absorption of mathematical knowledge" (p. 215). In addition to the strong preferences, the visuals and estimates also revealed a significant lack of support for the Social Reconstruction Ideology in the Nature of Knowledge and Nature of Childhood aspects.

These results prompted a general observation that it was important to classify teachers' philosophies into more than just four ideologies. Some theorists, as noted in Chapter 2, have claimed that teachers' philosophies cluster around the four ideologies, but these results do not support that claim. Many of the densest regions were ones that

represented a combination of two or three ideologies. These observations about the sample were beneficial because they gave the researcher focus for how to proceed with further data analysis knowing that teachers' philosophies must be classified into more than four regions and which regions lacked sufficient data to be used in further analysis. Additionally, these results provided valuable information about general preferences of secondary mathematics teachers in Texas and initialized ideas for areas of future research as will be discussed in Chapter 5.

How Do Teacher Attributes Vary Between the Different Regions?

When the questions about teacher experience were developed, suggestions were taken from literature regarding attributes of teachers that influence philosophies. In order to test whether these attributes vary with different philosophies, suggesting a relationship, a series of χ^2 tests for independence and ANOVA tests were constructed. This was done with both the data about overall philosophies and each aspect of teachers' philosophies in order to have a detailed picture of what attributes were significant and to what part of a philosophy. For each of the numerical attribute variables, a one-way ANOVA table was created with the averages in each region as is shown for the overall philosophies in the first three rows of Table 24. Regions with two or fewer data points were excluded from calculations because they did not contain enough information to get reasonable averages of the attributes. Two assumptions of ANOVA tests are normality and approximately equal standard deviations of the population in each group. With so few data points in a region it was impossible to gather enough information about the normality and sample standard deviation to ensure that the assumptions were met in these regions. For the

remaining regions the skewness, kurtosis and standard deviations were derived and then analyzed.

Table 24

Averages and Proportions of Each Attribute in Each Region for Overall Philosophies

		Center	SEI	LCI	not SAI	not SRI	SAI/SEI	SAI/LCI	SEI/LCI	LCI/SRI
	Counts	13	10	46	6	78	30	10	106	22
Averages	**Years Teaching**	7.923	15.3	11.70	5.333	15.83	17.03	16.8	15.12	11.182
	Years at Current School	4.692	6.3	7.935	4.167	8.423	9.900	12.3	6.882	7.455
	Number of Schools	1.846	2.3	2.239	1.667	2.833	2.867	3.0	2.821	2.364
Proportions	**Gender – Female**	0.538	0.7	0.739	1.000	0.705	0.567	0.9	0.774	0.636
	Current Level - HS	0.385	0.8	0.283	0.333	0.603	0.767	0.4	0.443	0.545
	Past Elementary	0.615	0.8	0.457	0.333	0.731	0.867	0.4	0.632	0.636
	Past Middle School	0.692	0.6	0.826	0.833	0.667	0.667	0.9	0.764	0.727
	Past High School	0.077	0.1	0.239	0.0	0.103	0.067	0.1	0.179	0.091
	Left a Position	0.077	0.2	0.217	0.333	0.192	0.233	0.2	0.160	0.182
	Administration	0.077	0.0	0.043	0.0	0.026	0.100	0.0	0.0	0.045
	Graduate Education	0.615	0.6	0.500	0.500	0.474	0.533	0.6	0.481	0.545
	Graduate Math	0.308	0.2	0.326	0.167	0.308	0.233	0.5	0.283	0.455
	Mentor	0.538	0.5	0.565	0.167	0.615	0.567	0.4	0.604	0.545
	Certification – University	0.462	0.6	0.761	0.333	0.731	0.700	0.7	0.726	0.773
	Certification - Alternative	0.462	0.2	0.109	0.667	0.192	0.300	0.3	0.217	0.227

Note. SAI, SRI, not SEI, SAI/SRI, and SEI/SRI regions contained no responses (Count = 0); notLCI removed because count=1 was too small for analysis.

For each of the categorical attribute variables a table was also created with the proportion of teachers within each region with a particular attribute. For simplicity,

Table 24 does not contain options for variables that can be deduced from the others. For example, the proportion of male teachers in each region can be calculated from the proportions of female teachers. Table 24 only shows these averages and proportions for the overall philosophies, but the ANOVA and χ^2 tests for independence were performed with the regions for each aspect as well. The results from these tests are summarized in Tables 25 and 26.

Table 25

F-Statistics from ANOVA Tests for Independence Between Region Classifications and Numerical Attribute Variables

	Purpose of Education	View of Math	Purpose of Math	Teaching	Learning	Nature of Knowledge	Nature of Childhood	Evaluation	**Overall Philosophy**
Years Teaching	1.489	0.599	2.451 ***	1.817 *	2.152 *	0.983	2.064*	1.059	**2.628 ****
Years at Current School	0.880	1.253	0.853	1.736	2.289 *	0.786	0.533	0.557	**1.547**
Number of Schools	1.011	0.835	1.564	1.699	1.392	1.105	1.255	1.054	**1.259**

* $p < 0.05$ ** $p < 0.01$ ***$p < 0.005$

Only six of the 15 tested attributes were significant with at least one of the aspects or overall philosophies. With both types of tests, a significant result indicated that at least two of the regions had significantly different averages or proportions. The current level that the teachers taught, middle school or high school, was significant to their philosophy on the purpose of education and very significant to their overall philosophy. Past high school experience was also very significant to overall philosophies even though past middle school or elementary school experience was not significant to any of the measures of teachers' philosophies.

Table 26

Results from Chi-Squared Tests for Independence Between Region Classifications and Categorical Attribute Variables

		Purpose of Education	View of Math	Purpose of Math	Teaching	Learning	Nature of Knowledge	Nature of Childhood	Evaluation	**Overall Philosophy**
Gender	χ^2	13.056	11.200	9.477	21.688	5.217	14.671	10.416	17.330	**12.016**
	df	9	14	13	13	11	8	10	14	**8**
District Type	χ^2	63.953	111.85	112.25	91.730	92.323	54.908	84.133	79.786	**51.449**
	df	63	6	6	91	77	56	70	98	**56**
			98	91						
Current Level	χ^2	22.889	14.685	9.024	12.397	17.293	13.943	13.687	16.537	**27.407**
	df	9	14	13	13	11	8	10	14	**8**
		**								****
Past	χ^2	12.661	16.203	10.000	10.641	8.685	9.974	3.756	11.928	**9.460**
Elementary	*df*	9	14	13	13	11	8	10	14	**8**
Past Middle	χ^2	9.139	9.770	13.319	9.354	7.544	10.558	15.918	15.724	**7.775**
School	*df*	9	14	13	13	11	8	10	14	**8**
Past High	χ^2	15.932	12.363	4.451	18.995	15.950	14.329	7.495	16.833	**22.478**
School	*df*	9	14	13	13	11	8	10	14	**8**
										***
Left a Position	χ^2	5.386	14.128	4.547	11.280	4.083	10.096	4.782	7.776	**3.120**
	df	9	14	13	13	11	8	10	14	**8**
Administration	χ^2	15.498	18.270	14.882	31.733	12.391	17.494	8.309	19.648	**11.312**
	df	9	14	13	13	11	8	10	14	**8**
					***		*			
Graduate	χ^2	8.752	12.345	10.307	13.822	13.383	5.513	15.275	10.291	**2.136**
Education	*df*	9	14	13	13	11	8	10	14	**8**
Graduate Math	χ^2	9.628	15.939	10.770	7.436	9.887	6.293	7.657	11.966	**6.241**
	df	9	14	14	13	11	8	10	14	**8**
Mentor	χ^2	16.201	13.965	12.020	27.589	11.661	8.503	6.957	10.475	**6.622**
	df	9	14	13	13	11	8	10	14	**8**
					**					
Certification	χ^2	15.373	37.935	26.976	18.275	17.411	17.569	18.685	39.464	**26.048**
	df	18	28	26	26	22	16	20	28	**16**

* $p < 0.05$ ** $p < 0.01$ ***$p < 0.005$ ****$p < 0.001$

Administration experience was significant to teachers' philosophies about teaching and the nature of knowledge. Formally mentoring another teacher was also shown to be significant to teachers' philosophies about teaching. The number of years that teachers served at their current school was significant relative to their philosophies about Learning, but the attribute displaying the most frequent significance relative to a

teacher's philosophy was the number of years of teaching experience. This pattern emerged relative to philosophies about the Purpose of Mathematics, Teaching, Learning, the Nature of Childhood, and overall philosophies. These significant findings did not reveal causal relationships since it would be inappropriate to conclude that the philosophies differed because of their experiences or that teachers had these different experiences because of their different philosophies. In summary, the evidence illustrated that for these specific areas, teachers' experiences were not independent of their philosophies.

What Model of Prediction Can Teacher Attributes Give for the Region of a Teacher's Philosophy?

After finding that some teacher experience attributes vary between regions of philosophies, the next step was to predict which region a teacher's philosophy would lie in based upon teacher attributes. Since the region classification was a categorical response variable, logistic regression was used to create prediction equations that were equal to the log odds of a philosophy being in each region over the Center region. The Center region was chosen to be the reference category because it never contained too few data points to include for any single aspect or for the overall philosophies. As was mentioned in the discussion of this method in Chapter 3, the log ratio for any pair of regions can be derived using results obtained between each unique region and the reference region using the properties of logs.

The logistic regression equations were derived using a hierarchical, or backward stepping, entry approach. First, all regions for an aspect and for the overall philosophies with fewer than three data points were eliminated from analysis. Then, using the regions as the response variable, all 14 possible attribute predictors listed in Table 26 were fit

with parameters in an equation that best fit the responses. The significance of the model was tested against a model without predictors using a likelihood ratio test with χ^2 distribution (Agresti & Finlay, 2009). Each predictor in the model was similarly tested for overall significance. The predictor with the least significance was removed and the new model was tested. This process was repeated until the most significant model was found or all predictors were significant at the 0.05 level. The results for the Overall Philosophies are shown in Table 27 with the model fit statistics.

Table 27

Logistic Regression Equations for Overall Philosophies Being Located in a Region

	Intercept	Years Teaching	Years at Current School	Current Level=HS	Certification =Alternative	Certification =None
SAI	-	-	-	-	-	-
SEI	-2.728*	0.110	-0.071	2.675*	-0.947	2.018
LCI	1.361*	0.007	0.069	-0.355	-1.752*	-0.080
SRI	-	-	-	-	-	-
not SAI	-0.443	-0.185	0.164	-0.419	0.597	-18.046
not SEI	-	-	-	-	-	-
not LCI	-	-	-	-	-	-
not SRI	0.600	0.095	-0.002	0.954	-0.997	-0.138
SAI/SEI	-1.142	0.102	0.022	1.490*	-0.401	-18.439
SAI/LCI	-1.489	0.063	0.098	-0.219	-0.153	-18.819
SAI/SRI	-	-	-	-	-	-
SEI/LCI	1.355*	0.104	-0.032	0.260	-0.819	-0.695
SEI/SRI	-	-	-	-	-	-
LCI/SRI	0.268	0.012	0.059	0.592	-1.116	-18.891

Model Fit Statistics:		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept only	1071			
	Final	977.227	93.285	40	< 0.001
Effect	Intercept	9772	0.000	0	
	Years Teaching	1002	25.140	8	0.001
	Years at Current School	993.513	16.286	8	0.038
	Current Level	1005	27.705	8	0.001
	Certification	1004	27.050	16	0.041

*p < 0.05

These results revealed a highly significant set of regression equations within which region teachers' overall philosophies would fall. Predictor variables in the equation included the number of years that they have taught, the number of years at their current school, whether they currently teach high school or middle school and how they received their initial certification. Each of these predictors was significant at a $p<0.05$ level for the model, but an examination of each regression equation revealed that each predictor was not significant to every equation using Wald's statistic (Agresti & Finlay, 2009). The predictors were still useful to the overall model in identifying variance explained by a predictor and by providing information about the comparison of two regions.

The regression equations predict the log odds of a philosophy being in the named region over the Center region. Thus the equation for SEI demonstrated that the log odds of a philosophy being in the SEI region over the Center region increased when the number of years of teaching experience increased, if a teacher taught high school or if they were not certified to teach in mathematics. The log odds decreased relative to the number of years a teacher taught at the same school or if they received initial certification through an alternative program. These observations provided insight into not only which teacher attributes were relevant to their philosophy, but also how those attributes specifically relate in either a positive or negative way and to what magnitude.

Since it was shown in previous analyses that teachers' philosophies about each aspect measured by the MTPI were not summarized completely by their overall philosophy, the same analyses were performed to find logistic regression equations for each of the eight aspects. The equations and their fit statistics can be found in Appendix

I. The predictors that resulted in the final model for each aspect are shown in Table 28 to illustrate which attributes were most relevant in the prediction of the region of a teacher's philosophy about an aspect.

Table 28

Summary of Attribute Variables used in Logistic Regression Equations for Each Aspect of Teachers' Philosophies

	Purpose of Education	View of Math	Purpose of Math	Teaching	Learning	Nature of Knowledge	Nature of Childhood	Evaluation	**Overall Philosophy**
Years Teaching	×		×				×		×
Years at Current School		×		×	×				×
Number of Schools				×	×			×	
Gender						×	×		
Current Level	×				×	×	×		×
Past Elementary		×							
Past Middle School								×	
Past High School				×		×			
Left a Position									
Administration				×					
Graduate Education				×			×		
Graduate Math									
Mentor	×			×	×				
Certification		×						×	×

These results often overlapped with the results from the χ^2 independence and ANOVA tests between the region classifications and teacher attributes shown in Tables 25 and 26. Importantly, the regression results provided additional information about what attributes were relevant to each part of a teacher's philosophy. Regression results

also revealed that at least two attributes that were considered, whether a teacher has left a position due to differences in philosophies and whether a teacher has taken graduate courses in mathematics, were not relevant to defining the region for a teacher's philosophies about any aspect. The other attributes were significant to at least one aspect and provided predictions about which regions were most likely to contain a teacher's philosophy based on their experience attributes.

What Model of Prediction Can Teacher Attributes Give for the Distance of a Teacher's Philosophy from a Balanced Philosophy?

Predicting the region that a teacher's philosophy will fall in using teacher experience attributes provided valuable information about the composition of the four ideologies. Additional information was gathered using experience attributes to predict how far a philosophy will be from the center, or an equal balance of all four ideologies. As was mentioned in Chapter 3, the possible scores for teachers' responses to the inventory were represented by points disproportionately dense near the center. The consequence of this for predicting distance from the center was that regression equations would be sensitive to the relatively few points farthest from the center, which would perform as outliers. To compensate for this, a weighted distance was used as the response variable in the regression equations, which was equal to the maximum distance that points could be from the center multiplied by the cumulative density function evaluated at the original distance.

A similar regression technique to that described for the logistic regression was used to find a most significant regression equation with the available attribute predictors. Table 29 provides the prediction equation for the distance from the center for teachers' overall philosophy. The likelihood ratio, which compared this equation to an equation

with just an intercept and no predictors using a χ^2 distribution, was not significant at the 0.05 level. This was the best prediction model using any combination of predictor variables, but it was not significant. Thus, these experience variables cannot be used to predict distance from an equal balance of the four ideologies for overall philosophies.

Table 29

Multiple Linear Regression Equation for Weighted Distance of Overall Teachers' Philosophies from the Center

d = 0.113 – 0.013(Current Level = HS)

	Likelihood Ratio (χ^2)	*df*	*p*
Model	3.440	1	0.064

Effects	Wald's χ^2	*df*	*p*
Intercept	964.526	1	< 0.001
Current Level	3.458	1	0.063

Since the overall philosophies have been shown through the previous analysis to be different from the aspect philosophies, regression equations were also derived for each aspect. These results are summarized in Table 30 with statistics about their significance. As illustrated, obtaining a significant (0.05 level) prediction equation was attainable for each of the eight aspects using some of the attribute information gathered about teachers' experience. All of the experience variables were used in the prediction of at least one of the aspects except for three: past middle school or high school teaching experience and graduate work in education. Each of the equations in Table 30 showed a significant amount of information about what attributes contributed to an increase or decrease in the distance from a balanced philosophy.

Table 30

Multiple Linear Regression Equations for Weighted Distance of Philosophies for Each Aspect from the Center

Purpose of Education: *d=0.347-0.025(Current Level=HS)+0.001(Years Teaching)-0.057(District Type=Ind)-0.004(District Type=MS)-0.080(District Type=MU)-0.078(District Type=NMFG)-0.008(District Type=NMS)-0.016(District Type=OCC)-0.041(District Type=OCCS)-0.025(Gender=F)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	26.656	10	0.003

Effects	Wald's χ^2	*df*	*p*
Intercept	640.288	1	< 0.001
Current Level	3.647	1	0.056
Years Teaching	2.638	1	0.104
District Type	19.558	7	0.007
Gender	3.043	1	0.081

View of Mathematics: *d=0.237+0.102(Administration)-0.022(Graduate Math)+2.790(Years at Current School)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	9.515	3	0.023

Effects	Wald's χ^2	*df*	*p*
Intercept	83.684	1	< 0.001
Administration	6.212	1	0.013
Graduate Math	2.086	1	0.149
Years at Current School	2.790	1	0.095

Purpose of Mathematics: *d=0.180-0.032(Graduate Math)+0.004(Years at Current School)+0.035(Left a Position)+0.010(Number of Schools)-0.002(Years Teaching)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	12.853	5	0.025

Effects	Wald's χ^2	*df*	*p*
Intercept	101.076	1	< 0.001
Graduate Math	4.287	1	0.038
Years at Current School	6.170	1	0.013
Left a Position	3.362	1	0.067
Number of Schools	3.014	1	0.083
Years Teaching	3.566	1	0.059

Teaching: *d=0.237+0.001(Years Teaching)+0.086(Administration)-0.043(Mentor)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	13.237	3	0.004

Effects	Wald's χ^2	*df*	*p*
Intercept	91.472	1	< 0.001
Years Teaching	3.807	1	0.051
Administration	4.714	1	0.030
Mentor	8.405	1	0.004

Table 30 (continued)

Multiple Linear Regression Equations for Weighted Distance of Philosophies for Each Aspect from the Center

Learning: *d=0.0278-0.002(Years Teaching)+0.033(Current Level=HS)+0.038(Past Elementary)+0.031(Graduate Math)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	11.898	4	0.018
Effects	**Wald's χ^2**	***df***	***p***
Intercept	245.264	1	< 0.001
Years Teaching	4.569	1	0.033
Current Level	4.384	1	0.036
Past Elementary	2.895	1	0.089
Graduate Math	3.950	1	0.047

Nature of Knowledge: *d=0.316+0.002(Years Teaching)-0.026(Certification=Alternative)-0.052(Certification=None)-0.002(Years at Current School)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	16.877	4	0.002
Effects	**Wald's χ^2**	***df***	***p***
Intercept	574.553	1	< 0.001
Years Teaching	7.903	1	0.005
Certification	7.096	2	0.029
Years at Current School	5.097	1	0.024

Nature of Childhood: *d=0.288+0.001(Years Teaching)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	4.322	1	0.038
Effects	**Wald's χ^2**	***df***	***p***
Intercept	706.680	1	< 0.001
Years Teaching	4.351	1	0.037

Evaluation: *d=0.279-0.029(Gender=F)-0.002(Years at Current School)-0.010(Number of Schools)*

	Likelihood Ratio (χ^2)	*df*	*p*
Model	13.209	3	0.004
Effects	**Wald's χ^2**	***df***	***p***
Intercept	298.762	1	< 0.001
Gender	3.369	1	0.066
Years at Current School	3.900	1	0.048
Number of Schools	6.314	1	0.012

For example, for the View of Mathematics aspect, administration experience increased the distance while graduate work in mathematics slightly decreased the distance. As the

number of years that a teacher taught at their current school increased so did the distance from a balanced philosophy. The equations for the other aspects can be similarly interpreted.

Summary

The focus of this study was to understand the relationship between attributes of teachers related to their experience and their philosophies in a quantifiable and measured way. The results in this chapter concerned a sample of 322 middle school and high school teachers who were representative of the population of secondary mathematics teachers in the state of Texas. This representation was verified through a number of demographic variables, some controlled for during the sampling protocol, such as the district type, and some uncontrolled, such as gender and teaching level. The only area where the sample underrepresented the population was in Major Urban districts due to difficulties getting permission from administrators. After the surveys were administered to teachers with a higher than expected response rate, the data were analyzed using a number of different methods to explore 11 problem questions.

This study involved mostly exploratory data analysis with two major objectives. The first was an analysis of the inventory of teachers' philosophies gathering evidence for the reliability and validity of the instrument and the second involved relating the information about teachers' philosophies to their experience. Without the former confirmation, all further analysis based on the results of the inventory would be useless. Item analyses revealed that each item contributed to a content oriented understanding of the corresponding aspect and contained no obvious wording bias. Verification of content validity and absence of item bias was performed using correlations between each item

and the aspect totals and counts of each response. These statistics showed a significant improvement from the pilot test results and evidence of both internal consistency and content validity. The content validity was also assessed using the qualitative responses from teachers who reflected on the survey and the researcher's analysis of their beliefs. No major gaps were found in the coverage of possible philosophies relative to each aspect. The format of the inventory seemed to be a hindrance to some teachers, but many agreed with the general analysis of their beliefs.

Further analysis of reliability and validity mainly focused on the structure and underlying theoretical framework of the MTPI. Principal component analysis was used to understand how well the hierarchical structure of philosophies, each aspect, and the four ideologies were supported by the data. This analysis along with information about how each of the four ideologies correlate with each other revealed four distinct ideologies and a hierarchy of classifications for philosophies that included the ideologies as subcategories of the aspects. The temporal stability of the inventory was evaluated by comparing paired responses from teachers who took portions of the inventory twice, which showed relatively little change from one administration to another. Finally, reduced versions of the inventory were tested for sufficient information. The results showed that reducing the number of items for each aspect was possible and the amount of possible reduction was dependent on whether conclusions would be drawn about overall philosophies only or if information about individual aspects was necessary. Overall, analyses of the structure, reliability and validity of the MTPI led the researcher to continue analysis with the results related to teachers' experience.

Analysis of teachers' philosophies and their experience was exploratory and thus began by describing the data. It was revealed that each aspect of teachers' philosophies had its own characteristics, which were different from the overall philosophy characteristics. By classifying each teacher's philosophy into one of the 15 regions in relation to combinations of the four ideologies, the researcher was able to describe general trends for the sample and test for particularly dense or sparse areas of the philosophy space. The attributes related to each teacher were then analyzed allowing for descriptions of which attributes varied between the regions. The tests of independence and predictive analysis revealed a number of variables related to different aspects of teachers' philosophies. From these analyses, conclusions that will be discussed in the next chapter were drawn about the usefulness of the inventory, the structure of teachers' curriculum philosophies and experience attributes that relate to teachers' philosophies.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This study was an investigation of the relationships between teachers' philosophies and experience attributes with a large enough sample to justify generalizations and predictions about the population of secondary mathematics teachers in Texas. A review of current literature suggested that teachers' philosophies were connected to important issues in mathematics education such as teacher retention, new teacher development, teacher training and reform practices. Existing research identified a potential connection between teachers' experience and their philosophies (Adler, et al., 2005; Melnick & Meister, 2008; Schiro, 2008). Attributes of teachers such as how many years they had taught, the grades taught, administrative experience, graduate studies, mentoring, and certification were all experiences mentioned for potential relationships with teachers' philosophies.

The first two tasks of this study were to develop a measurement tool for teachers' philosophies and to create a way to visualize teachers' philosophies in order to observe patterns and guide analysis. Both of these tasks relied on developed theories about the underlying structure of teachers' philosophies. The culminating task was to administer the inventory to a representative sample from the population of secondary mathematics teachers in Texas and explore relationships between teachers' philosophies and their experiences using a variety of analytical tools with visualizations as a guide.

Instrumentation

The Mathematics Teacher Philosophy Inventory (MTPI) developed during the course of this study was based on a foundation of existing theory from Schiro (2008) and Ernest (1991). A hierarchical structure was used to investigate eight specific aspects of teachers' philosophies: Purpose of Education, View of Mathematics, Purpose of Mathematics, Teaching, Learning, Nature of Knowledge, Nature of Childhood, and Evaluation. Each of the eight aspects was measured as a combination of four ideologies: Scholar Academic Ideology (SAI), Social Efficiency Ideology (SEI), Learner Centered Ideology (LCI), and Social Reconstruction Ideology (SRI).

Reliability and validity. Since all conclusions about teachers' philosophies depended on successfully measuring latent variables through the inventory, it was important in this study to establish the measurement reliability and validity of the MTPI. Validity evidence was evaluated from a content and construct perspective. Through relying on established theories and qualitative analysis of teachers' reactions to the inventory and analysis, it was observed that the four ideologies used to measure teachers' philosophies about each aspect sufficiently covered the major dimensions. Based on component analysis, no pattern emerged from the data or teacher comments suggesting that a fifth dimensions was necessary. Avoiding wording bias and differential item functioning was also essential to ensuring content validity. With very few exceptions, the results from calculating proportions of participants who chose each response choice indicated that each item presented participants with four viable, positively-worded options. These analyses showed significant improvement from the pilot study with only a little room for future improvement.

The construct validity evaluations were similarly strong. Perhaps the most revealing were the relationships between overall scores for the four ideologies. Bivariate correlations revealed no significant, positive relationships. This suggested that no pair were correlated enough to justify combining them. The four ideologies represented distinct dimensions, which only had significant negative correlations between pairs with one traditional and one progressive ideology supporting existing theory. The results of the principle component analysis revealed that the eight aspects could be considered distinct constructs as they showed independent (orthogonal) structure. Some properties were shared within each of the four ideologies including SAI, SEI, LCI, and SRI. Teachers' philosophies about Evaluation demonstrated the most independence from other aspects as shown in Table 17 with the results from PCA. As the questions for each aspect were separate and the results were approximately independent it is possible to consider the MTPI as eight different scales of teachers' curriculum philosophies that could be measured independently supporting the structure of the Theoretical Framework. The MTPI appeared to cover the necessary components of teachers' curriculum philosophies with results that gave evidence of the intended structure for the original constructs. Once the validity had been evaluated, it was necessary to assess the reliability of the scores for the inventory.

Reliability was assessed through internal consistency and temporal stability. The internal consistency showed significant improvement over the pilot study in the analysis between each item and the aspect that it was intended to measure. All correlations were positive and significant with only seven of the 192 correlations less that 0.3, which indicated that these items should be revised or eliminated to improve the reliability of the

inventory. All of the items showed significant correlations, however, indicating a high internal consistency.

The temporal stability was assessed by calculating the change in scores from one administration to another with a subsample of teachers. The scores were relatively stable having an average change between 4.6 and 6.1 out of 24. DeVillis (2003) stated that at least three confounding variables could contribute to a change in scores unrelated to the reliability of an instrument. He further argued that temporal stability should be considered an analysis of the construct and its measurement instead of just the latter. This was especially relevant in considering the more pronounced change for the aspect scores related to Evaluation, which changed slightly more than the other aspects. The results showed a general trend for this aspect away from SAI and SEI toward LCI. Both SAI and SEI place an emphasis on standardized or criteria-based testing, while LCI involves a greater emphasis on formative assessment and individualized assessment. The second administration of the inventory occurred closer to the state-mandated TAKS testing than the first one, during a potentially stressful preparation time for teachers. This possibly had a more dramatic effect on the Evaluation aspect than the others. Overall, the change in scores for each aspect was relatively low and the correlations between each item and the overall scores for each aspect were significant, suggesting that scores from the MTPI are reliable and conclusions based on data from this study can be expected in other samples of the same population.

Inventory improvements. As revealed in previous analysis, revisions to the MTPI could improve its reliability and validity, but other changes were also suggested through analysis of the data that could increase the usefulness of the MTPI. Suggested

changes beyond revisions to individual items included the addition of another aspect, shortening the length, and consideration of other item formats. In the qualitative analysis of teachers' reactions to the survey, teachers in both the pilot study and the main study suggested technology as an important part of their beliefs about education. Since technology is an important topic to many studies in mathematics education (Lawless & Pellegrino, 2007), a similar scale of measurement for teachers' philosophies about technology use could provide relevant insight for administrators and policy makers. Technology could be added as a ninth aspect to the inventory. It would not represent a missing dimension, or ideology, in relation to the other aspects, but an additional aspect for which teachers' philosophies could be measured. Similar principles to those in this study for each ideology could be applied to technology. This addition to the inventory would increase the need to reduce the number of items measuring the other aspects.

In their responses to the inventory, several teachers commented on the amount of time that this survey took to complete and the large number of questions. The length of the survey could have potentially discouraged participation and should be shortened if possible. As part of its development, more items were included than the researcher thought necessary in order to observe which questions were the most reliable, valid, and generally useful to the inventory. After such analysis, DeVillis (2003) suggested optimizing the length of an instrument as the final step in its development. Based on the reliability of each item, the least reliable item for each aspect was removed from the data set and new totals were calculated for each aspect. This was done to understand the amount of information lost with each removal.

The results showed that if the purpose of administering this survey to future teachers is to gain information about their overall philosophies then the inventory could be reduced by half with only three questions for each aspect and still share 77% of the information that was gained with the full inventory. As shown in Figure 14, the aspect totals had less opportunity to be reduced since removing more than one item from each aspect reduced the shared variance to less than 65% for the most affected aspect. Thus, the level of possible reduction is dependent on whether information about a teacher's total philosophy or about specific aspects is desired.

The third suggestion for future improvements to the MTPI is exploration of alternative formats. Some suggestions came from teachers during the qualitative analysis, emphasizing the difficulty of the format. Therefore, it would be worthwhile to explore other options that might be able to yield similar results without compromising the reliability and validity. The ipsative, forced-choice format was chosen to reduce the effects of social desirability and to simplify the choices. However, some teachers felt too restricted by the format and suggested related formats such as a ranking of the four statements. Ranking all four statements for each item would require more time, but it would provide more information and possibly decrease the frustration that some teachers felt. Conversely, it is possible that it would increase frustration because more comparisons and decisions about importance are needed in order to rank all of the statements. A ranking was one suggestion and other possible formats or modifications to the current format exist, which could be considered for future administrations. Additional aspects, a reduced number of items, and different formats are all considerations for future development of the MTPI.

Limitations of the MTPI. The MTPI was useful for gathering information about teachers' philosophies as compositions of four different ideologies, but conclusions from this study and specifically the data collected from the MTPI are restricted in some ways by the format and structure of the inventory. Since an ipsative format was used, it is important to remember that the teachers' philosophy results from the MTPI are quantitative compositions of four different ideologies, not just one overall score. Scores for all four ideologies must be interpreted together instead of individually because the scores measured each ideology in comparison to the other three. Each ideology score is dependent on the other three ideology scores. This fact also prevented responses from truly representing the "extreme" philosophies such as those where one ideology contains all of the points and the other three equal zero or indicating how strongly a teacher supports the composition of his or her philosophy.

Another fact about the MTPI that must be considered is that it was a self assessment about how each teacher perceived his or her philosophies. It was not an indication of how the teachers implement their philosophies or how the philosophies change since it is just one snapshot of teachers' philosophies. To study actual changes, a longitudinal study would be necessary. These limitations were mentioned earlier as decisions that were made during development of the MTPI about what would be measured. It was important to remember the purpose of the inventory as conclusions were drawn about what it could and could not measure. Some of these limitations were discovered through the use of the visualization tool developed as the second task for this study.

Visualization Tool

The visualization tool was created using the same structure as the inventory outlined in the Theoretical Framework. Compositional coordinates were utilized to place individual teachers' philosophies into a three dimensional space (Aitchison, 1982; Pamfilos, 2008). Then properties of teachers separated into interpretable regions were projected onto the surface of a cuboctahedron and a sphere in order to better understand the relationships between different compositions of ideologies for each of the aspects and also for the overall philosophies. The visualization began as a tetrahedron whose vertices represented the four different ideologies. Since the researcher was also considering the possibility that teachers' philosophies did not always cluster near a single ideology it was important to also be able to visualize combinations of the four ideologies. This was accomplished by having a geometric region to represent each combination, which included 14 pyramidal regions within the tetrahedron with a separate sphere in the center. Dissecting the space in this way allowed the researcher to also dissect the possible scores from the inventory into disjoint regions of similar philosophies. Through this process it was realized that the inventory did not allow for the extreme scores at the vertices of the tetrahedron as mentioned previously. Other properties discovered about the theoretical scores included a greater proportion of scores near the center of the tetrahedron and two natural figures to represent each possible combination of ideologies: a cuboctahedron with a sphere inside.

Beyond understanding the structure of the possible scores, the visualization tool was also useful during data analysis for two main purposes. It enabled the researcher to observe general properties for each region, which simplified the data without much loss

of information. The information that each teacher provided contributed to the colors and opacity of the region to which his or her philosophy belonged. As was seen with the results about each region, the distribution of data points and how attributes behave differently within each region, regions with unique characteristics could be identified through statistical testing and observation of descriptive statistics. However, understanding how each region related to the adjacent regions was difficult to observe without a visualization that projected values onto the surface of the cuboctahedron and permitted easy access to more information at the same time. These visualizations directly influenced the data analysis and exploration of relationships between teachers' philosophies and their experience.

Discussion of the Relationship Between Teachers' Experience and Philosophies

Initial results from this study revealed significant differences between each of the aspects measured and the overall philosophies as shown in the distribution of data points among the regions. Therefore, all analyses regarding the research question of the relationship between experience and philosophies were done with the overall philosophies and each of the aspects. These analyses combined descriptions of general properties, significance tests for each of the experience attributes, and regression equations predicting the region and distance from the center for a teacher's philosophy using their experience attributes. The following sections include a discussion of conclusions that were drawn for overall philosophies and philosophies about each of the aspects.

Overall philosophies. Teachers' curriculum philosophies can be interpreted many different ways as shown in Chapter 2, but in this study they were restricted to

philosophies related to eight aspects. The importance of looking at the overall philosophies instead of just the individual aspects was for information about general trends and for a broad perspective of how teachers approach education. The results showed that one third of the fifteen regions in the space of possible teacher philosophies were empty of data for this sample of teachers and another region only represented one teacher. By combining the aspect scores to get overall scores, the results ended up more polarized than each of the individual aspects. The empty regions had the SAI/SRI region at the center while the opposite region, SEI/LCI, was the densest region. About the Social Efficiency Ideology in recent years, Schiro (2008) claimed, "the ideology again began to reassert its influence on education with its views on accountability, efficiency, and the federal No Child Left Behind mandates" (p. 90). In a seemingly opposite view, the results also revealed strong support for the Learner Centered Ideology, which has been recently influential based on agendas to have more student-centered classrooms from the National Council of Teachers of Mathematics and other influential organizations. This study did not conclude that all teachers' philosophies are simply taken from current trends, but instead that current trends were observed in the overall philosophies for teachers in this study.

Exploration of the connections between teachers' overall philosophies and their experience utilized three different analyses: tests of independence, prediction of the region of a teacher's philosophies and prediction of the distance of the philosophy from a balanced philosophy. In the first set of analyses, three experience attributes of teachers were shown to be significantly different in at least two regions for overall philosophies. These were the number of years that teachers have taught, whether they currently taught

middle or high school and whether they had high school experience teaching. All other experience variables tested were not significant. Using the visualization tool, Figure 16 reveals how each of the three significant attributes displayed in the different regions. Actual proportions and averages are listed in Appendix Table K1.

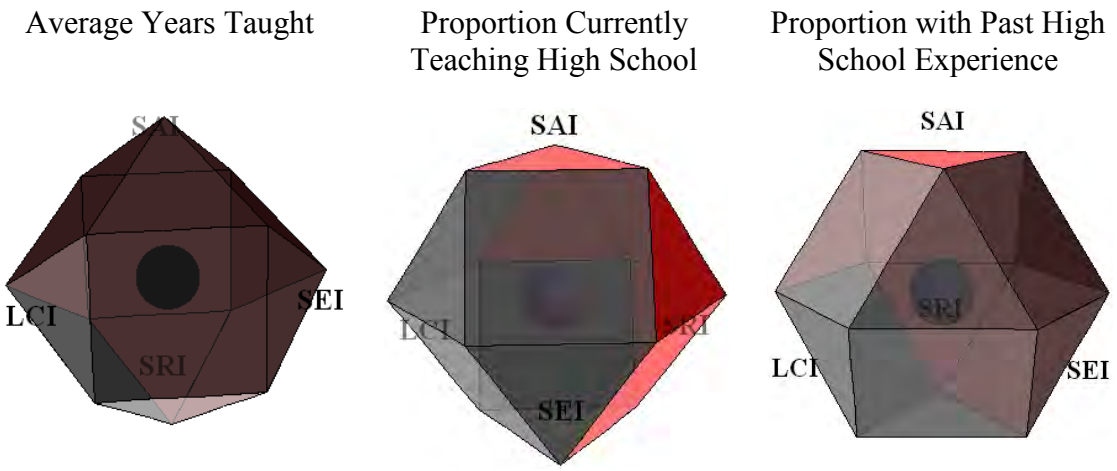


Figure 16. Averages and Proportions for Experience Attributes that Failed to Show Independence with Overall Philosophies. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher proportions or averages and are shown closest to the front.

The number of years that the teachers have taught had a significant relationship to the region where their overall philosophy was classified. According to the results and their portrayal in Figure 16, the highest averages for teaching experience were in the SAI/SEI and SAI/LCI regions while the lowest averages were in the Center and notSAI regions. This suggested that more experienced teachers tended to have an overall philosophy that included some composition of the SAI and SEI ideologies or the SAI and LCI ideologies. Unfortunately, not enough teacher philosophies were classified as just SAI to draw conclusions about whether SAI is really a key component of both of these areas. The fact that the notSAI region had one of the lowest averages for the number of

years teaching did suggest that teachers with more experience tended to have philosophies closer to the Scholar Academic Ideology, which supported the findings of Cheung and Wong (2002).

The other two significant experience variables in relation to teachers' overall philosophies had similar patterns in their visualizations. This is not surprising since the teachers who currently taught high school and the ones who had experience teaching high school probably overlapped significantly. With both variables, the SEI and SAI/SEI regions had the highest proportions and once again the SAI region did not have enough data to make any conclusions. The conclusion from this is that high school teachers tend to have philosophies that are more vocationally driven and concerned with preserving academic tradition than the other ideologies. This was a contradiction of Silvernail's (1992) that years of teaching experience had no significant relationship with teachers' philosophies.

The variable related to teachers' current teaching level, either middle or high school, reappeared in the prediction models. In the case of predicting the region of a philosophy, the results mirrored those already discussed about its significance. The logistic regression showed a significant increased chance for teachers' philosophies to be in the SEI and SAI/SEI regions if they were currently teaching high school. The multiple linear regression contained only one significant experience predictor and that was also the current teaching level. That analysis showed that teachers who currently taught high school usually had an overall philosophy closer to a balance of all of the ideologies than middle school teachers.

Another significant variable to the predictions of the composition of teachers overall philosophies was whether a teacher received initial certification through an alternative method. This attribute was revealed through analysis to significantly lessen the probability that a teacher's overall philosophy would agree with the Learner Centered Ideology. This variable did not result in a significant χ^2 test for independence at the 0.05 level, but it did have a p value less than 0.1 and was significant in the logistic regression analysis. Thus it might be a variable to still consider for future studies. Each of the variables that showed significance reflected a relationship between teachers' overall curriculum philosophies and their experience. This was further investigated for each individual aspect and similar types of conclusions were drawn.

Purpose of education. The ultimate goals for education and the purpose that it serves in society and to children were measured in the aspect of teachers' philosophies about the Purpose of Education including what teachers believed schools should be and do. Similar to the overall philosophies, the densest region of philosophies for this aspect was the SEI/LCI region. Adjacent regions were the next most populated while the five regions generally centered on the SAI/SRI region were empty or contained fewer than 3 data points, which is also similar to the overall philosophies. Of all of the aspects, the distribution of teachers' philosophies for this aspect most closely resembled those of the overall philosophies.

This aspect had only one significant experience variable related to the position of a teacher's philosophy about the purpose of education, which was whether a teacher currently taught middle school or high school. The proportions of teachers who taught high school are reflected in the visualization in Figure 17.

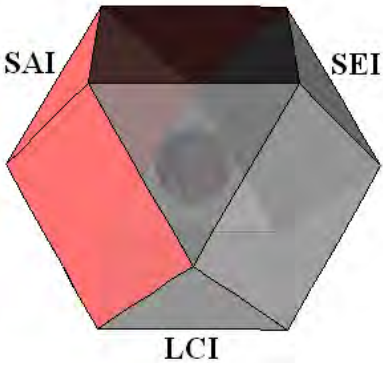


Figure 17. Proportions of Teachers who Currently Taught High School with Philosophies About the Purpose of Education. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher proportions and are shown closest to front. Actual proportions are listed in Appendix Table K1.

This attribute showed similar proportions to the analysis of the overall philosophies as demonstrated in Figure 17. The proportion of high school teachers was highest in the SAI/SEI region with the SEI region secondary. The SAI region did not contain enough data to make conclusions. Thus, from all of these results the researcher concluded that teachers who taught high school were more likely to think that schools should train students to be future productive members of society or that some combination of that ideology and the SAI, which claims that schools should pass on accumulated knowledge from one generation to the next. Again, this confirmed Cheung and Wong's (2002) results about teachers with 20 or more years of experience.

The teacher attribute about the current level taught was also significant in the logistic and multiple linear regression analysis for the Purpose of Education aspect. For the logistic regression, the number of years that a teacher had taught was also significant revealing an increase in the probability that a teacher's philosophy will be in the SEI

region with increased experience. Both of the previously mentioned attributes, the number of years taught and the current level, were also relevant in the prediction of how far from a balanced philosophy the teachers' philosophies about the Purpose of Education would be. This analysis revealed that teachers with more experience were predicted further from the center and teachers who currently taught high school were closer to a balanced philosophy. Through the many different analyses it seemed that only two attributes could be considered related to teachers' philosophies about the Purpose of Education: the number of years taught and the current teaching level.

View of mathematics. Two aspects related only to mathematics were included in this study. View of Mathematics was one of them and it pertained to how teachers viewed mathematics as a discipline. Teachers' philosophies about a View of Mathematics were relatively spread out among the different regions with no empty regions. The Center region was relatively dense, however, which led the researcher to conclude that teacher philosophies were more balanced in their View of Mathematics than in other aspects of their philosophies. Review of the sparse literature about this topic did not reveal any expectation in favor or against this conclusion.

In the χ^2 and ANOVA tests of independence none of the tested attributes had a significant relationship with the philosophies for this aspect. In the logistic regression analysis, if a teacher lacked certification to teach mathematics then the rise in probability for the SAI/SEI region was significant. This revealed that teachers without certification tended to agree with a combination of the Scholar Academic and Social Efficiency Ideologies as they pertained to their view of mathematics, which would include beliefs such as mathematics as structured pure knowledge and a useful set of truths and rules

(Ernest, 1991). Since this variable was not significant in the independence testing, this study was not conclusive about whether it is significantly related to teachers' philosophies about their view of mathematics.

Similarly, the number of years that teachers had taught at their current school, whether they had administrative experience and whether they had taken graduate courses in mathematics appeared significant in the multiple linear regression, but not in the independence testing. As the number of years that a teacher had been at their current school increased, so did the distance of their philosophy about how they viewed mathematics from a balanced philosophy. Administrative experience significantly increased the distance and graduate coursework in mathematics decreased it. It was not possible to determine the cause of such relationships, but one possibility regarding the number of years at their current school was that teachers who held to a more extreme philosophy tended to find and stay longer at a school where they were able to express that philosophy. Another explanation might be that the longer a teacher stays at a school, the more comfortable they feel and the more extreme they feel that their philosophy can be. A third speculation was less related to choices by the teachers and involved schools that emphasize more extreme practices possibly keeping teachers longer who agree with those philosophies about mathematics. These three ideas are only speculation and there could be other reasons for the significance of this variable in predicting the distance of teachers' philosophies about their view of mathematics. The significance of these results were that they identified possible teacher attributes related to experience, even ones that were not significant in the tests for independence, and described whether the linear relationship was directly or inversely related.

Purpose of mathematics. The second aspect of teachers' philosophies solely about mathematics regarded the purpose of mathematics and what the goals of mathematics curriculum should be. Teachers' philosophies for this aspect were similarly spread throughout the 15 regions. Only one region, SAI/SRI, was excluded from analysis due to insufficient data.

In analysis of teacher attributes that were significantly related to this aspect of teachers' philosophies, only one variable was found: the number of years that a teacher had taught. Figure 18 shows the average number of years taught in each region. The F-statistic which had a p-value less than 0.001 revealed that there were significant differences between at least two regions in the average years taught.

Figure 18. Averages of Years Taught with Philosophies About the Purpose of Mathematics. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher proportions and are shown closest to front. Actual averages are listed in Appendix Table K1.

The visualization made it obvious that the SAI, and to a lesser degree SRI, regions were the source of the significance. Teachers whose philosophies about the purpose of

mathematics fit in these two regions had higher averages for the number of years teaching experience than the other regions. Unfortunately the region between these two regions was the one eliminated from analysis for lack of sufficient data. If it could have been included then conclusions could have been drawn about whether it was just the two individual ideologies that attracted more experienced teachers or whether experienced teachers also had a combination of these two ideologies.

These patterns of relationships also appeared in the logistic regression analysis. For the prediction of probabilities for which region teachers' philosophies would be in, the number of years taught was the only one to show significance again. As the number of years taught increased so did the probability that a teacher's philosophy about the purpose of mathematics would be in the SAI, LCI, SRI, SEI/LCI, LCI/SRI, and notSRI regions. An interesting result of those relationships is that the greater the number of years that a teacher had taught, the more likely their philosophy would be in the SRI region, but the probability of being in the notSRI region also increased. This one variable seemed to have similar effects on opposite regions.

Several variables contributed to the prediction equation for the distance of a philosophy from the center. An increase in the number of years that a teacher had taught decreased the distance, as did graduate math coursework. As the number of years at their current school increased or number of different schools increased, so did the predicted distance from the center. This was also observed when teachers responded that they had left a position due to philosophy differences. All five of these variables were significant to how far philosophies about the purpose of education were from a balanced philosophy of the four ideologies. Since all of these variables except the number of years teaching

experience were not significant in the other analyses, it can be concluded that they only related to how unbalanced teachers' philosophies were without being specific to which ideologies. Thus for teachers' philosophies about the purpose of mathematics, the number of years teaching experience was definitely related along with four other possibilities: graduate coursework in mathematics, the number of years at the teachers' current school, the number of different schools, or having left a position due to differences in philosophies. Although Cheung and Wong (2002) did not specify different aspects of teachers' philosophies, support for their conclusions that more experienced teachers agreed with SAI came from several aspects in this study.

Teaching. The teaching aspect of teachers' philosophies focused on methods of teaching and scholarly attributes of teachers. For this aspect, the data points were spread relatively evenly throughout the 15 regions, which indicated no significant trends in the populations supporting one ideology or combination of ideologies over the others. All were represented except the SAI/LCI region, which contained no data points.

The other 14 regions were included in the tests for independence with the experience attributes and three variables related to experience were significant. Once again years of teaching experience was related to teachers' philosophies about teaching as well as administrative experience and formal mentoring experience. All three of these variables presumably relate to working with other teachers, whether through being an administrator, a mentor, or just as colleagues through years of experience. It is not surprising from that perspective that they would be related to philosophies about teaching. The averages and proportions for these variables in each region are shown in Figure 19.

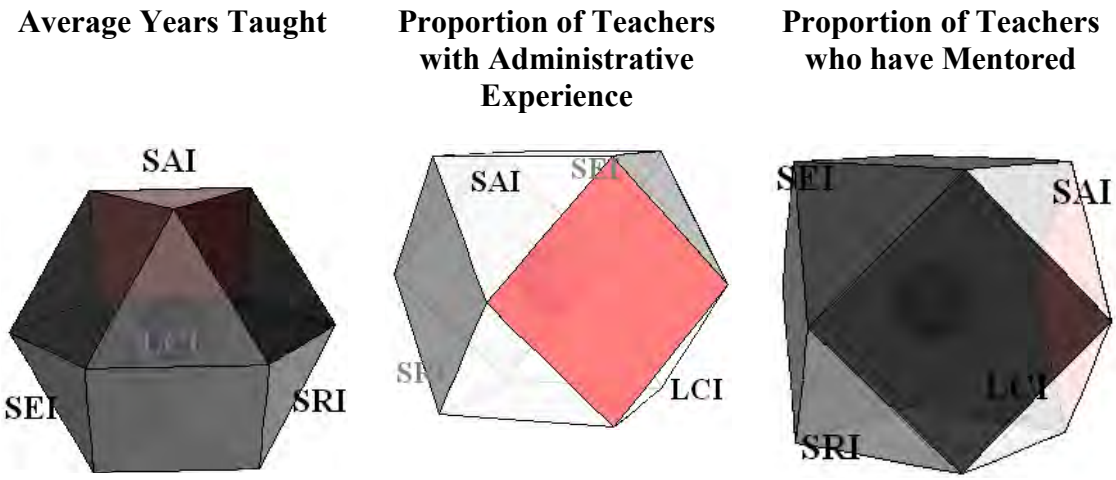


Figure 19. Averages and Proportions for Experience Attributes that Failed to Show Independence with Philosophies About Teaching. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher averages or proportions and are shown closest to front. Actual proportions and averages are listed in Appendix Table K1.

The average years of teaching experience for the SAI/SEI and SAI/SRI regions were significantly higher than other regions. The SAI region was not similarly elevated. Thus, it was not appropriate to just conclude that the overlapping ideology, SAI, was related.

The conclusions related to this observation were that more experienced teachers favored these combinations of ideologies, which would contribute to an overall philosophy appearing to follow the pattern of Cheung and Wong's (2002) research, which concluded that more experienced teachers favored SAI. Similar results were observed for the other two variables. The SAI/SRI region had a higher proportion of teachers with administrative experience and mentoring experience than the other regions. While the SAI/SEI region was not significant for administrative experience, it was related to mentoring experience. If both observations were combined it would suggest that

somehow having significant contact with other teachers increases the chances for a teacher to have a philosophy about teaching combining the Scholar Academic and Social Efficiency or Scholar Academic and Social Reconstruction Ideologies.

These three attributes were also significant in predicting how far a teacher's philosophy would be from a balanced philosophy. As years of teaching experience increased the distance from a balanced philosophy also increased. Administrative experience increased the distance while mentoring experience decreased it. The reasons for any of these relationships were unclear, but it is possible that by mentoring other teachers, the mentors often consider other ways of teaching in the process of having to guide teachers with different teaching styles from their own. This might help them see the benefits of other teaching philosophies and create more of a balance of different ideologies consistent with Schiro's (2008) theorized maturation of teaching philosophies detailed in Chapter 2.

There is very little overlap of experience attributes that were significant in the analysis just described and the logistic regression analysis. The same combinations of ideologies were observed as significant with other experience attributes. The number of years that teachers had taught at their current school and the number of schools that they had taught at previously both showed significant positive relationships with the probabilities for the SAI/SRI region. An increase in the number of schools taught at also increased the probabilities for the SAI/SEI and SEI/LCI regions. Finally, graduate work in education was a significant predictor of higher probabilities for two opposite regions, SEI and notSEI. From these observations, the researcher concluded that while these variables did not show significance in the other analyses for this aspect, they might be

related to teachers' philosophies about teaching and could be explored in future research. Years of teaching experience, administration experience, and formal mentoring experience are related in several ways to teachers' philosophies about teaching.

Learning. The measurement of teachers' philosophies about learning included ideas about how students learn best, the learning process, and students' roles in learning. Teachers' philosophies for this aspect were not as evenly distributed among the different regions as the last three aspects. The preferences seemed to center around the SEI/LCI region, while the opposite region, SAI/SRI, was eliminated with two other regions for not containing enough information for additional analysis. This would suggest a trend in the population similar to the overall philosophies of teachers that favors the Social Efficiency and Learner Centered Ideologies and combinations including them.

The experience attributes that showed significance related to this aspect of teachers' philosophies included two variables regarding time spent teaching. The total number of years teaching and the number of years at their current school were both significant in the ANOVA tests. As can be seen in Figure 20, the SAI, SRI and notSEI regions had the highest averages for both variables indicating that teachers with more experience and those who have been at their school longer had philosophies about learning that agreed with these ideologies. However, these observations were not conclusive because these three regions represented few teachers despite not being sparse enough to eliminate. The SAI, SRI, and notSEI regions included four, seven and three teachers, respectively. It was not possible to confidently conclude whether the few teachers with philosophies in these regions just happened to be more experienced

teachers or whether the more experienced teachers were the only ones with philosophies in these regions. This does suggest a relationship that can be explored in future studies.

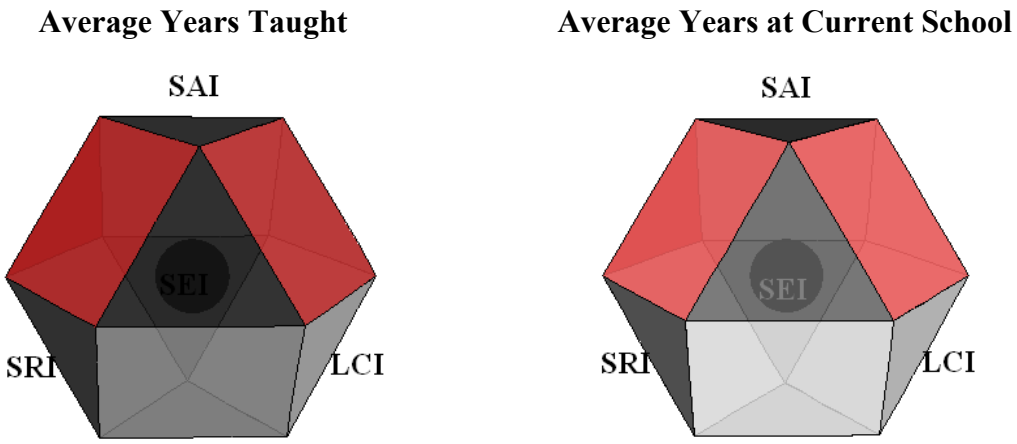


Figure 20. Averages for Experience Attributes that Failed to Show Independence with Philosophies About Learning. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher averages and are shown closest to front. Actual averages are listed in Appendix Table K1.

The logistic regression equations had similar limitations, but also supported the same suggestions as those just discussed for significant experience attributes. The only one significant variable used as a predictor of a region with more teachers' philosophies was the whether the teachers currently taught middle or high school. Teaching high school increased the probability of being in the SEI region, which was observed with other aspects as well. The variable was also significant to the prediction of the distance for philosophies about learning from the center.

Four experience attributes were included in the most significant prediction equation of the distances of philosophies from the center. The number of years taught was inversely related to the distance of philosophies about learning from a balance of all

ideologies. Teaching high school, experience teaching elementary school, and graduate coursework in mathematics each had positive coefficients in the regression equation suggesting that teachers with these attributes should have a philosophy farther from the center than teachers without them. This analysis did not depend on region classifications and thus was not limited by regions with few data points. These results conclusively put forward these four variables: years of teaching experience, currently teaching high school, experience teaching elementary school and graduate coursework in mathematics as attributes related to teachers' philosophies about learning. As was mentioned with other aspects, years of teaching experience was shown in studies such as the one by Cheung and Wong (2002) to be related to teachers' philosophies. The results from this study showing that experience at different levels of education was related to teachers' philosophies supports suggestions from smaller, qualitative studies such as one by Blake (2002).

Nature of knowledge. The aspect of teachers with the label "Nature of Knowledge" pertained to teachers' philosophies about what knowledge is of most worth. The totals for items measuring this aspect favored the notSRI region with LCI as secondary. The distribution of teachers' philosophies about the nature of knowledge showed a clear shift from the Social Reconstruction Ideology. The SRI region and all regions with a combination including SRI were eliminated for lack of sufficient data except the notSAI region, which included three data points, the minimum needed to not be eliminated. Thus, for all analyses with this aspect the experience attributes were tested with philosophies based on combinations of three ideologies instead of four.

There was only one variable, administrative experience that showed significance in the tests of independence. Figure 21 shows the proportions of teachers in each region with administrative experience. The SAI/LCI region was the region with a significantly higher proportion than the other regions. Only a small proportion of the entire sample had administrative experience, but the results showed that a more than expected proportion of those teachers' philosophies about the nature of knowledge were classified in the SAI/LCI region. These results could not be compared with the results from the logistic regression because none of the numerical predictors were significant and the prediction equation with only categorical predictors provided results that could not be interpreted in a meaningful way.

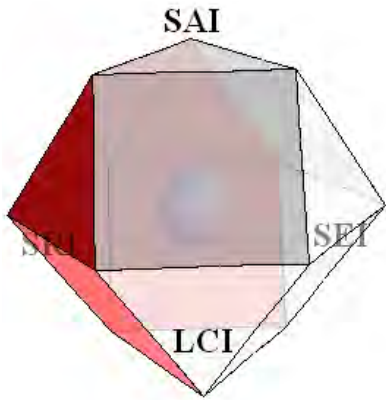


Figure 21. Proportions of Teachers with Administrative Experience with Philosophies About the Nature of Knowledge. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher proportions and are shown closest to front. Actual proportions are listed in Appendix Table K1.

The multiple linear regression analysis used to predict the distance from the center of teachers' philosophies about the nature of knowledge was more useful for

interpretation. Three experience attributes were significant. As the number of years of experience increased the distance of their philosophy from the center also increased. In contrast, as the number of years that teachers taught at their current school increased the distance from the center decreased. In fact, the coefficients for these two variables were equal in the prediction equation indicting that the number of years at their current school cancelled the effects of years of experience for the number of years at their current school.

The third variable significantly related to the distance of philosophies about the nature of knowledge was how initial certification was acquired. The teachers that obtained their certification through a university program were generally farther from the center than those who received their certification alternatively or did not have certification in mathematics, which supported claims from studies such as Bullough and Draper (2004) that suggested university certification programs might encourage more extreme philosophies. The aspect of teachers' philosophies related to the nature of knowledge had some interesting conclusions because of the general trend away from the Social Reconstruction Ideology, because administrative experience was overly represented in the SAI/LCI region and because of the three attributes that predicted how balanced the philosophies would be sometimes cancelled out each others' effects.

Nature of childhood. Childhood can be a time to explore natural curiosities, prepare for adulthood, develop intellectually, and practice influencing the world according to the four ideologies in relation to this aspect. The patterns of teachers' philosophy scores were different for this aspect than the other seven. The regions SAI and SAI/LCI were the densest regions for data points. In the other aspects, SAI was on

the sparse side when teachers' philosophies were unevenly distributed, but concerning the nature of children, teachers' generally identified more often with the Scholar Academic Ideology, which states that childhood is a time of intellectual development. Since SAI was central to this aspect it was not surprising that the number of years taught was significant as the relationship between these two was observed several times in this study and in another study done by Cheung and Wong (2002).

Figure 22 represents the average number of years of teaching experience for each region. The general trend observed for other aspects seemed to hold true with this aspect in that teachers with more experience tended to favor the Scholar Academic Ideology. Some of the regions such as SEI/LCI appeared to have more experienced teachers, but this region in particular only represents three teachers and it would not be appropriate to draw significant conclusions about the population from such a small sample. The logistic regression was not able to support these observations either.

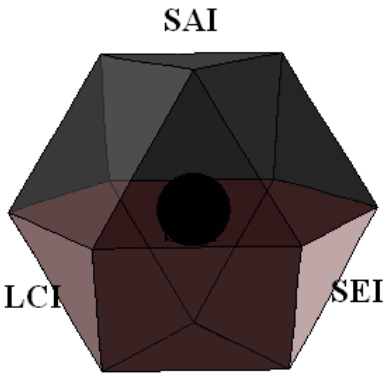


Figure 22. Averages of Years Taught with Philosophies About the Nature of Childhood. Red indicates a region that had two or fewer data points and was excluded from calculations. Darker regions reflect higher averages and are shown closest to front. Actual averages are listed in Appendix Table K1.

None of the experience variables were significant to any specific regions, but the number of years teaching was significant again for predicting the distance from the center of teachers' philosophies about the nature of childhood. The number of years taught was directly related to the distance of teachers' philosophies from a balanced philosophy. These observations all supported one conclusion, which was that teachers' philosophies about the nature of childhood were related to the number of years teaching experience.

Evaluation. In many of the analyses performed for this study, teachers' philosophies about evaluation were unique. In the principal component analysis, the evaluation scores always loaded on the same component. Evaluation was also specifically mentioned by teachers in the qualitative analysis. This indicated that the evaluation aspect might be different from the other aspects. The distribution of the teachers' philosophies about evaluation was evenly distributed among 14 of the 15 regions. One region, LCI, was significantly denser than the others suggesting some general trend in philosophies toward alternative and individual assessments.

None of the experience attributes were significant in the tests for independence, but for the logistic regression, as the number of schools that teachers had taught at increased, the probability of their philosophy fitting into the LCI, SAI/LCI, or LCI/SRI regions decreased significantly. This suggested that perhaps teaching at many schools is related inversely to having a philosophy about evaluation supporting LCI. There is nothing in the reviewed literature to explain the reason for this relationship, which makes it an excellent topic for further research.

This attribute was also significant in the prediction of how far a teaching philosophy would be from an equal balance of the four ideologies. As the number of

schools for a teacher increased, the distance from the center would decrease. Similarly, as the number of years at their current school increased, the distance from the center would also decrease. These two variables were the only significant experience attributes related to teachers' philosophies about evaluation.

Summary and Conclusions to Research Question

The research question for this study was whether any relationships exist between teachers' philosophies and their experience. The results for this study clearly revealed that relationships exist. However, exploration of those relationships showed that they were not easily defined. The conclusions from this study included observations about general trends in teachers' philosophies; descriptions about attributes of teachers related to experience that did, did not, or were not conclusively related to teachers' philosophies; and observations about the underlying hypothesis that teachers with more experience have a more balanced philosophy.

The general trends that were observed in teachers' philosophies were related to overall philosophies and each aspect that was measured. Three aspects did not reveal any special preferences for one or several ideologies. Teachers' philosophies for these aspects were evenly distributed among the different regions. For two of the aspects, Purpose of Education and Learning, and the overall philosophies, a tendency was observed for teachers to have philosophies aligned with the Social Efficiency or Learner Centered Ideologies, which supported current trends in education, as discussed previously. Teachers' philosophies about Evaluation showed support for only LCI. The Nature of Knowledge aspect revealed a different tendency that was also observed in the qualitative analysis, which was opposing the Social Reconstruction Ideology. The other

unique aspect in this regard was the Nature of Childhood, which showed significant promotion for the Scholar Academic Ideology. The Scholar Academic Ideology was also often connected with teachers who had more experience.

Years of teaching experience was the most obvious attribute that related to teachers' philosophies. It was significant to the regions of teachers' philosophies for half of the aspects and the overall philosophies. It was also significant in six aspects' predictions of the distance of philosophies from the center. Several other attributes including how many years teachers have taught at their current school, whether they taught middle or high school, administration experience, and formal mentoring experience were revealed to be significantly related to teachers' philosophies in several aspects. Of the 14 original attributes tested, four others showed possibilities for relationships with teachers' philosophies, but conclusive evidence could not be found in this study. Those four attributes were the number of schools that teachers have taught at, graduate coursework in education and mathematics, and how initial certification was obtained. These are important topics for future exploration and study.

As discussed in Chapter 2, the current literature about teachers' philosophies was controversial about whether a teacher exhibiting a balance of ideologies was inconsistent (Jackson, 1992; Schiro, 2008) or just agreed with a balance of the different ideologies (Cheung, 2000; Cheung & Wong, 2002; Blake (2002); Ostler, et al., 1998). Resolving this question was not the focus of this study, but relevant results were a natural part of the exploration and include the following: several teacher comments during the course of the qualitative analysis spoke of a balance of the different ideologies as important to education with a few exceptions and in doing the quantitative analysis using region

classifications, it was obvious that if teachers were restricted to just one ideology it would not adequately describe their philosophies. This led to a conclusion that teachers' philosophies do not focus entirely or even mostly on one ideology and tend to include combinations of the four ideologies rejecting the theories of Jackson (1992) and Schiro (2008) about the relationship between teachers' philosophies and social ideals. As far as experience being related to a balanced philosophy, no clear conclusions existed from observations and analysis of the data.

Limitations of the Study

Conclusions from this study were limited by the nature of the sampling protocol and analytic methods used. Data were collected using survey research methods and were limited to teachers' perceptions of themselves. Efforts were made through the format of the inventory to reduce bias attributable to social desirability, but the survey measured teachers' perceptions regarding their beliefs and philosophies rather than their actual implemented philosophies. Therefore, it is possible that results from the inventory do not match the actions of teachers in their classrooms and it would be inappropriate to draw conclusions about general trends of what is happening in Texas math classrooms based on this study.

This was also just a snapshot of teachers' philosophies, not a longitudinal study of them. Therefore, conclusions regarding causality are not suitable. For example, in this study the researcher concluded that the number of years that a teacher has taught is related to their philosophies, but it is not known whether that relationship exists because of how long teachers have taught, when they have taught or other reasons entirely. Even causation between experience attributes and teaching philosophies is not appropriate

because it was not shown whether the experience caused changes in the philosophies or that differences in philosophies guided experience.

Implications for Future Research

The tools developed for this study will be useful in the continued exploration of teachers' philosophies. The MTPI can be used to not only further investigate findings from this study, but it can be used in studies designed to better understand teachers' philosophies and how they relate to other attributes of teachers such as demographics or personalities. It can also be used as a tool to measure changes in teachers' philosophies for studies aimed at affecting change in the way that teachers teach by first effecting their beliefs about it. With all of these investigations, the visualization tool would also be useful in the exploration, classification and presentation of results. The visualization graphs are powerful tools for communicating results with teachers, administrators, policy makers, and others who might be interested in the development of teachers and their philosophies.

The motivating reasons for this study included better understanding of teachers' philosophies to inform policy makers, administrators, and teacher educators so that decisions about new teacher mentoring, professional development and curriculum could be more sensitive to differences in teaching philosophies and how they change with experience. Several opportunities for future research have already been mentioned as extensions of observations from this study. This study was mostly exploratory and all of the findings could be extended in future studies. Questions of causation and generalization to other populations would add significantly to the understanding of

teachers' philosophies. Teachers' stated philosophies also need to be explored in relation to their actual practices.

Longitudinal studies that can map teachers' philosophies over years or even the course of careers would be of great benefit to the study of when, how and why teachers' philosophies change. If teachers' philosophies can be better understood from the perspective of developing realistic philosophies, then teacher preparation programs and new teacher induction programs could more successfully guide new teachers in the development of their philosophies.

Mentoring programs could also benefit from more research about how teachers with different philosophies interact and how those interactions influence their philosophies. As a simple example, research about whether teachers with similar philosophies or different philosophies are more successful as mentors would help in decisions about how to match teachers with mentor teachers. There are many ways that the conclusions of this study could be extended through future research with the goal of helping improve the development of teachers while still being sensitive to individual philosophies.

APPENDIX A

Experience Questions Portion of Survey

In addition to the previous questions about your beliefs please answer a few questions about you and your experience as a teacher.

1. Gender

Male Female

2. What grade level do you currently teach? (Only select multiple grades if each one represents more than 30% of your students)

Grade: 5 6 7 8 9 10 11 12

3. What grade levels have you taught during your career as a teacher including this year?

Grade: 5 6 7 8 9 10 11 12

4. How many years have you taught as a full-time classroom teacher including this year? (Round to the nearest whole year)

Years _____

5. How many years have you taught at your current school as a full-time classroom teacher including this year? (Round to the nearest whole year)

Years _____

6. How many different schools have you taught at as a full-time classroom teacher including your current school?

Number of schools _____

7. Have you ever left a teaching position at a school due to differences in your beliefs with either the curriculum or administration?

Yes No

8. Have you ever been a school administrator?

Yes No

9. Have you ever taken graduate coursework in education?

Yes No

10. Have you ever taken graduate coursework in mathematics?

Yes No

11. Have you ever formally mentored a student teacher or new teacher?

Yes No

12. How did you obtain your initial mathematics certification?

Through a university program
Through an alternative certification program

You do not have certification in mathematics

Table A

Correlation Between the Reasons Given by Schiro (2008) for Teacher Philosophy Changes and the Survey Questions About Teaching Experience

	Reasons Reported by Schiro	Survey Questions
Demographic questions		1
Current and previous teaching assignments	1, 2	2, 3, 4, 5, 6
Conflicts with school situation and curriculum philosophies	1, 8	7
Administrative positions	4, 7	8
Graduate coursework	5	9, 10
Being mentored and mentoring	12	11, 12

APPENDIX B

Review Instrument of Math Teacher Philosophies

On this form I have listed phrases for each of my areas of teacher philosophies. Each phrase starts with the words in bold at the top of the list. Please try to classify each of the phrases as Scholar Academic (SAI), Social Efficiency (SEI), Learner Centered (LCI) or Social Reconstruction (SRI) according to Schiro's (2008) ideologies. Please use Schiro as a reference for any that you are unsure of. Many of the phrases will not be obvious, but if any are extremely difficult to classify please let me know by a check mark in the "Difficult" column. Also, if you have wording suggestions to make any of the items clearer, note that. One more thing, I would like your personal judgments on this. So please do not collaborate with others. Thank you so much for your help and if I can return the favor at anytime let me know.

Schools should…	SAI	SEI	LCI	SRI	Difficult
Envision a better society	☐	☐	☐	☐	☐
Manage accumulated knowledge	☐	☐	☐	☐	☐
Promote social interaction	☐	☐	☐	☐	☐
Have clear objectives	☐	☐	☐	☐	☐

APPENDIX C

Sample of Revised Mathematics Teacher Philosophy Inventory

		Schools should…
M	L	
▲	●	Manage accumulated knowledge
▲	●	Fulfill society's needs
▲	●	Be child-centered
▲	●	Help students see society's evils

INSTRUCTIONS:

1. Each box below contains four phrases. Carefully read each of the four phrases in the box. Circle the "▲" next to the phrase that MOST describes you as a teacher.
2. Circle the "●" next to the phrase that LEAST describes you as a teacher.
3. For each box, choose ONLY ONE MOST and ONLY ONE LEAST response.
4. These two sheets should be completed within FIFTEEN MINUTES, or as close to that as possible.

APPENDIX D

Initial Email to Teachers

Dear Teacher,

I am writing to ask for your participation in a survey that I am conducting for my dissertation as part of a doctoral program in Mathematics Education at Texas State. I am asking middle and high school math teachers like you to answer questions about your beliefs as a teacher and your teaching experience. Your responses to this survey are very important and will help in understanding how teachers' beliefs change as they gain experience.

This is a short survey and should take you about 20 minutes to complete. I have already received the approval of your administrators and they encourage your participation. Please click on the link below to go the survey website (or copy and paste the survey link into your Internet browser).

Survey Link:

Your participation is voluntary (you can withdraw at any time without penalty) and your responses are confidential. No personally identifiable information will be associated with your responses in any reports of this data. Should you have any further questions or comments, please feel free to contact me at jc1781@txstate.edu or 512-850-5766.

I appreciate your time and consideration in completing the survey. I hope that you enjoy taking it. Through help of teachers like you I think that we can make better decisions about teacher training and the math curriculum taught in schools.

Thank you,

Jill Cochran
Doctoral Student
Texas State University-San Marcos

Appendix E

Additional Pilot Test Results

Table E1
Counts for the Number of Teachers that Chose Each Response in Pilot Study

		M	L	M	L	M	L	M	L	M	L	M	L
Purpose of Education		**A1**	**A1**	**A2**	**A2**	**A3**	**A3**	**A4**	**A4**	**A5**	**A5**	**A6**	**A6**
	SAI	9	3	16	10	2	33	7	25	2	25	7	2
	SEI	3	15	24	5	38	2	24	1	25	2	35	0
	LCI	39	2	7	11	10	1	12	2	23	2	8	4
	SRI	0	31	4	25	1	15	8	23	1	22	1	45
View of Mathematics		**B1**	**B1**	**B2**	**B2**	**B3**	**B3**	**B4**	**B4**	**B5**	**B5**	**B6**	**B6**
	SAI	3	23	5	18	2	26	28	1	9	5	29	1
	SEI	0	21	33	2	42	0	1	29	12	2	18	5
	LCI	13	6	12	5	1	13	7	9	30	0	4	20
	SRI	35	1	1	26	6	12	15	12	0	44	0	25
Purpose of Mathematics		**C1**	**C1**	**C2**	**C2**	**C3**	**C3**	**C4**	**C4**	**C5**	**C5**	**C6**	**C6**
	SAI	8	0	22	0	7	11	6	9	3	10	15	8
	SEI	4	8	21	1	23	5	4	10	26	2	12	6
	LCI	7	18	7	12	19	10	5	32	22	3	14	15
	SRI	32	5	1	38	2	25	36	0	0	36	10	22
Teaching		**D1**	**D1**	**D2**	**D2**	**D3**	**D3**	**D4**	**D4**	**D5**	**D5**	**D6**	**D6**
	SAI	17	1	4	18	4	15	2	19	19	9	12	12
	SEI	2	21	36	2	0	35	35	0	24	0	3	26
	LCI	24	4	7	17	33	0	1	26	6	13	11	5
	SRI	8	25	4	14	14	1	13	6	2	29	25	8
Learning		**E1**	**E1**	**E2**	**E2**	**E3**	**E3**	**E4**	**E4**	**E5**	**E5**	**E6**	**E6**
	SAI	26	3	2	12	11	4	14	8	0	40	0	17
	SEI	5	15	6	3	13	6	4	19	18	3	45	2
	LCI	16	5	42	1	26	2	5	17	21	3	0	19
	SRI	4	28	1	35	1	39	28	7	12	5	6	13
Nature of Knowledge		**F1**	**F1**	**F2**	**F2**	**F3**	**F3**	**F4**	**F4**	**F5**	**F5**	**F6**	**F6**
	SAI	21	5	7	12	21	1	7	12	2	15	15	4
	SEI	9	11	25	7	17	5	11	12	0	24	24	2
	LCI	18	8	16	2	10	7	29	4	46	0	9	7
	SRI	3	27	3	30	3	38	4	23	3	12	3	38
Nature of Childhood		**G1**	**G1**	**G2**	**G2**	**G3**	**G3**	**G4**	**G4**	**G5**	**G5**	**G6**	**G6**
	SAI	33	3	31	3	8	14	25	1	14	6	31	0
	SEI	11	6	7	14	25	3	1	28	6	19	10	3
	LCI	6	19	11	3	13	12	20	5	29	0	10	5
	SRI	1	23	2	31	5	22	5	17	2	26	0	43
Evaluation		**H1**	**H1**	**H2**	**H2**	**H3**	**H3**	**H4**	**H4**	**H5**	**H5**	**H6**	**H6**
	SAI	12	7	2	26	16	4	11	16	13	12	15	10
	SEI	20	2	17	2	15	13	4	18	8	16	11	20
	LCI	17	3	13	9	12	13	10	7	18	11	18	13
	SRI	2	39	19	14	8	21	26	10	12	12	7	8

Note. The column headers specify the question. A1-H6 are the question numbers and M stands for the ideology that was picked for "most" and L for the ideology that was picked for "least."

Table E2

Correlations Between Items and Totals for the Corresponding Aspect of Philosophies in Pilot Study

		SAI		SEI		LCI		SRI	
Purpose of Education	**A1**	0.499	**	0.361	**	0.580	**	0.302	*
	A2	0.661	**	0.590	**	0.641	**	0.615	**
	A3	0.668	**	0.511	**	0.323	*	0.683	**
	A4	0.728	**	0.501	**	0.398	**	0.680	**
	A5	0.494	**	0.470	**	0.672	**	0.543	**
	A6	0.206		0.469	**	0.456	**	0.282	*
View of Mathematics	**B1**	0.535	**	0.369	**	0.560	**	0.086	
	B2	0.509	**	0.294	*	0.234		0.303	*
	B3	0.436	**	0.336	*	0.348	*	0.619	**
	B4	0.509	**	0.518	**	0.479	**	0.621	**
	B5	0.411	**	0.534	**	0.404	**	0.411	**
	B6	0.510	**	0.170		0.435	**	0.355	*
Purpose of Mathematics	**C1**	0.632	**	0.365	**	0.554	**	0.479	**
	C2	0.364	**	0.398	**	0.478	**	0.251	
	C3	0.550	**	0.604	**	0.700	**	0.506	**
	C4	0.323	*	0.349	*	0.499	**	0.153	
	C5	0.600	**	0.669	**	0.718	**	0.554	**
	C6	0.447	**	0.314	*	0.373	**	0.376	**
Teaching	**D1**	0.543	**	0.441	**	0.537	**	0.582	**
	D2	0.611	**	0.565	**	0.552	**	0.515	**
	D3	0.600	**	0.344	*	0.376	**	0.324	*
	D4	0.378	**	0.407	**	0.318	*	0.352	*
	D5	0.400	**	0.363	**	0.503	**	0.435	**
	D6	0.568	**	0.438	**	0.328	*	0.660	**
Learning	**E1**	0.314	*	0.317	*	0.322	*	0.419	**
	E2	0.669	**	0.360	**	0.273		0.506	**
	E3	0.447	**	0.508	**	0.592	**	0.450	**
	E4	0.560	**	0.534	**	0.493	**	0.593	**
	E5	0.287	*	0.535	**	0.561	**	0.367	**
	E6	0.452	**	0.505	**	0.134		0.619	**
Nature of Knowledge	**F1**	0.521	**	0.328	*	0.692	**	0.624	**
	F2	0.387	**	0.581	**	0.480	**	0.734	**
	F3	0.367	**	0.671	**	0.451	**	0.732	**
	F4	0.434	**	0.242		0.597	**	0.466	**
	F5	0.333	*	0.429	**	0.257		0.355	*
	F6	0.320	*	0.386	**	0.543	**	0.700	**
Nature of Childhood	**G1**	0.658	**	0.638	**	0.547	**	0.488	**
	G2	0.441	**	0.610	**	0.454	**	0.526	**
	G3	0.463	**	0.625	**	0.637	**	0.661	**
	G4	0.429	**	0.636	**	0.615	**	0.621	**
	G5	0.402	**	0.364	**	0.384	**	0.637	**
	G6	0.352	*	0.531	**	0.535	**	0.533	**
Evaluation	**H1**	0.508	**	0.428	**	0.465	**	0.183	
	H2	0.567	**	0.636	**	0.621	**	0.574	**
	H3	-0.012		0.623	**	0.149		0.563	**
	H4	0.504	**	0.457	**	0.491	**	0.594	**
	H5	0.548	**	0.431	**	0.519	**	0.365	**
	H6	0.389	**	0.460	**	0.487	**	0.393	**

**Correlations are significant at the 0.01 level (2-tailed).

*Correlations are significant at the 0.05 level (2-tailed).

APPENDIX F

Description of Each Ideology Given to Participants After Completion of the MTPI

Scholar Academic Ideology (SAI)

Schools should be communities where the accumulated knowledge of the culture is transmitted to the youth. Teachers should be knowledgeable people, transmitting that which is known to those who do not know it. Learning best occurs when the teacher clearly and accurately presents to the student that knowledge which the student is to acquire. The knowledge of most worth is the structured knowledge and ways of thinking that have come to be valued by the mathematicians over time. Childhood is essentially a period of intellectual development highlighted by growing reasoning ability and capacity for memory that results in an even greater absorption of mathematical knowledge. Mathematical evaluation should objectively determine the amount of knowledge students have acquired. It allows students to be ranked from those with the greatest intellectual gain to those with the least. Mathematics is a body of structured pure knowledge. The aim of mathematics classes is to transmit mathematical knowledge. (Ernest, 1991, p. 138-139; Schiro, 2008, p. 214-215)

Social Efficiency Ideology (SEI)

Schools should fulfill the needs of society by efficiently training youth to function as mature constructive members of society. Teachers should be supervisors of student learning, utilizing instructional strategies that will optimize student learning. Learning best occurs when the student is presented with the appropriate stimulus materials and positive reinforcement. The knowledge of most worth is the specific skills and capabilities for action that allow an individual to live a constructive life. Childhood is essentially a time of learning in preparation for adulthood, when one will be a constructive, contributing member of society. Mathematical evaluation should objectively indicate to others whether or not students can or cannot perform specific skills. Its purpose is to certify students' competence to perform specific tasks. Mathematics is a set of truths and rules, which are useful. The aim of mathematics classes is numerical fluency and training in useful mathematics to appropriate levels. (Ernest, 1991, p. 138-139; Schiro, 2008, p. 214-215)

Learner Centered Ideology (LCI)

Schools should be enjoyable, stimulating, child-centered environments organized around the developmental needs and interests of children as those needs and interests present themselves from day to day. Teachers should be aids to children, helping them learn by presenting them with experiences from which they can

make meaning. Learning best occurs when children are motivated to actively engage in experiences which allow them to create their own knowledge and understanding of the world. The knowledge of most worth is the personal meaning of oneself and of one's world that comes from one's direct experience in the world and one's personal response to such experience. Childhood is essentially a time when children unfold according to their own innate natures, felt needs, organic impulses, and internal timetables. The focus is on children as they are during childhood rather than as they might be as adults. Mathematical evaluation should continuously diagnose children's needs and growth so that further growth can be promoted by appropriate adjustment of their learning environment. It is primarily for the children's benefit, not for comparing children with each other or measuring them against predetermined standards. Mathematics is a personalized process of investigation. The aim of mathematics classes is creativity and self-realization through mathematics. (Ernest, 1991, p. 138-139; Schiro, 2008, p. 214-215)

Social Reconstruction Ideology (SRI)

Schools should provide children with the ability to perceive problems in society, envision a better society, and act to change society so that there is social justice and a better life for all people. Teachers should be companions to students, using the environment within which the student lives to help the student learn. Learning best occurs when a student confronts a real social crisis and participates in the construction of a solution to that crisis. The knowledge of most worth is a set of social ideals, a commitment to those ideals, and an understanding of how to implement those ideals. Childhood is essentially a time for practice in and preparation for acting upon society to improve both oneself and the nature of society. Mathematical evaluation should be a subjective comparison of students' performance with their capabilities. Its purpose is to indicate to both the students and others the extent to which they are living up to their capabilities. Mathematics is a tool for analyzing society and constructing changes. The aim of mathematics classes is promoting critical awareness and democratic citizenship through mathematics. (Ernest, 1991, p. 138-139; Schiro, 2008, p. 214-215)

APPENDIX G

Inequalities that Defined the 15 Regions within the Tetrahedron

Region		Defining Inequalities			
	Center	$x^2 + y^2 + z^2 \leq 0.0049$			
Vertices	SAI	$z \leq x + y$	$z \geq -x + y$	$z \geq x - y$	
	SEI	$z \leq -x - y$	$z \geq -x + y$	$z \geq x - y$	
	LCI	$z \leq -x - y$	$z \leq x + y$	$z \geq x - y$	
	SRI	$z \leq -x - y$	$z \leq x + y$	$z \geq -x + y$	
Faces	notSAI	$z \leq x - y$	$z \leq -x + y$	$z \geq x + y$	
	notSEI	$z \leq x - y$	$z \leq -x + y$	$z \geq -x - y$	
	notLCI	$z \leq x - y$	$z \geq x + y$	$z \geq -x - y$	
	notSRI	$z \leq -x + y$	$z \geq x + y$	$z \geq -x - y$	
Edges	SAI/SEI	$z \geq x + y$	$z \geq -x + y$	$z \geq x - y$	$z \geq -x - y$
	SAI/LCI	$y \geq x + z$	$y \geq -x + z$	$y \geq x - z$	$y \geq -x - z$
	SAI/SRI	$x \leq y + z$	$x \leq -y + z$	$x \leq y - z$	$x \leq -y - z$
	SEI/LCI	$x \leq y + z$	$x \leq -y + z$	$x \leq y - z$	$x \leq -y - z$
	SEI/SRI	$y \leq x + z$	$y \leq -x + z$	$y \leq x - z$	$y \leq -x - z$
	LCI/SRI	$z \leq x + y$	$z \leq -x + y$	$z \leq x - y$	$z \leq -x - y$

APPENDIX H

Additional Reliability and Validity Results

Table H1
Counts for the Number of Teachers that Chose Each Response

		M	L	M	L	M	L	M	L	M	L	M	L
Purpose of Education		**A1**	**A1**	**A2**	**A2**	**A3**	**A3**	**A4**	**A4**	**A5**	**A5**	**A6**	**A6**
	SAI	45	120	90	84	9	169	15	135	10	190	84	48
	SEI	56	140	156	57	245	2	139	15	137	15	160	6
	LCI	185	29	42	59	63	12	114	26	160	10	50	126
	SRI	36	33	34	122	5	139	54	146	15	107	28	142
View of Mathematics		**B1**	**B1**	**B2**	**B2**	**B3**	**B3**	**B4**	**B4**	**B5**	**B5**	**B6**	**B6**
	SAI	8	79	17	131	17	141	129	7	42	64	139	23
	SEI	3	221	116	34	278	4	11	207	76	16	144	52
	LCI	103	19	134	31	9	85	93	48	195	12	19	132
	SRI	208	3	55	126	18	92	89	60	9	230	20	115
Purpose of Mathematics		**C1**	**C1**	**C2**	**C2**	**C3**	**C3**	**C4**	**C4**	**C5**	**C5**	**C6**	**C6**
	SAI	41	141	128	7	42	93	21	98	17	73	63	68
	SEI	22	62	145	18	87	51	15	82	166	15	88	76
	LCI	49	83	45	54	149	26	15	138	123	23	80	76
	SRI	210	36	4	243	44	152	271	4	16	211	91	102
Teaching		**D1**	**D1**	**D2**	**D2**	**D3**	**D3**	**D4**	**D4**	**D5**	**D5**	**D6**	**D6**
	SAI	70	10	16	154	5	204	16	137	133	69	69	95
	SEI	15	178	214	9	45	83	210	4	113	31	35	116
	LCI	154	24	62	69	144	18	4	165	38	118	56	53
	SRI	83	110	30	90	128	17	92	16	38	104	162	58
Learning		**E1**	**E1**	**E2**	**E2**	**E3**	**E3**	**E4**	**E4**	**E5**	**E5**	**E6**	**E6**
	SAI	101	41	5	97	41	39	76	62	10	221	44	129
	SEI	53	100	114	24	93	18	28	117	70	50	171	17
	LCI	123	31	193	4	184	10	33	108	133	23	9	126
	SRI	45	150	10	197	4	255	185	35	109	28	98	50
Nature of Knowledge		**F1**	**F1**	**F2**	**F2**	**F3**	**F3**	**F4**	**F4**	**F5**	**F5**	**F6**	**F6**
	SAI	88	37	29	117	159	21	75	60	33	120	100	28
	SEI	63	60	178	20	107	37	57	73	15	80	103	39
	LCI	155	39	94	27	53	32	180	8	244	5	110	31
	SRI	16	186	21	158	3	232	10	181	30	117	9	224
Nature of Childhood		**G1**	**G1**	**G2**	**G2**	**G3**	**G3**	**G4**	**G4**	**G5**	**G5**	**G6**	**G6**
	SAI	233	4	176	12	62	73	166	6	60	27	210	5
	SEI	41	73	41	48	160	23	4	186	26	109	37	81
	LCI	34	135	99	29	73	69	134	10	220	10	47	80
	SRI	14	110	6	233	27	157	18	120	16	176	28	156
Evaluation		**H1**	**H1**	**H2**	**H2**	**H3**	**H3**	**H4**	**H4**	**H5**	**H5**	**H6**	**H6**
	SAI	82	62	12	171	136	38	58	124	81	103	83	87
	SEI	88	33	106	46	43	93	47	116	49	89	51	100
	LCI	142	35	90	39	91	90	73	27	133	52	131	82
	SRI	10	192	114	66	52	101	144	55	59	78	57	53

Note. The column headers specify the question. A1-H6 are the question numbers and M stands for the ideology that was picked for "most" and L for the ideology that was picked for "least."

Table H2

Correlations Between Items and Totals for the Corresponding Aspect

		SAI		SEI		LCI		SRI	
Purpose of Education	**A1**	0.533	**	0.384	**	0.546	**	0.257	**
	A2	0.562	**	0.592	**	0.563	**	0.627	**
	A3	0.559	**	0.493	**	0.463	**	0.661	**
	A4	0.524	**	0.475	**	0.515	**	0.662	**
	A5	0.473	**	0.446	**	0.476	**	0.474	**
	A6	0.434	**	0.299	**	0.427	**	0.626	**
View of Mathematics	**B1**	0.344	**	0.371	**	0.421	**	0.267	**
	B2	0.537	**	0.507	**	0.536	**	0.599	**
	B3	0.545	**	0.197	**	0.431	**	0.562	**
	B4	0.354	**	0.303	**	0.398	**	0.496	**
	B5	0.547	**	0.425	**	0.420	**	0.468	**
	B6	0.507	**	0.519	**	0.474	**	0.422	**
Purpose of Mathematics	**C1**	0.561	**	0.292	**	0.548	**	0.492	**
	C2	0.410	**	0.474	**	0.565	**	0.439	**
	C3	0.538	**	0.639	**	0.623	**	0.586	**
	C4	0.369	**	0.247	**	0.355	**	0.156	**
	C5	0.333	**	0.604	**	0.497	**	0.474	**
	C6	0.490	**	0.538	**	0.446	**	0.588	**
Teaching	**D1**	0.417	**	0.467	**	0.431	**	0.495	**
	D2	0.500	**	0.499	**	0.373	**	0.402	**
	D3	0.401	**	0.419	**	0.431	**	0.463	**
	D4	0.481	**	0.380	**	0.493	**	0.377	**
	D5	0.364	**	0.527	**	0.443	**	0.520	**
	D6	0.486	**	0.315	**	0.362	**	0.574	**
Learning	**E1**	0.595	**	0.495	**	0.445	**	0.519	**
	E2	0.561	**	0.317	**	0.348	**	0.608	**
	E3	0.481	**	0.470	**	0.448	**	0.436	**
	E4	0.491	**	0.413	**	0.419	**	0.602	**
	E5	0.244	**	0.571	**	0.397	**	0.474	**
	E6	0.553	**	0.423	**	0.354	**	0.560	**
Nature of Knowledge	**F1**	0.491	**	0.492	**	0.656	**	0.473	**
	F2	0.456	**	0.462	**	0.309	**	0.597	**
	F3	0.410	**	0.486	**	0.455	**	0.448	**
	F4	0.513	**	0.423	**	0.538	**	0.393	**
	F5	0.434	**	0.283	**	0.470	**	0.478	**
	F6	0.580	**	0.422	**	0.584	**	0.551	**
Nature of Childhood	**G1**	0.504	**	0.530	**	0.579	**	0.376	**
	G2	0.600	**	0.431	**	0.628	**	0.488	**
	G3	0.526	**	0.337	**	0.573	**	0.561	**
	G4	0.599	**	0.395	**	0.515	**	0.382	**
	G5	0.360	**	0.327	**	0.374	**	0.546	**
	G6	0.451	**	0.510	**	0.394	**	0.421	**
Evaluation	**H1**	0.505	**	0.453	**	0.581	**	0.430	**
	H2	0.313	**	0.561	**	0.480	**	0.467	**
	H3	0.400	**	0.463	**	0.452	**	0.442	**
	H4	0.540	**	0.422	**	0.387	**	0.498	**
	H5	0.446	**	0.381	**	0.486	**	0.353	**
	H6	0.548	**	0.462	**	0.621	**	0.295	**

**Correlations are significant at the 0.01 level (2-tailed).

Table H3
Order of Item Removal for Reduced Inventories

Purpose of Education	A1, A6, A5, A4, A3
View of Mathematics	B1, B4, B3, B5, B6
Purpose of Mathematics	C4, C2, C1, C5, C6
Teaching	D3, D4, D6, D2, D1
Learning	E5, E2, E3, E6, E4
Nature of Knowledge	F5, F3, F2, F4, F1
Nature of Childhood	G5, G6, G4, G1, G3
Evaluation	H5, H3, H2, H4, H1

APPENDIX I

Logistic Regression Equations for Each Aspect

Table I1

Logistic Regression Equations for Log Odds of Philosophies about the Purpose of Education Being Located in a Region

	Intercept	Years Teaching	Current Level=HS	Mentor
SAI	-	-	-	-
SEI	0.165	0.094*	-0.449	0.867
LCI	-0.304	0.086	-1.123	1.151
SRI	0.981	-0.317	-1.416	-0.065
not SAI	0.036	0.081	-0.803	1.086
not SEI	-	-	-	-
not LCI	-	-	-	-
not SRI	-0.395	0.118	-0.923	1.662
SAI/SEI	-3.399	0.100	1.557	1.590
SAI/LCI	-	-	-	-
SAI/SRI	-	-	-	-
SEI/LCI	1.181	0.086	-1.333	0.886
SEI/SRI	-3.351	0.093	0.373	3.228
LCI/SRI	-1.210	0.002	-0.756	1.434

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	807.835			
	Final	811.849	58.985	27	< 0.001
Effect	Intercept	811.8	0.000	0	
	Years Teaching	829.826	17.976	9	0.035
	Current Level	836.166	24.316	9	0.004
	Mentor	828.978	17.129	9	0.047

* p < 0.05 ** p < 0.01 *** p < 0.005 **** p < 0.001

Table I2

Logistic Regression Equations for Log Odds of Philosophies about the View of Mathematics Being Located in a Region

	Intercept	Years at Current School	Certification=Alternative	Certification=None	Past Elementary Experience
SAI	-1.622	-0.017	0.425	-16.744	-0.275
SEI	-2.173*	-0.004	0.557	1.675	-1.004
LCI	-0.509	0.027	-0.336	0.287	-0.007
SRI	-19.470****	0.042	0.208	-16.101	-
not SAI	-0.911	0.020	-0.841	1.395	-0.113
not SEI	-21.104	0.092	0.788	-15.487	-
not LCI	-2.572*	0.016	0.470	-16.602	-0.815
not SRI	-0.878	0.039	-0.188	1.482	-0.311
SAI/SEI	-3.536***	-0.025	1.026	3.109***	-1.683
SAI/LCI	-18.816****	-0.007	-17.512	1.041	-
SAI/SRI	-19.079****	-0.219	0.189	-	-
SEI/LCI	-2.650*	-0.021	0.684	1.271	-1.451
SEI/SRI	-1.271	-0.266	0.978	-16.506	0.302
LCI/SRI	-17.960****	-0.093	-0.259	-15.951	-

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	914.632			
	Final	830.786	83.846	56	0.009
Effect	Intercept	830.8	0.000	0	
	Years at Current School	849.879	19.093	14	0.161
	Certification	870.343	39.557	28	0.072
	Past Elementary Experience	852.616	21.829	14	0.082

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

Table I3

Logistic Regression Equations for Log Odds of Philosophies about the Purpose of Mathematics Being Located in a Region

	Intercept	Years Teaching
SAI	-4.622****	0.155****
SEI	-0.209	0.025
LCI	-0.889*	0.054*
SRI	-2.615****	0.087**
not SAI	-1.158**	0.046
not SEI	-1.799*8	-0.024
not LCI	-1.195*	0.017
not SRI	-1.774****	0.071**
SAI/SEI	-0.879*	0.034
SAI/LCI	-2.678****	0.050
SAI/SRI	-	-
SEI/LCI	-1.681****	0.060*
SEI/SRI	-1.020*	0.007
LCI/SRI	-1.369***	0.057*

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	798.718			
	Final	768.930	29.788	13	0.005
Effect	Intercept	845.952	77.022	13	<0.001
	Years Teaching	798.718	29.788	13	0.005

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

Table I4

Logistic Regression Equations for Log Odds of Philosophies about Teaching Being Located in a Region

	Intercept	Years at Current School	Number of Schools	Graduate Education	Mentor	Administration	Past HS Experience
SAI	-6.049	0.094	-0.117	1.209	-9.078	-	6.931
SEI	-0.062	-0.010	0.179	1.072*	-0.513	-	-0.093
LCI	-1.361	-0.100	0.366	-0.214	0.091	-	-0.184
SRI	15.107	-0.039	0.174	0.085	-0.763	15.037	0.283
not SAI	-0.178	-0.006	0.172	0.232	-0.525	-	0.584
not SEI	-5.492	0.001	-1.236	2.998*	-8.861	-	-1.221
not LCI	16.058	0.031	-0.245	-0.711	0.0696	17.530	0.125
not SRI	16.391	-0.024	0.067	0.525	-0.051	16.893	1.092
SAI/SEI	-2.951**	0.070	0.446*	0.489	-1.008	-	0.035
SAI/LCI	-	-	-	-	-	-	-
SAI/SRI	13.083	0.111*	0.536*	0.142	0.025	17.795	-0.283
SEI/LCI	-0.943	-0.020	0.325*	-0.197	-0.179	-0.108	-0.355
SEI/SRI	15.844	-0.032	0.210	0.683	-0.422	16.015	0.143
LCI/SRI	14.938	0.029	-0.099	0.713	-1.606*	16.412	-1.131

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	1385			
	Final	1250	135.051	78	< 0.001
Effect	Intercept	1250	0.000	0	
	Years at Current School	1272	21.882	13	0.057
	Number of Schools	1275	24.547	13	0.026
	Graduate Education	1268	18.195	13	0.150
	Mentor	1281	30.718	13	0.064
	Past HS Experience	1270	20.437	13	0.085

* p < 0.05 ** p < 0.01 *** p < 0.005 **** p < 0.001

Table I5

Logistic Regression Equations for Log Odds of Philosophies about Learning Being Located in a Region

	Intercept	Years at Current School	Number of School	Current Level	Mentor
SAI	-6.766****	0.166*	0.410	1.087	-1.736
SEI	-2.366**	0.042	0.212	1.433*	-0.423
LCI	-0.012	-0.020	0.015	-0.149	-0.639
SRI	-4.439***	0.095	0.153	2.073	-0.099
not SAI	-0.084	0.016	0.017	0.126	0.223
notSEI	-5.532*	0.096	0.688*	-0.394	-
not LCI	-	-	-	-	-
not SRI	-0.702	0.013	0.230	0.570	-0.354
SAI/SEI	-2.248*	0.032	0.168	0.390	-0.913
SAI/LCI	-	-	-	-	-
SAI/SRI	-	-	-	-	-
SEI/LCI	0.622	-0.038	-0.071	0.677	0.279
SEI/SRI	-0.264	-0.195	-0.051	0.170	1.801
LCI/SRI	0.060	-0.017	-0.011	0.421	0.302

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	1178			
	Final	1112	66.666	44	0.015
Effect	Intercept	1112	0.000	0	
	Years at Current School	1135	22.774	11	0.019
	Number of Schools	1129	17.135	11	0.104
	Current Level	1127	15.677	11	0.154
	Mentor	1127	14.925	11	0.186
	District Type	1263	94.879	77	0.082
	Current Level	1186	18.315	11	0.075

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

Table I6

Logistic Regression Equations for Log Odds of Philosophies about the Nature of Knowledge Being Located in a Region

	Intercept	Current Level=HS	Past HS Experience	Gender=F
SAI	17.005****	-17.122****	34.827	0.872
SEI	17.106****	-18.085****	17.611****	-0.009
LCI	18.165****	-17.617****	17.696****	1.560*
SRI	-	-	-	-
not SAI	15.956****	-18.340****	18.205****	0.798
not SEI	-	-	-	-
not LCI	-	-	-	-
not SRI	18.418****	-16.795****	17.238****	1.149
SAI/SEI	-1.750	0.650	0.704	2.215*
SAI/LCI	17.133****	-17.187****	18.036	1.099
SAI/SRI	-	-	-	-
SEI/LCI	16.397****	-16.203****	-	1.674*
SEI/SRI	-	-	-	-
LCI/SRI	-	-	-	-

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	162.507			
	Final	115.557	46.950	24	0.003
Effect	Intercept	115.6	0.000	0	
	Current Level	132.088	16.532	8	0.035
	Past HS Experience	135.969	20.413	8	0.009
	Gender	127.322	11.766	8	0.162

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

Table I7

Logistic Regression Equations for Log Odds of Philosophies about the Nature of Childhood Being Located in a Region

	Intercept	Years Teaching	Current Level=HS	Gender=F	Graduate Education
SAI	1.184	0.038	0.009	0.341	0.294
SEI	-1.059	-0.184	1.911	1.266	1.127
LCI	0.537	0.005	-0.588	-0.285	-0.365
SRI	-	-	-	-	-
not SAI	-	-	-	-	-
not SEI	-1.644	0.021	0.509	0.517	19.086
not LCI	-19.750****	-0.050	1.230	-	-0.041
not SRI	1.093	0.063	-0.682	0.049	0.653
SAI/SEI	-1.749	0.066	0.733	0.190	-0.867
SAI/LCI	1.207	0.019	-0.031	1.015	0.475
SAI/SRI	-19.720****	-0.070	-	1.136	-0.007
SEI/LCI	-2.361	0.077	-1.050	-0.385	-0.633
SEI/SRI	-	-	-	-	-
LCI/SRI	-	-	-	-	-

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	935.414			
	Final	864.044	71.370	40	0.002
Effect	Intercept	864.0	0.000	0	
	Years Teaching	888.404	24.360	10	0.007
	Current Level	883.903	19.859	10	0.031
	Gender	880.665	16.622	10	0.083
	Graduate Education	879.869	15.825	10	0.105

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.005$ **** $p < 0.001$

Table I8

Logistic Regression Equations for Log Odds of Philosophies about Evaluation Being Located in a Region

	Intercept	Number of Schools	Past MS Experience	Certification=Alternative	Certification=None
SAI	-0.932	-0.096	0.421	1.091	1.262
SEI	-0.194	-0.141	0.351	-0.546	-
LCI	1.384***	-0.246*	0.367	-0.349	0.432
SRI	-1.492	-0.081	-1.019	-18.543	1.499
not SAI	-1.120	0.023	-0.163	-0.613	1.722
not SEI	0.333	-0.311	-0.668	-1.708	-
not LCI	-0.367	-0.115	0.282	-0.455	0.733
not SRI	-0.156	-0.146	-0.275	-0.312	1.902
SAI/SEI	-0.036	-0.198	-0.477	-0.090	-17.627
SAI/LCI	0.883	-0.598*	1.895	-1.469	-18.053
SAI/SRI	-2.724*	0.077	-0.741	0.986	2.371
SEI/LCI	-0.280	-0.181	1.371	0.719	-
SEI/SRI	-1.934	0.012	17.888	-17.987	2.028
LCI/SRI	1.662****	-0.433***	0.944	-0.646	1.350

		-2 Log Likelihood	χ^2	*df*	*p*
Model	Intercept Only	649.880			
	Final	569.174	80.706	56	0.017
Effect	Intercept	569.2	0.000	0	
	Number of Schools	589.585	20.410	14	0.118
	Past MS Experience	589.992	20.817	14	0.106
	Certification	614.326	45.817	28	0.021

APPENDIX J

Component Loading Pattern and Structure Matrices After Rotation

Table J1
Pattern Matrix for PCA with 32 Aspect Totals Reduced to 13 Components

		Component												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Purpose of Education	SAI	**.052**	.255	.133	**.035**	**.127**	.177	.169	.843	**.079**	**.064**	**.209**	**.112**	.048
	SEI	.228	**.169**	.282	.131	**.124**	.244	.176	**.442**	**.193**	.111	.049	**.153**	.111
	LCI	.186	**.335**	**.137**	**.061**	.249	**.227**	**.108**	.358	.071	**.041**	.144	.032	**.093**
	SRI	**.298**	.188	**.236**	**.019**	.004	**.170**	**.211**	**.759**	.171	.007	.034	.203	**.055**
View of Mathematics	SAI	.816	.106	.127	**.240**	**.093**	**.063**	**.175**	**.069**	**.162**	**.146**	.350	.003	**.034**
	SEI	.174	**.318**	**.209**	.243	.171	.205	.183	**.040**	.161	.092	.435	.148	**.009**
	LCI	.046	.050	.018	**.008**	.132	.242	**.224**	.182	**.003**	.122	**.958**	**.084**	.075
	SRI	**.954**	.104	.028	.044	**.170**	**.327**	.229	**.072**	.030	**.048**	.210	**.043**	**.030**
Purpose of Mathematics	SAI	.368	.163	**.295**	.384	**.215**	**.074**	**.084**	.131	**.025**	**.032**	**.044**	**.010**	**.078**
	SEI	**.094**	.038	.143	.764	**.034**	**.011**	.048	**.029**	.094	**.060**	.000	**.035**	**.055**
	LCI	.138	**.098**	**.029**	**.952**	.035	**.072**	.197	.047	.112	**.048**	**.049**	**.069**	**.024**
	SRI	**.397**	**.084**	.166	**.085**	.196	.155	**.178**	**.144**	**.188**	.138	.093	.117	.151
Teaching	SAI	**.004**	.088	**.086**	.063	**.825**	**.032**	.150	.062	**.019**	**.055**	.065	**.036**	.193
	SEI	**.288**	**.210**	.037	**.105**	**.005**	.157	.806	.135	.072	**.030**	.196	**.087**	**.208**
	LCI	.112	.379	**.066**	**.040**	.890	**.127**	.199	.000	**.094**	.140	**.070**	.191	.192
	SRI	.148	**.214**	.098	.064	**.015**	.003	**.956**	**.165**	.034	**.043**	**.160**	**.054**	**.153**
Learning	SAI	**.039**	.867	.121	.036	.064	**.167**	.024	.079	.109	**.052**	**.138**	.001	**.106**
	SEI	.240	.330	**.072**	.005	.132	.500	.059	**.105**	.080	**.082**	.194	**.291**	**.098**
	LCI	**.143**	**.377**	.187	.154	.028	**.313**	**.165**	.196	.030	.079	.237	**.106**	.379
	SRI	**.063**	**.764**	**.179**	**.145**	**.185**	**.045**	.048	**.122**	**.182**	.057	**.209**	.315	**.096**
Nature of Knowledge	SAI	.234	.088	.078	**.146**	**.401**	**.004**	**.067**	.096	.206	.202	.170	.169	.055
	SEI	**.194**	**.044**	**.136**	.038	.141	.156	**.003**	**.025**	**.039**	.923	**.048**	**.300**	**.187**
	LCI	.135	**.167**	.110	.049	.246	**.304**	.118	**.200**	.123	**.293**	**.268**	**.126**	.084
	SRI	**.208**	.122	**.070**	.069	.039	.175	**.048**	.130	**.312**	**.783**	.144	.235	.031
Nature of Childhood	SAI	**.109**	.222	.071	**.028**	**.060**	**.218**	.000	**.104**	.955	.141	.037	**.236**	.084
	SEI	.135	**.174**	.069	.039	**.064**	.868	.059	.189	**.140**	.060	**.215**	**.048**	.080
	LCI	**.013**	.043	**.208**	**.023**	.015	**.392**	**.035**	.067	**.635**	.101	.051	**.521**	**.122**
	SRI	.006	**.122**	.104	.020	.101	**.103**	**.013**	**.139**	**.125**	**.315**	.096	.884	**.018**
Evaluation	SAI	**.076**	.121	.762	**.002**	.013	.109	**.154**	.133	.140	**.086**	**.013**	**.093**	**.327**
	SEI	.118	.127	.318	.125	.069	**.205**	.163	**.005**	**.169**	.203	.044	.383	**.439**
	LCI	**.023**	**.167**	**.834**	**.083**	**.026**	.016	**.023**	**.141**	**.069**	.053	.058	**.249**	**.007**
	SRI	**.010**	**.067**	**.174**	**.028**	**.056**	.075	.032	.029	.106	**.186**	**.106**	.009	.860

Note. Rotation converged in 19 iterations with Promax rotation. Bold numbers represent negative component loadings. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

Table J2

Structure Matrix for PCA with 32 Aspect Totals Reduced to 13 Components

		Component												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Purpose of Education	SAI	.248	.344	.080	.183	**.316**	.113	.137	.701	.139	.122	**.010**	**.002**	**.143**
	SEI	.254	.079	.565	.257	**.156**	.287	.441	**.538**	**.237**	.208	.032	**.240**	.119
	LCI	.065	**.478**	**.348**	**.087**	.368	**.391**	**.268**	.472	.181	**.196**	.078	**.075**	**.035**
	SRI	**.501**	.025	**.231**	**.308**	.107	**.001**	**.256**	**.645**	**.097**	**.114**	**.084**	.262	.071
View of Mathematics	SAI	.677	.281	.211	.009	**.254**	**.008**	.030	.089	**.031**	.056	.302	**.078**	**.051**
	SEI	.182	**.112**	**.126**	.370	.165	.283	.192	.130	.270	.127	.478	.110	**.086**
	LCI	**.004**	**.102**	**.070**	**.115**	.063	**.088**	**.135**	.014	.010	**.056**	**.820**	**.104**	.093
	SRI	**.783**	**.083**	**.036**	**.195**	.052	**.134**	**.055**	**.200**	**.194**	**.103**	.094	.083	.031
Purpose of Mathematics	SAI	.550	.320	**.185**	.504	**.369**	**.025**	.125	.357	.214	.095	.015	**.002**	**.218**
	SEI	.246	.155	.240	.788	**.164**	.155	.333	.059	.207	.078	.085	**.114**	**.174**
	LCI	**.120**	**.260**	**.134**	**.850**	.163	**.258**	**.106**	**.072**	.000	**.226**	**.225**	**.074**	.039
	SRI	**.621**	.171	.081	**.328**	.329	.147	**.326**	**.312**	**.400**	.077	.143	.192	.330
Teaching	SAI	.274	.425	.126	.209	**.806**	.078	.212	.121	.066	.215	.047	.087	**.031**
	SEI	**.033**	**.062**	.166	.144	.007	.238	.671	**.016**	.140	**.008**	.150	**.113**	**.323**
	LCI	**.038**	.047	**.146**	**.067**	.696	**.126**	.123	**.091**	**.244**	.045	**.020**	.131	.361
	SRI	**.178**	**.354**	**.126**	**.245**	.118	**.160**	**.836**	**.017**	.029	**.216**	**.148**	**.090**	**.004**
Learning	SAI	.230	.777	.153	.169	**.343**	.108	.191	.110	.108	.149	**.024**	.131	**.207**
	SEI	.310	.444	.102	.253	**.082**	.619	.249	**.072**	.182	.008	.329	**.205**	**.233**
	LCI	**.158**	**.505**	.053	.004	.282	**.416**	**.289**	**.190**	**.081**	**.002**	.150	**.178**	.462
	SRI	**.346**	**.689**	**.256**	**.360**	.167	**.311**	**.167**	**.172**	**.187**	**.136**	**.358**	.181	.045
Nature of Knowledge	SAI	.362	.404	.175	.071	**.589**	.153	.024	.268	.278	.439	.246	.303	**.109**
	SEI	**.067**	.088	.079	.116	**.033**	.219	.067	.008	**.058**	.743	.120	**.025**	**.108**
	LCI	.074	**.473**	.016	.038	.398	**.476**	.141	.264	.028	**.487**	**.480**	**.419**	.162
	SRI	**.400**	**.020**	**.279**	**.146**	.245	.126	**.236**	**.019**	**.272**	**.664**	.125	.139	.049
Nature of Childhood	SAI	.211	.119	.072	.140	.201	**.026**	.080	.134	.843	.085	.006	**.159**	**.141**
	SEI	.134	.164	.205	.204	**.154**	.723	.181	.022	.025	.176	.047	.015	**.059**
	LCI	**.064**	**.188**	**.150**	**.138**	.191	**.520**	**.098**	**.027**	**.630**	**.108**	**.106**	**.503**	.114
	SRI	.262	.054	.084	.168	.125	**.024**	**.131**	**.127**	**.164**	**.121**	.073	.727	.066
Evaluation	SAI	.107	.196	.689	.129	.240	.262	.082	.051	.192	.076	.099	**.125**	**.380**
	SEI	.261	.347	.384	.267	**.283**	.049	.356	.049	**.058**	.417	.113	.350	**.404**
	LCI	**.218**	**.312**	**.791**	**.224**	.281	**.166**	**.254**	**.024**	**.057**	**.263**	**.063**	**.160**	.056
	SRI	**.130**	**.207**	**.216**	**.155**	.228	**.147**	**.157**	**.081**	**.089**	**.206**	**.157**	**.031**	.805

Note. Rotation converged in 19 iterations with Promax rotation. Bold numbers represent negative component loadings. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

Table J3

Pattern Matrix for PCA with 32 Aspect Totals Reduced to 11 Components

	Component										
	1	2	3	4	5	6	7	8	9	10	11
edSAI	.155	.108	.859	-.104	.031	.040	.204	-.097	.163	-.103	-.075
edSEI	.048	.279	-.431	.268	.171	.080	-.282	.175	.240	-.192	-.019
edLCI	-.582	-.125	.375	.136	-.105	.064	-.035	-.039	-.203	.058	.091
edSRI	.321	-.221	-.798	-.239	-.077	-.159	.065	-.016	-.174	.204	.008
mathSAI	.046	.123	-.055	.988	-.231	-.098	.045	-.103	-.037	-.193	-.030
mathSEI	-.369	-.176	-.039	.123	.250	.369	.191	.060	.173	.230	.149
mathLCI	.198	.044	.298	-.249	-.091	-.545	-.267	.168	.205	.069	.169
mathSRI	.065	-.018	-.193	-.804	.106	.305	.054	-.104	-.292	-.064	-.246
mgoalSAI	.154	-.193	.287	.251	.346	-.121	.119	-.007	-.096	.009	-.057
mgoalSEI	-.060	.171	.078	-.199	.788	.092	-.203	-.034	-.008	.120	-.048
mgoalLCI	.065	-.045	-.025	.217	-1.019	.155	-.128	.000	-.068	.059	.001
mgoalSRI	-.154	.060	-.316	-.270	-.002	-.142	.223	.039	.168	-.189	.098
teachSAI	.339	-.030	.067	.032	.141	-.064	.249	-.025	-.078	-.050	-.479
teachSEI	-.017	.110	.172	-.326	-.144	.872	-.149	-.015	.133	.087	-.032
teachLCI	.177	-.107	-.062	.096	.006	.071	-.189	.099	-.095	-.106	.947
teachSRI	-.425	.024	-.148	.161	-.009	-.720	.063	-.047	.037	.059	-.339
learnSAI	.759	.108	.107	.027	.060	-.058	.069	-.060	-.143	.063	.139
learnSEI	.302	-.164	-.070	.308	.003	.246	.057	-.094	.504	.085	-.026
learnLCI	-.680	.058	.042	-.053	.312	-.152	-.163	.093	-.258	-.100	-.027
learnSRI	-.431	.000	-.066	-.241	-.278	-.045	.008	.064	-.108	-.055	-.081
knowSAI	.139	.118	.045	.288	-.087	-.134	.473	.200	-.042	.207	-.195
knowSEI	-.084	-.099	-.044	-.238	.038	.031	.444	.885	.157	-.075	.109
knowLCI	-.151	.102	-.120	.035	-.010	.035	-.894	-.160	-.265	.084	.182
knowSRI	.089	-.139	.120	-.120	.067	.077	.008	-.884	.173	-.238	-.084
childSAI	.070	-.024	-.151	-.124	.013	.070	-.230	.249	-.197	.841	-.164
childSEI	.033	.046	.220	.012	.049	-.008	.243	.012	.792	-.011	-.064
childLCI	-.089	-.217	.112	.115	-.037	.003	-.206	.122	-.300	-.793	-.046
childSRI	.001	.232	-.171	-.016	-.015	-.068	.256	-.406	-.162	.058	.279
evalSAI	-.046	.695	.136	.023	-.005	.045	-.109	-.069	.149	.126	-.285
evalSEI	.164	.511	.083	.102	.053	.170	.223	.181	-.218	-.085	.185
evalLCI	-.078	-.808	-.087	-.091	-.171	.065	.104	.040	.005	-.077	-.051
evalSRI	-.024	-.338	-.137	-.022	.165	-.316	-.244	-.165	.056	.042	.195

Note. Rotation converged in 33 iterations with Promax rotation. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

Table J4

Structure Matrix for PCA with 32 Aspect Totals Reduced to 11 Components

	Component										
	1	2	3	4	5	6	7	8	9	10	11
edSAI	.341	.088	.750	.212	.199	.076	.082	.149	.005	.166	-.192
edSEI	.221	.383	-.362	.236	.318	.295	-.247	.344	.461	-.251	-.163
edLCI	-.563	-.343	.328	.051	-.197	-.097	-.031	-.152	-.339	.144	.184
edSRI	-.014	-.095	-.708	-.439	-.277	-.228	.149	-.290	-.083	-.080	.155
mathSAI	.203	.109	.146	.770	.160	.134	.062	.087	-.074	.047	-.207
mathSEI	-.237	-.107	-.021	.284	.373	.471	.254	.009	.154	.292	.162
mathLCI	.100	-.066	.281	-.307	-.292	-.629	-.436	.166	.187	.000	.092
mathSRI	-.098	.043	-.382	-.671	-.177	.083	.144	-.243	-.226	-.276	-.018
mgoalSAI	.341	-.172	.494	.529	.501	.101	.066	.189	-.166	.260	-.252
mgoalSEI	.222	.190	.162	.246	.740	.328	-.078	.205	.120	.189	-.183
mgoalLCI	-.182	-.139	-.045	-.183	-.853	-.191	-.186	-.127	-.143	-.044	.066
mgoalSRI	-.338	.124	-.568	-.535	-.275	-.209	.214	-.239	.189	-.378	.341
teachSAI	.520	.095	.223	.312	.334	.126	.164	.195	-.118	.105	-.575
teachSEI	.083	.184	.035	-.034	.094	.719	-.059	.128	.214	.052	-.065
teachLCI	-.106	-.136	-.120	-.120	-.078	-.008	-.055	-.109	-.003	-.171	.814
teachSRI	-.431	-.122	-.123	-.143	-.302	-.694	-.048	-.185	-.072	.008	-.120
learnSAI	.752	.223	.265	.252	.280	.094	.128	.127	-.106	.179	-.121
learnSEI	.410	.021	.024	.448	.368	.426	.009	.141	.507	.188	-.168
learnLCI	-.591	-.136	-.011	-.126	-.008	-.192	-.131	-.035	-.245	-.130	.099
learnSRI	-.577	-.116	-.245	-.501	-.544	-.298	-.027	-.203	-.152	-.220	.175
knowSAI	.327	.231	.229	.434	.213	.097	.413	.236	-.121	.370	-.307
knowSEI	.051	.104	-.035	-.066	.133	.151	.195	.664	.201	-.105	.007
knowLCI	-.240	-.157	-.035	-.115	-.205	-.160	-.721	-.074	-.103	-.069	.121
knowSRI	-.147	-.181	-.176	-.282	-.139	-.079	.128	-.803	.048	-.224	.195
childSAI	.207	-.038	.239	.234	.162	.108	-.165	.311	-.129	.774	-.331
childSEI	.185	.195	.071	.119	.220	.145	.072	.156	.725	.066	-.069
childLCI	-.131	-.304	.037	-.077	-.156	-.109	-.345	.137	-.277	-.739	-.067
childSRI	-.227	.214	-.351	-.258	-.184	-.115	.500	-.616	-.199	-.005	.477
evalSAI	.234	.675	.097	.166	.158	.171	-.021	.181	.222	.160	-.343
evalSEI	.322	.591	.075	.237	.275	.343	.357	.226	-.131	.016	.016
evalLCI	-.312	-.788	-.066	-.203	-.289	-.143	-.084	-.157	-.124	-.125	.092
evalSRI	-.226	-.426	-.110	-.191	-.116	-.386	-.254	-.255	.040	-.045	.265

Note. Rotation converged in 33 iterations with Promax rotation. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

Table J5

Pattern Matrix for PCA with 32 Aspect Totals Reduced to Eight Components

	Component							
	1	2	3	4	5	6	7	8
edSAI	.445	-.124	-.423	-.002	-.106	.151	.025	-.024
edSEI	-.047	.596	.312	.341	-.047	.043	.247	-.181
edLCI	.384	-.553	.229	-.143	.289	-.031	-.075	.069
edSRI	-.722	.117	-.050	-.151	-.113	-.152	-.159	.111
mathSAI	.610	.052	-.060	.336	.072	-.273	-.235	-.211
mathSEI	.121	.137	.179	-.120	.706	.160	-.001	.168
mathLCI	.020	.146	.068	-.189	-.666	-.230	.159	.064
mathSRI	-.694	-.293	-.148	-.048	-.011	.346	.076	.007
mgoalSAI	.533	.042	-.425	-.214	.113	-.080	.014	.003
mgoalSEI	.162	.314	-.045	-.037	.273	.201	.200	.129
mgoalLCI	-.031	-.424	.289	.201	-.395	.034	-.255	.083
mgoalSRI	-.618	.108	.131	.020	.050	-.158	.065	-.217
teachSAI	.117	.022	-.635	.046	-.118	-.078	.100	.047
teachSEI	-.074	.000	.266	.208	.225	.759	.050	.152
teachLCI	.047	.148	.389	-.163	.087	.244	-.224	-.356
teachSRI	-.080	-.141	.010	-.077	-.155	-.757	.057	.128
learnSAI	.133	.166	-.509	.098	-.269	.142	-.179	-.020
learnSEI	.170	.617	-.009	-.060	.133	.124	-.106	.085
learnLCI	.096	-.338	.275	-.062	.228	-.163	.229	-.066
learnSRI	-.326	-.416	.257	.008	-.036	-.110	.081	-.006
knowSAI	.168	-.071	-.515	.263	.099	-.231	.047	.184
knowSEI	-.210	.127	-.177	.048	.069	.009	.712	-.118
knowLCI	.187	-.075	.695	-.030	-.267	.174	-.112	.083
knowSRI	-.176	.033	-.008	-.294	.108	.058	-.606	-.172
childSAI	.099	-.056	-.005	-.003	-.011	.081	.089	.807
childSEI	-.021	.616	-.003	-.011	.049	-.064	.127	.040
childLCI	.233	-.279	.034	-.127	-.274	.043	.259	-.693
childSRI	-.350	-.173	-.031	.158	.283	-.076	-.502	-.068
evalSAI	.028	.102	.028	.630	-.101	.046	.082	.212
evalSEI	.058	-.081	-.243	.577	.138	.204	.055	-.166
evalLCI	-.056	-.155	.006	-.683	.047	-.049	-.004	-.049
evalSRI	-.025	.164	.222	-.491	-.090	-.212	-.149	-.007

Note. Rotation converged in 24 iterations with Promax rotation. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

Table J6

Structure Matrix for PCA with 32 Aspect Totals Reduced to Eight Components

	Component							
	1	2	3	4	5	6	7	8
edSAI	.507	.080	-.482	.076	-.108	.289	.062	.143
edSEI	.018	.588	.111	.416	.034	.091	.246	-.133
edLCI	.242	-.569	.323	-.302	.190	-.183	.008	.027
edSRI	-.711	-.057	.087	-.147	-.091	-.190	-.266	-.051
mathSAI	.536	.195	-.164	.380	.109	-.208	-.185	-.070
mathSEI	.135	.177	.027	-.034	.663	.103	.091	.133
mathLCI	.062	-.014	.182	-.227	-.655	-.158	.115	.101
mathSRI	-.674	-.313	-.035	-.123	-.022	.262	-.003	-.132
mgoalSAI	.585	.177	-.457	-.065	.116	.079	.064	.165
mgoalSEI	.282	.415	-.230	.112	.281	.286	.258	.205
mgoalLCI	-.132	-.468	.358	-.020	-.455	-.102	-.260	.013
mgoalSRI	-.677	-.070	.266	-.027	.104	-.243	-.033	-.366
teachSAI	.241	.207	-.642	.200	-.056	.119	.072	.189
teachSEI	.004	.154	-.006	.191	.162	.680	.127	.132
teachLCI	-.084	.023	.354	-.225	.040	.138	-.202	-.417
teachSRI	-.143	-.324	.268	-.145	-.118	-.776	-.001	.070
learnSAI	.240	.357	-.619	.248	-.231	.328	-.197	.123
learnSEI	.281	.673	-.250	.148	.149	.247	-.061	.167
learnLCI	-.014	-.433	.413	-.205	.199	-.296	.255	-.130
learnSRI	-.433	-.561	.455	-.193	-.063	-.281	.042	-.153
knowSAI	.269	.152	-.559	.392	.163	-.087	.046	.303
knowSEI	-.093	.152	-.140	.113	.156	.093	.670	-.071
knowLCI	.097	-.222	.651	-.222	-.365	.017	-.048	.021
knowSRI	-.301	-.074	.050	-.294	.059	-.012	-.633	-.279
childSAI	.288	.052	-.146	.052	-.070	.122	.166	.835
childSEI	.097	.606	-.152	.170	.108	.059	.127	.098
childLCI	.073	-.366	.238	-.282	-.265	.009	.225	-.646
childSRI	-.466	-.176	.012	.119	.280	-.189	-.543	-.202
evalSAI	.138	.299	-.186	.662	-.048	.097	.100	.288
evalSEI	.098	.192	-.401	.619	.202	.255	.058	-.073
evalLCI	-.134	-.369	.235	-.732	-.023	-.106	-.016	-.136
evalSRI	-.096	-.088	.352	-.512	-.133	-.253	-.159	-.084

Note. Rotation converged in 24 iterations with Promax rotation. Light and dark gray highlighting represents significant positive and negative component loadings, respectively.

APPENDIX K

Averages and Proportions by Region for Each Significant Experience Attribute

	Center	SAI	SEI	LCI	SRI	not SAI	not SEI	not LCI	not SRI	SAI/ SEI	SAI/ LCI	SAI/ SRI	SEI/ LCI	SEI/ SRI	LCI/ SRI
Purpose of Education															
Counts	*15*	*1*	*59*	*26*	*3*	*38*	*1*	*1*	*53*	*12*	*0*	*0*	*94*	*13*	*6*
Current Level=HS	0.667	0	0.593	0.423	0.333	0.5	0	1	0.491	0.917	0	0	0.372	0.769	0.5
Purpose of Mathematics															
Counts	*46*	*8*	*50*	*38*	*12*	*26*	*6*	*17*	*21*	*29*	*6*	*1*	*19*	*18*	*25*
Years Taught	10.8	27.3	12.8	15.6	19.3	14.8	9.3	12.2	17.5	13.7	15.2	6.0	16.2	11.4	16.0
Teaching															
Counts	*33*	*6*	*34*	*14*	*49*	*47*	*4*	*9*	*13*	*13*	*0*	*8*	*39*	*31*	*22*
Years Taught	13.2	12.2	16.4	14.1	11.1	13.7	7.0	15.1	14.4	20.5		23.1	16.3	14.4	11.9
Administration	0	0	0	0	0.020	0	0	0.111	0.154	0		0.250	0	0.065	0.045
Mentor	0.667	0	0.618	0.643	0.469	0.574	0	0.778	0.692	0.615		0.875	0.641	0.613	0.364
Learning															
Counts	*36*	*4*	*23*	*42*	*7*	*38*	*3*	*2*	*56*	*14*	*2*	*2*	*53*	*5*	*35*
Years Taught	13.5	23.3	18.0	10.6	23.1	14.9	23.0	25.5	15.5	14.3	14.0	18.0	12.4	13.4	13.1
Current School	7.6	18.3	9.5	5.9	15.6	8.7	11.3	19.0	7.5	7.9	2.5	4.0	6.5	4.4	7.3
Nature of Knowledge															
Counts	*13*	*13*	*8*	*75*	*0*	*3*	*2*	*0*	*123*	*12*	*21*	*1*	*50*	*0*	*1*
Administration	0	0.077	0	0.013		0	0.50		0.008	0.083	0.143	0	0.020		0
Nature of Childhood															
Counts	*15*	*85*	*6*	*22*	*0*	*0*	*3*	*6*	*59*	*20*	*100*	*3*	*3*	*0*	*0*
Years Taught	10.9	14.9	5.3	10.6			16.3	9.0	17.4	16.8	13.6	7.7	16.7		
Overall Philosophies															
Counts	*13*	*0*	*10*	*46*	*0*	*6*	*0*	*1*	*78*	*30*	*10*	*0*	*106*	*0*	*22*
Years Taught	7.9		15.3	11.7		5.3		10.0	15.8	17.0	16.8		15.1		11.2
Current Level=HS	0.385		0.800	0.283		0.333		1	0.603	0.767	0.400		0.443		0.545
HS Experience	0.615		0.800	0.457		0.333		1.000	0.731	0.867	0.400		0.623		0.636

Note. Values for Years Taught and Years at Current School are averages for that region. All others are proportions.

REFERENCES

Adler, J., Ball, D., Krainer, K., Lin, F., & Novotna, J. (2005). Reflections on an emerging field: Researching mathematics teacher education. *Educational Studies in Mathematics, 60*, 359-381.

Agresti, A. & Finlay, B. (2009). *Statistical methods for the social sciences* (4th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Aitchison, J. (1982). The statistical analysis of compositional data. *Journal of the Royal Statistical Society: Series B (Methodological), 44*(2), 139-177.

American Educational Research Association (AERA), American Psychological Association (APA), and the National Council on Measurement in Education (NCME) (1999). Standards for educational and psychological testing. Washington, DC: American Physiological Association.

Andrews, P., & Hatch, G. (1999). A new look at secondary teachers' conceptions of mathematics and its teaching. *British Educational Research Journal, 25*(2), 203-223.

Andrews, P., & Hatch, G. (2000). A comparison of Hungarian and English teachers' conceptions of mathematics and its teaching. *Educational Studies in Mathematics, 43*(1), 31-64.

Barrett, J., Jones, G., Mooney, E., Thornton, C., Cady, J., Guinee, P., & Olson, J. (2002). Working with novice teachers: Challenges for professional development. *Mathematics Teacher Education and Development, 4*, 15.

Barrett Paterson, V. U. (2009). Teachers' beliefs and practices in relation to reform oriented mathematics teaching. *Dissertation Abstracts International: Section A. Humanities and Social Sciences, 70*(9), 236.

Benken, B. M. (2004). An investigation of two beginning secondary mathematics teachers: Unpacking the complex relationship between beliefs and practice. (Doctoral dissertation, University of Michigan, 2004). *Dissertation Abstracts International, 65,* 3732.

Berger, M., Pansu, P., Berry, J., & Saint-Raymond, X. (1982). *Problems in geometry* (S. Levy Trans.). New York: Springer-Verlag.

Black, J. H. (1978). The multicandidate calculus of voting: Application to Canadian federal elections. *American Journal of Political Science, 22*(3), 609-638.

Blake, R. W. (2002). *An enactment of science*. New York, NY: Peter Lang Publishing.

Bowen, C., Martin, B. A. & Hunt, S. T. (2002). A comparison of ipsative and normative approaches for ability to control faking in personality questionnaires. *The International Journal of Organizational Analysis, 10*(3), 240-259.

Brandell, J. L. (2005). Mentoring beginning high school mathematics and science teachers. (Doctoral dissertation, Wayne State University, 2005). *Dissertation Abstracts International, 66,* 874.

Bullough, R. V., Jr., & Draper, R. J. (2004). Making sense of a failed triad: Mentors, university supervisors, and positioning theory. *Journal of Teacher Education, 55*(5), 407.

Campbell, D. T. & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81-105.

Cattell, R. B. (1944). Psychological measurement: Normative, ipsative, interactive. *Psychological Review, 51*(5), 292-303.

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245-276.

Cheung, D. (2000). Measuring teachers' meta-orientations to curriculum: Application of hierarchical confirmatory factor analysis. *The Journal of Experimental Education, 68*(2), 149-165.

Cheung, D., & Wong, H. (2002). Measuring teacher beliefs about alternative curriculum designs. *Curriculum Journal, 13*(2), 225-248.

Cohen, R. J. & Swerdlik, M. E. (2005). *Psychological testing and assessment* (6th ed.). Boston, MA: McGraw Hill.

Cooney, T. J., Shealy, B. E., & Arvold, B. (1998). Conceptualizing belief structures of pre-service secondary mathematics teachers. *Journal for Research in Mathematics Education, 29*(3), 306-333.

Costigan, A. (2004). Finding a name for what they want: A study of New York City's teaching fellows. *Teaching and Teacher Education, 20*(2), 129-143.

DeVillis, R. F. (2003). *Scale development: Theory and applications. Applied social research methods series.* Thousand Oaks, CA: Sage.

Dillman, D. A., Smyth, J. D., Christian, L, M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Eisner, E. W. (1992). Curriculum ideologies. In P. W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 302-326). New York: MacMillan.

Eisner, E. W. & Vallance, E. (Eds.). (1974). *Series on contemporary education issues: Conflicting conceptions of curriculum.* Berkeley, CA: McCutchan.

English, L. D., Jones, G., Bussi, M. B., Lesh, R. A., Tirosh, D., & Sriraman, B. (2008). Moving forward in international mathematics education research. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed., pp. 862-888). New York: Routledge.

Ennis, C., & Hooper, L. M. (1988). Development of an instrument for assessing educational value orientations. *Journal of Curriculum Studies, 20*, 277-280.

Ennis, C., Mueller, L. K., & Hooper, L. M. (1990). The influence of teacher value orientations on curriculum planning within the parameters of a theoretical framework. *Research Quarterly for Exercise and Sport, 61*, 360-368.

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

Ertmer, P. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25-39.

Friedrichsen, P., Chval, K. B., & Teuscher, D. (2007). Strategies and sources of support for beginning teachers of science and mathematics. *School Science and Mathematics, 107*(5), 169-181.

Frykholm, J. (2004). Teachers' tolerance for discomfort: Implications for curricular reform in mathematics. *Journal of Curriculum and Supervision, 19*(2), 125-149.

Gallagher, J. J. (1994). Teaching and learning: New models. *Annual Reviews Psychology, 45*, 171-195.

Goldin, G. (2008). Moving forward in international mathematics education research. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed., pp. 862-888). New York: Routledge.

Gregg, J. L. (1992). The acculturation of a beginning high school mathematics teacher into the school mathematics tradition. (Doctoral dissertation, Purdue University, 1992). *Dissertation Abstracts International, 53,* 3466.

Handal, B. (2003). Teachers' mathematical beliefs: A review. *The Mathematics Educator, 13*(2), 47-57.

Hijazi, R. H. (2003). Analysis of compositional data using Dirichlet covariate models. (Doctoral dissertation, American University, 2003). *Dissertation Abstracts International, 64,* 1788.

Jackson, P. W. (1992). Conceptions of curriculum and curriculum specialists. In P. W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 3-40). New York, NY: MacMillan.

Jain, A. K. & Dubes, R. C. (1988). *Algorithms for clustering*. Englewood Cliffs, NJ: Prentice Hall.

Kagan, D. M. (1992). Professional growth among pre-service and beginning teachers. *Review of Educational Research, 62*(2), 129-169.

Kaiser, H. F. (1960). The application of electronic computer to factor analysis. *Educational and Psychological Measurement, 20*(1), 141-151.

Kardos, S. M. (2004). Supporting and sustaining new teachers in schools: The importance of professional culture and mentoring. (Doctoral dissertation, Harvard University, 2004). *Dissertation Abstracts International, 65,* 1609.

Kliebard, H. M. (1992). Constructing a history of the American curriculum. In P. W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 157-184). New York, NY: MacMillan.

Knoke, D., & Yang, S. (2008). Social network analysis. In T. F. Liao (Ed.), *Quantitative applications in the social sciences* (2nd ed.). Los Angeles, CA: Sage.

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

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77*(4), 575-604.

LeCompte, M. D. (2000). Analyzing qualitative data. *Theory into Practice, 39*(3), 146-154.

Lewis, A. C. (2007). Focus math content. *The Education Digest, 72*(6), 72-74.

National Council of Teachers of Mathematics (NCTM) (2000). *Principles and standards for school mathematics.* Reston, VA: NCTM.

McNeil, J. D. (1996). Curriculum: A comprehensive introduction (5th ed.). New York City, NY: Harper Collins College.

McNeil, J. D. (2006). *Contemporary curriculum in thought and action* (6th ed.). Hoboken, NJ: J. Wiley & Sons.

Melnick, S. A., & Meister, D. G. (2008). A comparison of beginning and experienced teachers' concerns. *Educational Research Quarterly, 31*(3), 39.

Miller, J. L. (2001). Understanding the experiences of first-year secondary mathematics teachers: What helps and what hinders their professional development? (Doctoral dissertation, University of Maryland College Park, 2001). *Dissertation Abstracts International, 63,* 2168.

Ostler, E., Grandgenett, N., McGlamery, S., & Topp, N. (1998). Ten ways to mess up a mathematics curriculum: Suggestions for avoiding common mistakes. *Education, 119*(1), 63-67.

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

Pamfilos, P. (October 10, 2008). *Formulas in barycentrics.* Retrieved November 30, 2008, from http://www.math.uoc.gr/~pamfilos/eGallery/problems/BarycentricsFormulas.html

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Perry, W. G. (1999). *Forms of intellectual and ethical development in the college years*. San Francisco, CA: Jossey-Bass.

Peterson, B. E., & Williams, S. R. (1998). Mentoring beginning teachers. *The Mathematics Teacher, 91*(8), 730.

Price, L. R. (2006). *DISC instrument validation study: Technical report.* Retrieved from The Institute for Motivational Living, Inc. website: http://www.discinsights.com /cyber/images/web_iml_disc_validation_study_2006.pdf

Ross, E. W., Cornett, J. W., & McCutcheon, G. (1992). *Teacher personal theorizing: Connecting curriculum practice, theory, and research*. Albany: State University of New York Press.

Saville, P., & Wilson, E. (1991). The reliability and validity of normative and ipsative approaches in the measurement of personality. *Journal of Occupational Psychology, 64*, 219-238.

Schiro, M. (1992). Educators' perceptions of the changes in their curriculum belief systems over time. *Journal of Curriculum and Supervision, 7*(3), 250-286.

Schiro, M. S. (2008). *Curriculum theory: Conflicting visions and enduring concerns*. Los Angeles, CA: Sage.

Seaver, B., Triantis, K., & Reeves, C. (1999). The identification of influential subsets in regression using a fuzzy clustering strategy. *Technometrics, 41*(4), 340-351.

Silvernail, D. L. (1992). The educational philosophies of secondary school teachers. *The High School Journal, 75*(3), 162-167.

Smith, T. M. & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal, 41*(3), 681-714.

Texas Education Agency (2008). *Snapshot 2008 summary tables: Community type.* Retrieved from Texas Education Agency website: http://ritter.tea.state.tx.us/perfreport/snapshot/2008/commtype.html

Wayne, A. J., & Youngs, P. (2003). Teacher characteristics and students achievement gains: A review. *Review of Educational Research, 73*(1), 89-122.

Whittemore, A. S. (1997). Multistage sampling designs and estimating equations. *Journal of the Royal Statistical Society. Series B (Methodological), 59*(3), 589-602.

Wiegert, E. M. (2002). Developing expertise in elementary mathematics teaching. (Doctoral dissertation, Clemson University, 2002). *Dissertation Abstracts International, 63,* 3915.

Windschitl, M. & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teachers' beliefs, social dynamics and institutional culture. *American Educational Research Journal, 39*(1), 165-205.

VITA

Jill Ashdown Cochran was born in Riverton, Wyoming on July 27, 1983, and is the daughter of Greg and Robyn Ashdown. She completed high school at Klein High School in Spring, Texas in 2001. Afterward, she attended Southern Utah University where she received a Bachelor of Science in Mathematics Education in 2004. During the following three years she taught 7th and 8th grade math and science in the Austin Independent School District. In August 2007, she entered the Graduate College of Texas State University-San Marcos.

Permanent E-mail Address: jill.cochran@gmail.com

This dissertation was typed by Jill A. Cochran