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The relationship between curriculum alignment and selected mathematics teacher characteristics: An opportunity to learn study

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THE RELATIONSHIP BETWEEN CURRICULUM ALIGNMENT AND SELECTED MATHEMATICS TEACHER CHARACTERISTICS: AN OPPORTUNITY TO LEARN STUDY

A Dissertation

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Of the Requirement for the Degree

Doctor of Philosophy

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by

Leslie W. Grant

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The Relationship Between Curriculum Alignment and Selected Mathematics Teacher Characteristics: An Opportunity to Learn Study

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Approved March, 2006

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DEDICATION

This dissertation is dedicated to the people in my life who prepared me for this journey and who provided support and encouragement along the way. To my mother and father who demonstrated the ethic of hard work and stressed the importance of education. To the many friends and family who cheered me on along the way. To my husband, Allen, who willingly set out on this journey with me and without whose help I would not have achieved this dream. To my son, Matthew, who was brought along on this journey and always encouraged Mom to "get an A." I am truly blessed.

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ABSTRACT

This study explored the extent to which opportunity to learn was related to selected background characteristics of grades 5-8 mathematics teachers. Opportunity to learn was viewed in terms of curriculum alignment - that is alignment between teacher perceptions of instructional content and content covered in state standards. Teachers in twenty states who had completed the Survey of Enacted Curriculum (N=2037) were included in this study. Findings indicated that teacher major field of study was not related to curriculum alignment. Instructional content of teachers who held a permanent state license was not significantly more aligned to state standards than teachers who held an emergency or temporary state license. Instructional content of teachers who held a secondary mathematics license to teach and teachers who held an elementary license to teach was significantly more aligned to state standards than teachers who held a secondary license to teach in a subject other than mathematics. There was no relationship between the number of refresher mathematics courses taken by teachers or the number of mathematics education courses taken by teachers and curriculum alignment. The number of advanced mathematics courses taken by teachers was positively and significantly correlated to curriculum alignment, although the significance was not meaningful.

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CHAPTER 1: THE PROBLEM

Introduction

In recent years, state and national reforms in American public education have focused on outcomes. States have developed mathematics standards and mathematics tests to assess the degree to which these standards have been achieved. The mission of education has changed from ensuring that every child has equal access to a public education to ensuring that every child succeeds in the American public education system, as evidenced by the No Child Left Behind Act (2002).

States conduct validity and reliability tests on their assessments to ensure that the assessments are an accurate and reliable measure of the state standards. They contend that because these assessments are sufficiently valid and reliable measures, they should be used to hold students, teachers, and schools accountable for student learning (Marzano & Kendall, 1996; Ravitch, 1995). However, the states and the federal government fail to pay proper attention to a crucial variable in this process – INSTRUCTION (Black & Wiliam, 1998). Instruction occurs in individual classrooms across America and individual teachers carry out instruction. Teachers translate state standards into day-to-day lessons. Consequently, teachers influence how and when to teach the content and skills contained within the standards. The content of instruction can vary from teacher to teacher and thereby affect alignment of instructional content to state standards.

Background

Opportunity to Learn

Opportunity to learn (OTL) is the degree to which students are exposed to the content and skills for which they will be held accountable. OTL was conceived in the 1960s and has evolved from a technical tool used to compare student mathematics achievement internationally into a policy tool used to develop standards that would hold schools accountable for providing students with opportunities to learn. Used to level the playing field when comparing mathematics student achievement from differing countries, OTL emerged through the minimum competency testing movement and was used to determine whether American public education provided the necessary access in order to achieve success (Airasian & Madaus, 1983; McDonnell, 1995; Starratt, 2003). Instead of merely focusing on student outcomes, researchers and policymakers began to focus on educational inputs – resources, content, teacher quality, and a host of others (Black & Wiliam, 1998). In an era of school accountability, OTL has had profound implications in the policy, legal, and research arena (McDonnell, 1985).

Accountability Movement

The pervasiveness of the accountability movement is evidenced by recent statistics from a yearly report through *Education Week* (Education Counts, 2005). As of 2005, 49 states had adopted academic standards for students in the core content areas. The core content areas include language arts, social studies, science, and mathematics. Iowa remains the only state that empowers local districts to create their own standards (Iowa State Code 280.12, 2005). Twenty-nine states impose sanctions on low performing schools. Conversely, 17 states provide awards for student mastery of minimum competency standards. Furthermore, 21 states require students to pass a high school exit examination in order to graduate and 5 states link student achievement to teacher evaluation.

In 2001 the No Child Left Behind Act (NCLB, 2002) further strengthened the accountability movement by requiring students to be tested in mathematics and reading during grades three through eight and during one year in high school (Abrams & Madaus, 2003). Schools must meet adequate yearly progress each year in order to avoid sanctions imposed by NCLB (NCLB, 2002). NCLB requires that all students be tested. Moreover, NCLB requires achievement data disaggregated by race, socio-economic status, limited English proficiency, and students with disabilities. Testing is high stakes for public schools across the country. Public schools risk losing federal funding if they do not demonstrate that students are making academic progress. Abrams and Madaus (2003) explained, "Today's widespread implementation of standards-based reform and the federal government's commitment to test-based accountability ensure that testing will remain a central issue in education for the foreseeable future" (p.31). In those states in which students must pass a high school exit examination in order to graduate, testing is also a high stakes activity for students.

Holding students accountable for their learning raises questions regarding the accountability of the system that provides education. If students are to be held accountable for their learning, then shouldn't school districts be held accountable for ensuring that the students have the opportunity to learn the material for which they will be held accountable? How does a school district determine whether a student has had sufficient opportunity to learn? Can school districts legally withhold diplomas from students who fail standardized achievement tests? Given these issues, addressing the issue of opportunity to learn is both a legal and an ethical imperative. Starratt (2003) explained that “imposing such accountability systems without fully addressing the issue of OTL is a violation of social justice” (p. 298).

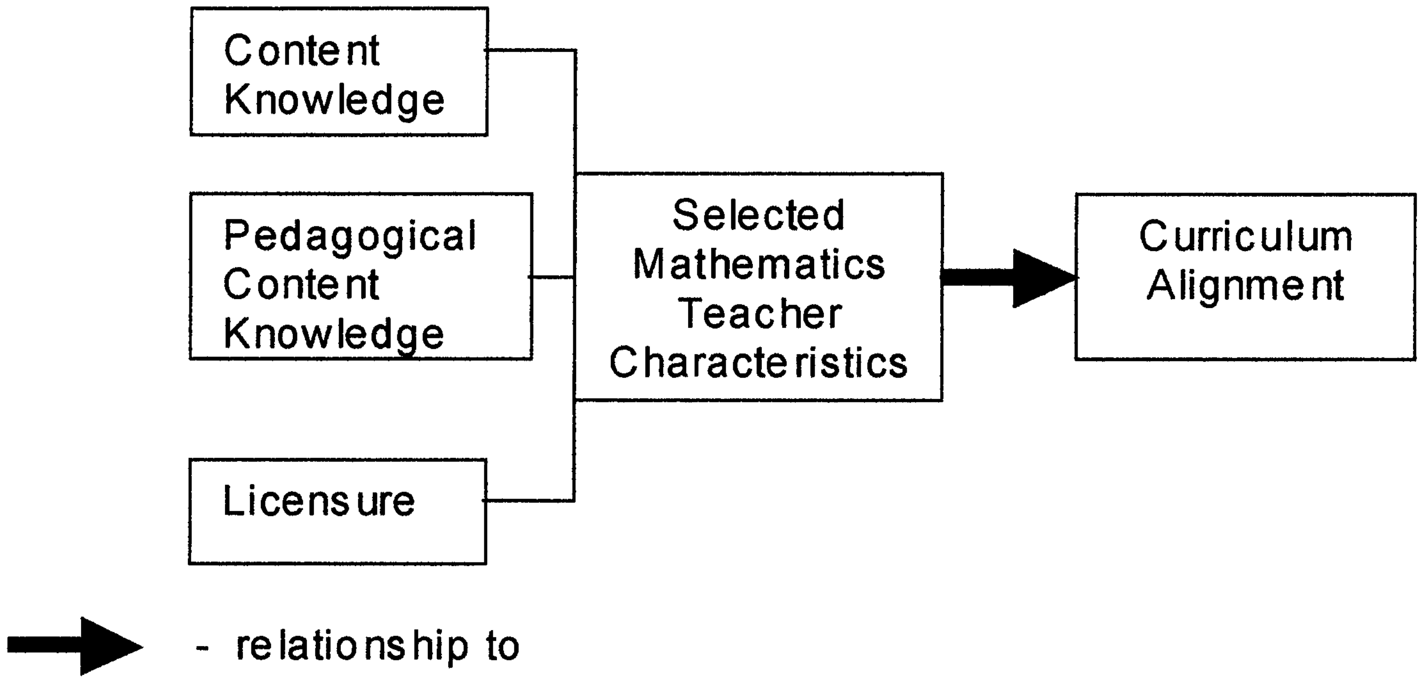
The accountability movement also extended to guidelines regarding teacher quality. The federal government made teacher quality part of No Child Left Behind when it proclaimed that every teacher must be “highly qualified” by 2005-06 (Alliance for Excellence in Education, 2003; Azordegan & Coble, 2004). The influence of teacher background characteristics research is evident in how NCLB defines a “highly qualified” teacher. A highly qualified teacher is one who has at least a bachelor’s degree, has full state licensure, and demonstrates content knowledge in the subject he or she teaches (NCLB, 2002). Therefore, the background characteristics of teachers are viewed as a hallmark of teacher quality by the federal government.

Conceptual Framework

Many variables affect student achievement. These can include societal variables, in-school variables, and familial variables (Barton, 2003; Kober, 2001). Figure 1 shows the conceptual framework for this study. This study focused on in-school variables to include teacher background characteristics and curriculum alignment.

Figure 1

Conceptual Framework



The Teacher

Early studies in the 1960s and 1970s maintained that students' socioeconomic background was a contributing factor to student achievement (Coleman, Campbell, Hobson, McPartland, Mood, Weinfield, & York, 1966; Jencks, 1972). However, these studies examined groups of schools together rather than investigating the effectiveness of individual schools or teachers (Glickman, Gordon, & Ross-Gordon, 2004). The effects of individual schools or teachers on student outcomes were not measured in these earlier studies and, in fact, these studies overshadowed the contribution individual teachers make to student achievement.

Teacher effects research has demonstrated that teachers do, in fact, make a difference in student achievement (Rowan, Correnti, & Miller, 2002; Wright, Sanders, & Horn, 1997). Researchers have noted significant differences in student achievement among teachers (Nye, Konstantopoulos, & Hedges, 2004; Stronge, Tucker & Ward, 2003). However, teacher effects research focuses on the differences of student achievement from classroom to classroom, not necessarily what teachers do in the classroom that increases student achievement.

Teacher Background Characteristics

Research also supports the notion that certain background characteristics of mathematics teachers can affect student achievement. This study focused on three distinct background characteristics of teachers: content knowledge, pedagogical content knowledge, and state licensure. Shulman (1986) provided a theoretical framework for understanding teacher knowledge to include both content knowledge and pedagogical content knowledge. For mathematics, content knowledge includes both a basic understanding of concepts related to mathematics and an understanding of the structure of mathematics. In production function studies, mathematics content knowledge has been measured by number of mathematics courses taken or whether a teacher has a major in mathematics (Darling-Hammond & Sykes, 2003; Hill, Rowan, & Ball, 2005). These variables have been found to have positive relationships with student achievement in mathematics (Goldhaber & Brewer, 1996; Monk, 1994; Hawk, Coble, & Swanson, 1985; Wenglinsky, 2000; Wenglinsky, 2002).

Pedagogical content knowledge includes understanding how to teach specific content (Shulman, 1986). Shulman (1986) explained that this type of knowledge refers to a teacher's ability to make learning mathematics easy or difficult for students. Teachers understand how to represent mathematical ideas and how to help students overcome misconceptions. In production function studies, pedagogical content knowledge has been measured by educational coursework. For mathematics, educational coursework would specifically focus on mathematics education coursework (Darling-Hammond & Sykes, 2003; Hill, Rowan, & Ball, 2005). Coursework in mathematics education has been shown to have a positive impact on student achievement (Begle, 1979; Monk, 1994; Wenglinsky, 2002).

State licensure is a function of content knowledge and pedagogical content knowledge and is a result of teacher preparation and participation in professional development. State licensure varies from state to state with overlapping types of licenses for the middle grades (Gaskill, 2002; NCTM, 2002; National Forum to Accelerate Middle-Grades Reform, 2002) Numerous studies have shown a positive relationship between teachers with permanent licensure and student achievement in mathematics (Darling-Hammond, 2000; Fidler, 2002; Hawk, Coble, & Swanson, 1985; Qu & Becker, 2003). Therefore, teacher licensure impacts student achievement as well, and possibly curriculum alignment.

Curriculum Alignment

Curriculum alignment is a crucial aspect of opportunity to learn. Alignment among all types of curriculum is necessary to insure that instructional content is aligned with the learning goals the state has put forth in state standards (Brophy, 2000; English & Steffy, 2001; Firestone, Camilli, Yurecko, Monfils, & Mayrowetz, 2000). Anderson (2002) explained, "poorly aligned curriculum results in our underestimating the effect of instruction on learning. Simply stated, teachers may be 'teaching up a storm' but if what they are teaching is neither aligned with the state standards nor the state assessments, then their teaching is in vain" (p. 258). In an era of accountability, instructional content must be examined in light of state standards. This is not an issue of whether different teachers are covering *more* content; it is an issue of whether teachers are covering the *right* content, in terms of alignment with state standards.

Curriculum alignment, and opportunity to learn, cannot be examined without focus on instructional content. In fact, Grouws (2004) maintained, "Teachers must ensure students are given the opportunity to learn important concepts and skills" (p. 162). Studies show that instructional content is a significant predictor of student achievement (Dunkin, 1978; Dunkin & Doenau, 1980; Wang, 1998).

Instructional content varies greatly among teachers; however, the source of the variations is unclear (Blank, Porter, & Smithson, 2001; Gehrke, Knapp, & Sirotnik, 1992;

Rowan, Harrison, & Hayes, 2004; Rowan, Camburn, & Correnti, 2004). For example, some teachers may focus more than others on number concepts while others may spend less time on adding whole numbers. A study of instructional content at the elementary level revealed that the chance of teaching a particular concept among teachers within a school could vary between 7.2% and 53.5% (Rowan, Harrison, & Hayes, 2004). The researchers found that "teachers working at the same grade varied widely in patterns of content and teaching" (p. 120). Perhaps the variation in instructional content, and therefore curriculum alignment could be related to content knowledge, pedagogical content, and type of state license.

Statement of the Problem

The problem addressed in this study is teacher impact on students' opportunity to learn in terms of instructional content and alignment to state standards. This is a particular concern in middle grades mathematics, in which teachers may have an elementary licensure, a middle grades licensure, or a secondary licensure with a concentration in mathematics or some other discipline and have a wide variation in content preparation as well as pedagogical preparation (NCTM, 2005). Gehrke, Knapp, & Sirotnik (1992) explained that during the middle school years, "At this critical time in a child's education … we seem to know the least about what we are teaching them" (p. 101). This study analyzed an extant database containing teacher reports of instructional content in grades 5-8 Mathematics classrooms across the United States.

Purpose of the Study

The major purpose of this study was to determine whether selected background characteristics of grade 5-8 Mathematics teachers affect alignment between instructional content and content covered in state standards. Data from an extant database was used to analyze teacher perceptions of instructional content and curriculum alignment in terms of elements related to teacher background characteristics. The research questions were as follows:

1. To what degree does major field of study relate to curriculum alignment?
2. To what degree does type of state licensure of grades 5-8 mathematics teachers relate to curriculum alignment?
3. What is the relationship between content knowledge of grades 5-8 mathematics teachers and curriculum alignment?
4. What is the relationship between pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?
5. What is the relationship between content knowledge and pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

Significance of the Study

Few studies exist regarding alignment (Anderson, 2002), and those that do focus on alignment between the intended or supported curriculum and the tested curriculum, not alignment between the taught curriculum and the intended curriculum (Mitchell, 1999; Rountree, 2000; Villareal, 2001). Moreover, this study examined what mathematics is taught in the middle years and whether instructional content is aligned with state standards. Gehrke, Knapp, & Sirotnik (1992) explained, "At this critical time in a child's education, where research suggests that students are making decisions about whether they will eventually attend college or whether they will drop out, we seem to know the least about what we are teaching them" (p. 101). This study focused on what is taught during these critical years and whether the instructional content is aligned with state standards.

As for the focus on background characteristics, Hill, Rowan, and Ball (2005) explained "…what knowledgeable teachers do in the classrooms – or how knowing mathematics affects instruction – has yet to be studied and analyzed. Does teachers' knowledge of mathematics affect the decisions they make?" (p.401). This issue is a particular concern at the middle school level where teachers have varied preparation experiences and varied content knowledge (Gaskill, 2002). Teachers of middle school mathematics may have an elementary license or they may have a secondary mathematics license. Teachers may also have a middle school license or endorsement, which possibly may include a minor in mathematics. The National Council of Teachers of Mathematics explained that in the middle grades, "teachers need to develop a sound knowledge of mathematical ideas and excellent pedagogical practices…" (NCTM, 2000, p.1).

More importantly, this study examined an avenue for school districts to assess whether students are afforded the opportunity to learn in their classrooms. The legal issues surrounding opportunity to learn center on the extent to which instructional content is aligned with state standards and state assessments. In a practical sense, finding ways to assess curriculum alignment serves to assist school districts in ensuring that students are provided opportunities to learn, especially when consequences are tied to student performance on state assessments.

Definitions of Key Terms

<u>Assessed curriculum.</u> The knowledge and skills contained within state assessments.

<u>Attained curriculum.</u> The knowledge and skills the student has learned from instruction as evidenced by an assessment (Travers & Westbury, 1989).

<u>Curriculum.</u> A plan or written document that details experiences and activities to achieve curricular goals (Ornstein & Hunkins, 1998).

<u>Curriculum alignment.</u> The degree to which instructional content and the content of state standards are comparable (Anderson, 2002).

<u>Curricular validity.</u> The degree to which the intended curriculum, the implemented curriculum, and the assessed curriculum are aligned (*Debra P. v. Turlington*, 1981).

<u>Major fields of study.</u> Field of study in college.

<u>High-stakes testing.</u> State testing tied to state developed content standards, which hold consequences for students and schools (Abrams & Madaus, 2003).

<u>Implemented curriculum.</u> The knowledge and skills taught in the classroom (Travers & Westbury, 1989).

<u>Intended curriculum.</u> The knowledge and skills contained within state standards and the written curriculum (Travers & Westbury, 1989).

<u>Instructional content.</u> The knowledge and skills a teacher teaches and what the teacher expects students to know or be able to do regarding the topics (Porter, 2002).

<u>Level of cognitive demand.</u> What students are expected to know about a specific content and be able to do (Porter, 2002).

<u>Middle level license</u>. State certification in which a teacher holds necessary credentials to teach grades 5 through 8.

Opportunity to learn. The extent to which students have been exposed to the content and skills for which they will be held accountable (Husen, 1967).

Secondary mathematics license. State certification in which a teacher holds necessary credentials to teach mathematics at both the middle and secondary school levels.

Secondary other license. State certification in which a teacher holds necessary credentials to teach a subject other than mathematics at both the middle and secondary school levels.

State standards. Content and performance standards developed by individual states.

Supported curriculum. The curriculum in texts, software, multimedia and other resources used by teachers (Glatthorn, 1999).

Temporary or emergency license. State certification in which a teacher may be lacking required coursework or teacher preparation in order to teach the subject/grade level they are teaching.

Limitations

Limitations are those elements of the study of which the researcher failed to control (Rudestam & Newton, 2001). For this study, limitations included:

1. The researcher did not collect the data and therefore relied on reports from those who gathered the data through the Survey of Enacted Curriculum.
2. The descriptions of instructional content are based on teacher reports, not observed phenomenon.
3. State mathematics standards vary from state to state.
4. There may be factors which affect curriculum alignment that were not identified in this study.

Delimitations

Delimitations are the restrictions that the researcher deliberately places on the study (Rudestam & Newton, 2001). For this study delimitations included:

1. The researcher chose to use data from an extant database of teacher reports of instructional content and data from content analyses of state standards. This database was chosen as it offered teacher reports from a large group of teachers (N=2038) and from 20 different states.
2. The study was also purposefully limited to grades 5 – 8 mathematics teachers. Middle school mathematics teachers vary in the depth of content knowledge and pedagogical content knowledge and in type of state licensure (Alliance for Excellent Education, 2003; NCTM, 2005; NMSA, 2006).
3. The researcher focused on mathematics because research studies have shown a positive link between a student's opportunity to learn mathematics and student achievement in mathematics (Gamoran, Porter, Smithson, & White, 1997; Grouws, 2004; Helscher, et al., 2001; Husen, 1967).
4. Additionally, only teachers for whom a target state standard could be identified were included in the study.

Assumptions

1. Teachers are a central part of providing OTL to students.
2. Teacher self-reports of instructional content accurately reflect instructional content in their classrooms.
3. Alignment among the intended, implemented, and assessed curriculum result in opportunities to learn and, therefore, result in increased student achievement.

4. Teacher background characteristics positively impact student achievement.

CHAPTER II: REVIEW OF THE LITERATURE

Introduction

In recent years, public attention has focused on the outcomes of student achievement through the advent of high stakes testing. Supporters of rigorous academic standards and rigorous assessments explain that an aligned curriculum provides equal opportunities for students (Anderson, 2002; English & Steffy, 2001; Schwartz, 1998). Much attention has been given to developing state standards and much attention has been given to developing state assessments, however, the critical link between state standards and state assessment must be examined as well (Black & Wiliam, 1998). That critical link is instruction, or the implemented curriculum.

More than forty years ago, the International Association for the Evaluation of Educational Achievement emphasized the importance of instruction in explaining student achievement (Husen, 1967). This realization is called opportunity to learn (OTL). Part of OTL involves whether students have been exposed to content for which they will be held accountable. OTL has implications for today's accountability environment. These implications include exposure to the content that is within state standards and access to high quality instruction (Schwartz, 1998; Stevens, 1993). However, opportunity to learn can be difficult to measure.

This literature review explores three major areas in an effort to illuminate the complexities and the importance of opportunity to learn for today's students. These areas include (1) technical, political, and legal beginnings of OTL; (2) the accountability movement at both the national and state levels; (3) policy and research related to selected teacher background characteristics; and, (4) measuring OTL. Areas one and two provide the foundation for examining instructional content and curriculum alignment. Issues to be addressed in area three include instructional content, teacher effects research, and selected teacher background characteristics that may impact instructional content and curriculum alignment. These issues will be discussed in light of OTL.

Opportunity to Learn

Concept Evolution

Over the past 40 years, the concept of OTL has expanded from a technical tool used to adequately measure and compare student learning to a policy tool to ensure an adequate public education. This section provides an overview of the technical beginnings of OTL, the evolution of the OTL definition, and uses of OTL in public policy.

Technical Beginnings

OTL has its roots in the technical world of research. During the 1960s the International Association for the Evaluation of Educational Achievement (IEA) conducted its first international comparison of student achievement in mathematics (Husen, 1967). The IEA first piloted a mathematics achievement test in order to provide a gauge of mathematics achievement cross-nationally. During the pilot study of measuring student academic achievement in mathematics, mathematics teachers expressed concern that their students would not perform as well on certain items of the test because they had not been given instruction on a particular concept. The IEA then surveyed mathematics teachers in each country to determine whether their students had had the opportunity to learn each test item. The researchers hypothesized that students' mathematics scores would be related to the opportunity to learn the mathematics content contained on the mathematics achievement test as determined by the teachers' perceptions. The researchers' hypothesis was supported. The researchers found a significant positive correlation between the mathematics scores and students' opportunity to learn the material as perceived by their mathematics teachers in some of the countries. Scotland and England both had correlation coefficients at .56 and .54, respectively. However, the correlations were low (r = 0 to .30) in Finland, France, Germany, Israel, Japan, Sweden, and the United States. An analysis of variation of OTL between countries revealed that student mathematics scores were higher in countries where teachers indicated students had opportunities to learn the material on the mathematics achievement test, with correlation coefficients for four different populations at .40, .64, .73, and .80.

After the first international study, recommendations were made for future international comparisons. One recommendation involved the development of a framework for understanding curriculum. The recommendation divided curriculum into three levels: the intended, the implemented, and the attained (Travers & Westbury, 1989). This framework provided the lens through which comparisons among countries could be made.

In both the second and the third IEA studies, the researchers employed the use of this curriculum framework (Helscher, Levine, Moore, Rizzo, Roey, Smith, & Williams, 2001; Robitaille & Garden, 1989). Both the second and third study extended the work of the first IEA study by gathering data regarding both the intended curriculum and the implemented curriculum to provide a lens through which the attained curriculum could be explored. The second and third studies set out to determine the intended curriculum by asking national committees from each country to rate each item on the test as to its appropriateness in regards to content coverage. The third study also analyzed textbooks and curriculum guides in an effort to describe the intended curriculum (Helscher, et al., 2001).

The second and third IEA studies used similar data collection techniques to determine the implemented curriculum (Helscher, et al., 2001; Robitaille & Garden, 1989). The second IEA study involved 13 year old students and students in their last year of school and teachers from 18 countries. The third 1995 IEA study involved students and teachers from 42 countries. Mathematics teachers completed a survey in which they ranked each mathematics test item in terms of whether or not students had the opportunity to learn the knowledge and skills associated with each test item. In some cases, the intended curriculum and the implemented curriculum varied greatly. The researchers decided to use the implemented curriculum data to interpret mathematics achievement results. The researchers reasoned, "Of the two, the Implemented Coverage data probably reflects more accurately what is taught since they were obtained from teachers who were working on a daily basis with the curriculum" (Robitaille & Garden, 1989, p.99). For example, in performance on descriptive statistics portion of the mathematics test in the second IEA study, teachers in the United States reported that over 70% of the students had the opportunity to learn the material on the descriptive statistics subtest. However, the percent correct for this subtest for students in the United States was 58% (Robitaille & Garden, 1989). Thus, mathematics students in the United States underperformed according to the implemented curriculum.

The IEA studies essentially introduced the OTL concept into the research, policy, and legal arenas of American public education. Moreover, the studies provided a lens through which to understand and align the levels of curriculum. OTL would later be explored as both a legal standard and an educational standard (McDonnell, 1995; Noddings, 1997; Ravitch, 1995; Schwartz, 1998).

Policy Beginnings

The use of OTL as a policy tool emerged in the 1980s and 1990s due to the advent of minimum competency testing (McDonnell, 1995). Standardized achievement tests were being used for a multitude of purposes, including assessing equal access to education, evaluating school and program effectiveness, evaluating teachers, and certifying high school completion (Airasian & Madaus, 1983). In regards to certifying high school completion, questions began to surface related to the degree to which students had the opportunity to learn the material upon which they were tested. These questions found their way into the courts in a precedent setting case *Debra P. v. Turlington* (1981). A student sued the state of Florida maintaining that the state of Florida violated due process by not ensuring that students were taught the material on the test. The court ruling in this case held the state of Florida accountable for the instructional validity of their minimum competency test. This case is discussed in more detail later in the literature review.

In 1985, the American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME) jointly developed *Standards for Educational and Psychological Testing*. The development of these standards stemmed from the use of standardized tests to make high stakes decisions regarding a student's educational future. For example, Standard 8.7 states, "When a test is used to make decisions about student promotion or graduation, there should be evidence that the test covers only the specific or general knowledge, skills, and abilities that students have had the opportunity to learn" (p. 53). This standard relates to the curricular validity of the test or the overlap among the test, the curriculum, and the instruction. Likewise, the National Council on Education Standards in Testing (NCEST) called for policymakers to ensure that "schools provide all their students with opportunities to master the demanding new material in the standards atmosphere where achievement is prized" (1992, p.10). Thus, AERA, APA, NCME, and the NCEST essentially called for OTL as a policy tool. These professional groups suggested that if it is the policy of the state, local or federal government to require that students demonstrate learning, there must also be a policy that students are afforded appropriate opportunity to learn.

OTL also began to move toward policy through federal legislation of the 1980s and 1990s. The Goals 2000: Educate America Act (1993) made OTL a cornerstone in measuring achievement and evaluating the effectiveness of educational programs (Schwartz, 1998). The Improving America's Schools Act addressed OTL as well by requiring evidence of alignment among state assessments and content standards (National Research Council, 1997; 1999). Through legislation, the government attempted to encourage OTL standards at the state level.

The idea of OTL standards emerged on the policy scene in expanded form. The IEA studies defined OTL in terms of whether students had been exposed to the content on the mathematics achievement test used in the IEA studies (Husen, 1967; Robitaille & Garden, 1989; Travers & Westbury, 1989). The definition of OTL expanded to include "the availability of programs, staff, and other resources that schools, districts, and states provide so that students are able to meet challenging content and performance standards"

(Ravitch, 1995, p. 13). The definition of OTL changed from alignment between what is taught and what is tested to include support structure to the teaching and learning process, or what Glatthorn (1999) referred to as the supported curriculum. Supporters of OTL standards argued that low-income and minority students must have access to the same resources as middle and upper income students. Opponents of OTL standards raised concerns that the implementation of standards would result in increased government regulation (Noddings, 1997; Ravitch, 1995). While content and performance standards remained at the forefront of accountability, Noddings (1997) explained that the debate over OTL standards disappeared due to the strong demands for accountability and the concerns over the cost and the burden for local school districts. Therefore, as support for the standards movement continued to increase, the support for OTL standards as part of the accountability movement decreased (Firestone, Camilli, Yurecko, Monfils, & Mayrowetz, 2000; McDonnell, 1995).

As stated previously, Goals 2000 called for voluntary national standards and assessments to measure achievement of those standards as well as the development of OTL standards. The Act stated, "The Council, which may consult with outside experts, shall certify exemplary, voluntary national opportunity to learn standards that will establish a basis for providing all students a fair opportunity to achieve the knowledge and skills set out in the voluntary national content standards" (Section 213, c). Goals 2000 called for the OTL standards to address the following:

- A safe and secure learning environment,
- Policies and practices to ensure nondiscrimination,
- Access to curricula, resources, technologies, and high quality instruction, and

- Alignment among assessments, standards, and instruction.

Although national content standards were never adopted and enforced, the concept of OTL standards tied to content standards thrust the opportunity to learn concept into the national policy arena. Porter (1995) commented that

> For those who want OTL standards to be used for school accountability, Goals 2000 legislation is probably the kiss of death for such use. The political battles were fought in drafting Goals 2000 language, and clearly those in favor of national OTL standards with teeth lost out (p. 26).

Porter called for OTL standards to be used not merely for accountability purposes but for improvement purposes as well. Starratt (2003) called for OTL standards as a moral imperative because of the possibility that students are not exposed to material for which they will be held accountable and face high states consequences if they do not pass a state examination. Therefore, the movement of OTL into the national arena spurned discussions of OTL and what role it should play in the accountability and school reform movement.

Legal Issues

While the OTL standards debate occurred in the policy arena, OTL emerged in a different setting – the court system. Beginning in the 1970s OTL made its way to the courthouse steps. While the courts have been reluctant to make judgments on instructional matters, the courts have stepped in when students have been denied a diploma (Fischer, Schimmel, & Stellman, 2003; McCarthy, Cambron-McCabe, &

Thomas, 1998). In particular, the courts have become involved when a student has been denied a diploma based on the failure to pass an exit examination.

The Precedent Setting Case. The precedent setting case in which OTL became a legal standard was *Debra P. v. Turlington* (1981;1984). In this case Debra P. filed a lawsuit against the Commission of Education maintaining that her rights under due process and equal protection had been violated. The student was denied a diploma based on failure to pass Florida's minimum competency test. The plaintiff argued that the state of Florida violated her rights because the test covered material that was not taught. Thus, the assessed curriculum and the implemented curriculum were not aligned.

The plaintiffs in *Debra P.* argued that the SSATII (Florida's minimum competency test) violated the due process clause of the Fourteenth Amendment. In applying the due process standard the courts examined the procedural issues related to high stakes testing and curricular validity. The court reasoned that if a state education agency (SEA) or a local education agency (LEA) was to withhold a diploma based on a students' failure to pass an exit examination, then the SEA or LEA must provide proof that the material on the test had actually been taught in the classroom. The ruling stated:

> The overriding legal issue of this appeal is whether the state of Florida can constitutionally deprive public school students of their high school diplomas on the basis of an examination which *may* cover matters not taught in the curriculum. We hold that the State may not constitutionally so deprive its students unless it has submitted proof of the curricular validity of the test. (p. 400)

While the courts held that schools have the right to require students to pass an exit examination in order to receive a diploma, the court also reasoned that schools have a responsibility to ensure that the implemented curriculum and the intended curriculum match the content of the test.

In 1984, Florida submitted its evidence of curricular validity to the Eleventh Circuit Court of Appeals. The evidence was obtained from a research study conducted by a consulting firm in which it was concluded that instructional content in Florida schools matched the objectives of the Florida test. The consulting firm conducted a four-part study. Teachers were surveyed (n = 47,000) as to whether they taught the skills on the SSATII. The districts were surveyed regarding remediation programs, staff development initiatives, instructional materials, and the grades in which students were actually taught the required skills. Third, the consulting firm made on-site visits to each Florida school districts to determine the veracity of the surveys. Finally, randomly selected classes of students (n = 3200) were surveyed as to whether they were taught the skills tested on the Florida competency test at any time while they were a student in the school district. Using a Mastery Exposure Index, the consulting firm concluded that each student in the state of Florida had an average of 2.7 opportunities to master the required skills. The court cited the most compelling evidence that 90% - 95% of the Florida students surveyed indicated that they had been taught the skills on the test. The Court of Appeals accepted this evidence and ruled the test valid.

The courts' decision in its finality still failed to address which types of evidence would be required to demonstrate curricular validity, thus leaving SEAs and LEAs to make this determination on their own. Florida's proffered evidence met the burden of the court, but what other type of evidence could have also satisfied the courts' requirement? The only guidance given by the Eleventh Circuit Court of Appeals hinged on the admissibility of circumstantial versus direct evidence. In its interpretation of the Fifth Circuit Court ruling the Eleventh Circuit Court of Appeals explained

> The opinion gives no indication that in requiring that the state prove "that the test covered things actually taught in the classroom," the panel meant to limit the proof to *direct* evidence of classroom activities. In the absence of such an indication, the normal rule that evidence whether direct or circumstantial, may be considered if relevant. (p. 1409)

Therefore, the courts considered surveys of teachers, school district personnel and students relevant to the case and admissible.

The *Debra P.* case set a precedent for future challenges to schools that denied students a diploma based on exit examinations. The courts that ruled in this case set the standard of curricular validity as a burden of proof to be met by the SEA or LEA. In applying such a standard the courts were interested in the fundamental fairness of the test. The standard, however, remained vague. The courts offered no guidelines about the types of evidence required other than the admissibility of circumstantial evidence. Rulings in subsequent cases demonstrated the lack of direction provided by the Fifth Circuit Court due to the varied evidence of curricular validity accepted by other courts.

Interpretations of Debra P. In 1992, the Eastern District Court in Texas applied the curricular validity fundamental fairness standard to the Texas Assessment of Academic Skills (TAAS) in *Crump et al. v. Gilmer Independent School District* (1992).

Carlos Crump and Sharon Jeffrey were high school seniors at Gilmer High School in Gilmer, Texas. At the time, the state of Texas required students to pass the TAAS to receive a high school diploma. Both Mr. Crump and Ms. Jeffrey failed to pass the TAAS. The plaintiffs argued that the Gilmer school district violated their constitutional rights by not giving them a diploma. The Eastern District interpreted the *Debra P.* ruling in its most strict sense. The court ruled that the school district could not possibly demonstrate the curricular validity of TAAS. The ruling hinged on the fact that administrators and teachers were not allowed to view the actual tests and therefore could not make the determination that the curricula in English and Mathematics was aligned with TAAS. The court also ruled that the more specific the academic standards in English and Mathematics, the better. The more vague the standards, the more difficult it would be to match curriculum and instruction with the test. The court also stated that even if school administrators and teachers could view the test and even if the academic standards were specific enough to match the content of the test, the school district still must provide proof that the content of TAAS was actually being taught in the classroom.

The *Crump* ruling interpreted this proof to mean alignment of the curriculum to the test and alignment of instruction to TAAS. The Eastern District Court's interpretation of the *Debra P.* ruling would make any school district concerned about how to prove instructional validity whereas the *Debra P.* ruling stated that Florida must show evidence of curricular validity, whether direct or circumstantial. The court determined that the only way for school districts to know whether the curriculum was aligned was to have access to the test itself and to ensure actual instruction matched the test contents.

During the time of the *Crump* ruling a similar case was being decided in the Western District Court in Texas. Again, the courts considered the curricular validity of TAAS in *Williams v. Austin Independent School District* (1992). The student was a senior at McCallum High School in Austin, Texas. He failed to pass the TAAS and was denied a diploma. The student's parent sued on his behalf stating that the school district had violated the students' right to due process by withholding a diploma. Austin Independent School District provided evidence that the student had an OTL the material on the TAAS. In this case, the mathematics coordinator for the school district testified that the math courses provided by the school district covered the same material tested by TAAS. He also testified that Williams (the plaintiff) had taken the courses necessary to prepare him for the test and he also took remedial courses. The mathematics coordinator also testified that the Texas Education Agency provided the school district with the objectives and sub-objectives related to the material covered on TAAS.

The court in *Williams* required a much less stringent burden to be met than did the court in *Crump*. The court was satisfied that the curriculum in the courses offered by the school district was aligned with the TAAS and that because the student had taken these courses, he had had sufficient opportunity to learn the material. The court also did not require that school administrators and teachers have access to the actual test because the state had provided teachers with detailed information about the TAAS objectives. The Western District Court deferred judgment to the school district. The ruling stated

> The Court believes the public interest is better served by this Court not interfering with the decisions of AISD, the Texas Legislature, the State Board of Education, and the Texas Education Agency

> ...The citizens of Texas are disserved when federal judges substitute their notions of fairness in place of officials elected to make these kinds of policy decisions and judgment calls. (p. 256)

The Western District explained its reluctance to interfere or to challenge a school district's assertion that curricula, instruction, and the TAAS were aligned. The evidence offered by the school district satisfied the court.

The final case that applied the curricular validity standard in *Debra P.* did little to provide additional guidelines. In 2000 a case before the Western District Circuit Court in Texas again examined the issue of whether the state could withhold diplomas if students did not pass the TAAS. The court ruling hinged on the alignment between the academic standards provided in the Texas Essential Knowledge and Skills standards and TAAS. As with each of the previous cases, the plaintiffs failed to pass the TAAS and were denied a high school diploma. The plaintiffs maintained that the denial of a high school diploma violated their due process rights because the material on the TAAS was not taught to the students. The court in *GI Forum v. Texas Education Agency* (2000) found that since the standards and skills were positively correlated that the students in Texas had the opportunity to learn the material. The court also stated "test-driven instruction undeniably helps to accomplish this goal" (p.681). The "goal" referred to the acquisition of the essential knowledge and skills.

The court rulings in these five cases reflect the debate in the legal arena in that different courts require different types of evidence (see Table 1). Essentially, the rulings in *Williams v. Austin Independent School District* and *GI Forum v. Texas Education Agency* focused on the curricular validity of the test – that is, the match between the curriculum content and the test content. Conversely, the rulings in *Debra P. v. Turlington, Anderson v. Banks,* and *Crump v. Gilmer Independent School District* hinged on the instructional validity of the test as well – that is, the match between instructional content and test content. Taking these five cases together, school districts must be prepared to demonstrate the match among all three levels of curriculum – the intended curriculum, the implemented curriculum, and the attained curriculum as measured by standardized tests, especially in today's accountability environment.

Table 1

Summary of case rulings involving opportunity to learn

Ruling	Proof accepted for opportunity to learn
Debra P. v. Turlington, 1981; 1984	Demonstration of alignment between instruction and the curriculum (content coverage) through teacher surveys, on-site observations, and student surveys
Crump v. Gilmer Independent School District, 1992	Demonstration of alignment between instructional content and test content through examination of actual tests
Williams v. Austin Independent School District, 1992	Demonstration that the school district offered and the student took courses to prepare him for the test through testimony of mathematics coordinator and teacher
GI Forum v. Texas Education Agency, 2000	Demonstration of alignment between the academic standards and the test

The Accountability Movement

National Movement

One of the most frequently cited events marking the inception of the accountability movement is the report, *A Nation at Risk,* published in 1983. (See, for example, Firestone, Schorr, & Monfills, 2004; Ravitch, 1995). This report scolded the American public education system and declared it to be mediocre and damaging to the future of American society. The report called for the adoption of rigorous academic standards, a national curriculum, rigorous graduation standards, and higher teacher pay (National Commission on Excellence in Education, 1983). School reform became the mantra of American public education critics.

In 1987, then President George Bush held an Education Summit along with state governors to discuss the issues facing American public education. The meeting resulted in support for rigorous national academic standards in core subject areas. As a result of the Education Summit, professional organizations such as the National Council for Teachers of Mathematics (NCTM), the Center for Civic Education, and the National Council for the Social Studies (NCSS) developed academic standards in their respective subject areas (Marzano & Kendall, 1998; Ravitch, 1995). The academic standards were general, often detailing overarching goals for a span of grades, rather than goals for each grade level (Reys, Dingman, Sutter, & Teuscher, 2005). In 1990, President Bush called for national standards and national testing; however, the discussion of national standards gave way to focus on state standards.

In 1994, President Bill Clinton continued the movement toward educational accountability through the Goals 2000: Educate America Act. This Act called for voluntary content and performance standards. Content standards include the skills and knowledge that students are expected to learn while performance standards delineate the level at which a student achieves the content standards (Ravitch, 1995) Concern over loss of local and state autonomy in public education led states to adopt state standards (Marzano & Kendall, 1998; National Research Council, 1997). In 1996, President Clinton held a second education summit in which he praised state efforts at educational reform. Marzano and Kendall (1998) explained that the reform at the state level was "consistent with the opinions of many educators and noneducators who believe that it is at the state level that the standards movement will either succeed or fail" (p.2).

The power of the federal government in the Goals 2000 remained limited. The federal government could not force states to adopt content standards or performance standards. In an effort to influence state policy, Congress passed the Improving America's Schools Act (1994), a reauthorization of the Elementary and Secondary Education Act. The federal government now required states receiving Title I funding to provide documentation of content and performance standards and documentation of progress toward meeting those standards. The law also required alignment of assessments and content standards (National Research Council, 1997; 1999). The Improving America's Schools Act forced states to essentially comply with the Goals 2000 call for content and performance standards.

In 2001 the No Child Left Behind Act (NCLB, 2002) further strengthened the accountability movement in three ways: 1) requiring testing of students in the areas of mathematics and reading in grades three through eight and during one year in high school; 2) requiring states to adopt rigorous academic standards in each of the content areas tested; and 3) mandating teacher quality. NCLB requires schools to meet adequate yearly progress for all children each year in order to avoid sanctions. All children means all children, including minority students, special education students, limited English proficiency students, and students from lower socio-economic backgrounds. These events as well as others listed in Table 2 influenced the development of standards at the state level.

Table 2

Some key events leading to state standards

• Publication of *A Nation at Risk* (1983)
• First Education Summit with the fifty governors and President Bush held (1989)
• National Council of Teachers of Mathematics publishes content standards for mathematics (1989)
• Announcement by President Bush of National Education Goals (1990)
• Establishment of the National Council on Education Standards and Testing (1991)
• Passage of Goals 2000: Educate America Act (1994)
• National Council for the Social Studies publishes content standards (1994)
• National Standards in Foreign Language Education Project publishes foreign language standards (1996)
• National Council of Teachers of English publish English Language Arts standards (1996)

Adapted from: Marzano, R.J. & Kendall, J.S. (1996). *A comprehensive guide to designing standards-based districts, schools, and classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

NCLB mandates that states develop rigorous mathematics standards, as well as language arts standards, and science standards (NCLB, 2002). Prior to NCLB, state standards were more general much like the NCTM standards (Reys, Dingman, Sutter, & Teuscher, 2005). However, state standards became more specific in developing mathematics standards, and developing them for each grade level. A recent survey of mathematics state standards revealed that 36 states have standards specific to each grade level in elementary and middle school and 13 have standards that span three or more grade levels in elementary and middle school (Reys, et al., 2005).

NCLB also requires that teachers be "highly qualified" by 2005-2006. The federal government defines highly qualified as those teachers who 1) demonstrate content knowledge in the subject they teach; 2) are licensed to teach the subject they are teaching; and 3) have a bachelor's degree (NCLB, 2002). The federal government has tied Title I funding to having highly qualified teachers. Thus, the federal government places a layer of accountability on school districts regarding teacher quality as well as accountability for student achievement (Alliance for Excellent Education, 2003; Azordegan & Coble,2004).

State Accountability Movement

In today's accountability environment, the focus remains at the state level. Every state administers some type of state-wide assessment (Table 3). All but one state, Iowa, has developed standards in the core subject areas. Over half of the states implement sanctions for low performing schools, and almost half of the states require an exit examination or end of course test.

Table 3

Some elements of state accountability systems, 2005.
Source: Education Week, 2005

Element	Number of states implementing element
Standards in core subject areas	49*
State-wide tests	50
Criterion-referenced tests	44
Norm-referenced/off the shelf tests	20
Sanctions for low performing schools	29
Rewards for high performing schools	17
Exit or end of course examination requirement	21
Use of student achievement data in teacher evaluation	7

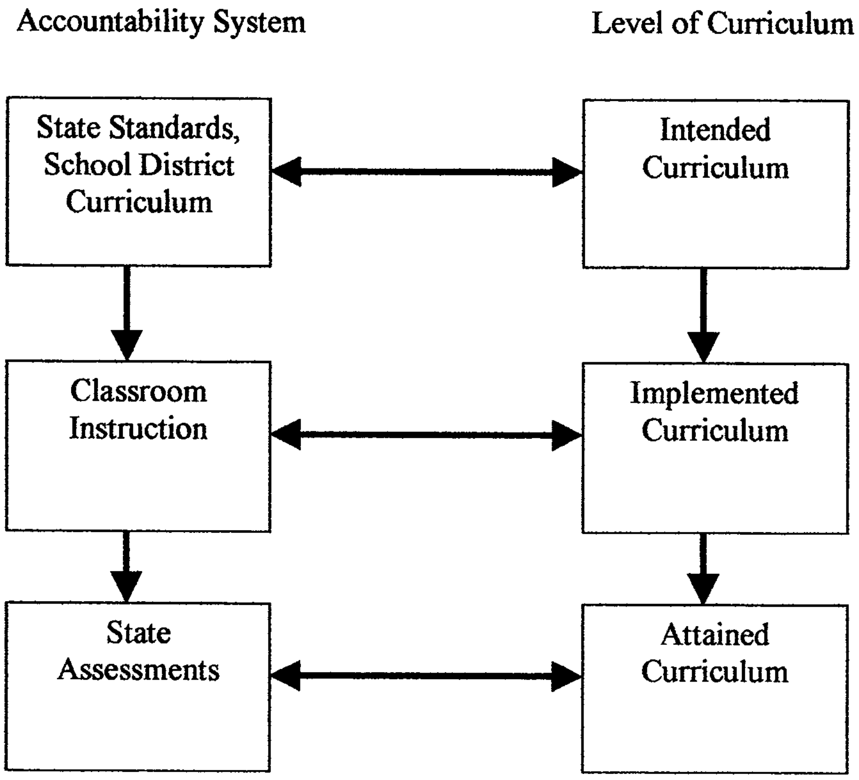
* Iowa is the only state without standards.

In terms of today's accountability movement, the state standards and school district curricula constitute the intended curriculum. Classroom instruction, which is to follow the school district curricula and therefore the state standards, constitute the implemented curriculum. State assessments such as the Virginia Standards of Learning End of Course Tests, the Wisconsin High School Graduate Test, and the Maryland High School Assessments are examples of how states measure the attained curriculum based on state developed standards. Alignment among all three levels of curriculum is critical to providing students with the OTL (See Figure 2). The state standards must be aligned with both instruction and assessments. Instruction must be aligned with both state standards and state assessments. State assessments must be aligned with both state standards and instruction. This study focuses on the alignment between the taught or the implemented curriculum and the intended curriculum.

States develop such assessments based on three assumptions (Kornhaber & Orfield, 2001). One assumption about testing is that the economy will improve if students are better prepared academically. Supporters of testing point to studies that show relationships between math scores and wage gains. Secondly, proponents of testing contend that high-stakes testing motivate students to learn because of the possible consequences of failing to achieve. These consequences possibly include retention in grade or denial of a diploma. Thirdly, testing will result in improved teaching and learning because awards and sanctions will lead to improved instructional practices (Kornhaber & Orfield, 2001; Roderick, & Engel, 2001; Ryan & Cooper, 2000). These assumptions serve as the driving force behind the national accountability movement and the state standards movement toward high stakes testing.

Figure 2

Relationship between state accountability systems and the three levels of curriculum



Curriculum Alignment

Alignment in today's accountability movement involves alignment among:

- the intended outcomes of learning as defined by state standards,
- the actual implementation of these intended learning outcomes by classroom teachers, and
- the knowledge and skills assessed on state assessments (Blank, Smithson & Porter, 2001; English & Steffy, 2001; McGehee & Griffith, 2001).

If alignment among all three does not exist then student achievement data from state assessments are not valid indications of student learning. Anderson (2002) explained that "over the past quarter century, the responsibility for accountability has shifted from students (and their home backgrounds) to schools" (p. 5). Therefore, alignment assists teachers in ensuring that their students have the knowledge and skills that will be tested on state mandated tests (Glatthorn, 1999).

A few studies have examined the effect of curriculum alignment on student achievement and those studies have yielded conflicting results (Brophy, 2000; Fuchs & Deno, 1994; Gorin & Blanchard; Levine & Lezotte, 1990; Mitchell, 1999; Rountree, 2000; Stevens, 1984; Villareal, 2001). Gorin & Blanchard (2004) conducted a study of curriculum alignment in two school districts in California. The two school districts were matched in terms of variables related to socio-economic status, size of districts, student-teacher ratio, race/ethnicity of students, and gender of students. In one school district, the mathematics curriculum had been aligned with the California state standards. The other school district did not align their mathematics curriculum with the California state standards. The researchers used the Stanford Achievement Test results, not a state criterion test in order to determine whether the fifth grade students in the treatment group (n = 131) scored significantly higher in mathematics in fifth grade than they did in third grade and whether the fifth grade students in the comparison group (n = 108) scored significantly higher on the SAT-9 in fifth grade than they did in third grade. Using a two-way repeated measures ANOVA, the researchers found a significant increase in mathematics scores for students in the treatment group ($p < .001$) and a significant decrease in mathematics scores for students in the comparison group ($p < .001$).

Another study conducted in 2001 found that curriculum alignment did not result in increased student achievement. Villarreal (2001) studied the effects of seven years worth of curriculum alignment on tenth-grade student achievement in mathematics. The treatment group consisted of 128 students in a school district in Rio Grande Valley who were taught under a curriculum-aligned program. The comparison group consisted of 283 students in a school district in Rio Grande Valley who were not taught under a curriculum-aligned program. The school districts were matched on percentage of minority students, percentage of students economically disadvantaged, and percentage of limited English proficient students. The mathematics portion Texas Assessment of Academic Skills (TAAS) served as the dependent variable. Using a pretest-posttest design, an analysis of covariance revealed that students in the treatment group did not perform significantly better on the TAAS mathematics test than did students in the comparison group ($p = .295$).

Although these studies have divergent findings as to the effects of curriculum alignment on student achievement, they are similar in that they do not address actual implementation of the intended curriculum. They either assume that because the school district has aligned the curriculum that instruction is aligned as well or they demonstrate alignment between the intended curriculum and the supported curriculum. This study focuses on the taught, or implemented curriculum and its alignment with the intended, or the written curriculum. Gehrke, Knapp, and Sirotnik (1992) provide a fundamental reason for focusing on the taught, or implemented, curriculum through their assertion that "teachers mediate the curriculum, and some would say they *are* the curriculum" (p.101).

Measuring Opportunity to Learn

Opportunity to Learn Variables

Variables associated with OTL have grown out of research that relates some type of in-school variable with student achievement. One aspect of OTL that is most common among research studies and central to the court ruling in *Debra P.* is instructional content. In the research studies reviewed, instructional content was included among those variables that should be considered when assessing OTL (For example, Blank, Porter, & Smithson, 2001; Hardy, 1984; Stevens, 1993; Stevens & Grymes, 1993; Weiss, Pasley, Smith, Banilower, & Heck, 2003; Winfield, 1993). Other variables used to assess OTL include instructional strategies, instructional resources, and quality of instructional delivery (Herman, Klein, & Abedi, 2000; Stevens, 1993; Wang, 1998).

Instructional Content

Why is instructional content an essential part OTL? Perhaps, it is because instructional content has been shown to be a significant predictor of student achievement (Dunkin, 1978; Dunkin & Doenau, 1980). Instructional content is a focus of this study due to its importance in determining student achievement and describing the implemented curriculum. Studies that examine instructional content in classrooms define instructional content in different ways. Blank, Porter, & Smithson (2001) viewed instructional content in terms of knowledge and skills assessed as well as the cognitive levels at which the knowledge and skills is explored. Stevens (1993) divided instructional content variable into three categories: content coverage, content exposure, and content emphasis. The overlap between the subject matter taught and the subject matter tested, as well as time-on-task and depth of coverage must be considered as a part of opportunity to learn, especially in mathematics (Grouws & Cebulla, 1999). Studies have shown that instructional content varies greatly from teacher to teacher (Blank, Porter, & Smithson, 2001; Rowan, Camburn, & Correnti, 2004; Rowan, Harrison, & Hayes, 2004). If instructional content varies, then logic would dictate that alignment must vary as well. These studies, however, do not indicate possible explanations for such variations.

Instructional content viewed in terms of both knowledge and skills and level of expectation provides a more in-depth view of content. In a study of the effects of content coverage on mathematics achievement, Gamoran, Porter, Smithson, and White (1997) found that when factoring in both topics covered (configuration) and level of depth (level), more of the variance between classes could be explained. The researchers explained "We used this compound indicator because we expected test scores to be higher not just when appropriate topics are covered, but when they are covered in depth" (Gamoran, et al., 1997, p. 331). Their hypothesis was supported by their findings.

When both level and configuration were considered, the researchers accounted for 20% of the variance in class achievement gains and 7% of the variance in student achievement gains. Using only topics, only 4% of the variance in class achievement gains and only 1% of the variance of student achievement gains could be explained. Depth of instructional content yielded even less significant correlation coefficients than the topics alone. Therefore, the researchers concluded "Clearly, to predict student achievement gains from knowledge of the content of instruction, a micro level description of content that looks at level of cognitive demand by topic is the most useful approach considered to date" (Gamoran, et al., 1997, p. 331).

Teacher Effects

The teacher, in this research study, is viewed as an input into the educational process. The teacher delivers the instruction and exerts influence on the implemented curriculum. Research in the 1960s and 1970s indicated student socio-economic status as the most significant factor affecting student achievement (Coleman, et al, 1966; Jencks, 1972). Schools were found not to have a significant impact on student achievement. The problem with this research is unit of analysis – the school. Recent research has shown significant differences among teachers in student achievement (Rivkin, Hanushek, & Kaine, 2001; Rowan, Correnti, & Miller, 2002; Stronge, Tucker, & Ward, 2003; Wright, Sanders, & Horn, 1997). This evidence supports the conclusion that teachers do make a difference in the academic lives of students.

A study conducted in 2004 demonstrated the relationship between teacher effectiveness and student achievement (Nye, Konstantopolous & Hedges, 2004). The researchers randomly assigned both students and teachers from kindergarten through third grade for four years. Data collected from the Stanford Achievement Test administered in all four grade levels provided academic achievement data. The researchers then measured academic achievement gains at the classroom level. Then, academic achievement gains were compared between classrooms and between schools.

Student background characteristics were accounted for using hierarchical linear modeling. The researchers found that teacher effects explained 7% of the variance in student achievement in reading. Results from mathematics indicated larger teacher effects on student achievement, explaining 12% of the variance in third grade student achievement, 14% of the variance in second grade achievement, and 13% of the variance in first grade achievement. Interestingly, the researchers found that "naturally occurring teacher effects are typically larger than naturally occurring school effects" (Nye, Konstantopolous, & Hedges, 2004, p. 247).

While the teacher effects research indicates that teachers do indeed make a difference in student achievement, a more pertinent question to OTL is what characteristics do these teachers possess that makes them more or less effective? Why do some teachers appear to be increasing students' OTL while others appear to be decreasing opportunities for students? Various aspects of teacher characteristics and behaviors have been examined for decades.

Teacher Background Characteristics

Background characteristics related to teacher preparation such as major field of study (Fetler, 1999; Goldhaber & Brewer, 2000; Wenglinsky, 2002) types of state licensure, (Darling-Hammond & Sykes, 2003; Fidler, 2002; Hawk, Coble, & Swanson, 1985; Laczko-Kerr & Berliner, 2001; Qu & Becker, 2003), mathematics content knowledge (Hawk, Coble, & Swanson, 1985; Hill, Rowan, & Ball, 2005; Monk, 1994), and mathematics pedagogical content knowledge (Hill, Rowan, & Ball, 2005; Monk, 1994) have all been associated with variations in student achievement. While connections between these variables and student achievement exist, what is unclear is what happens to cause this variation in student outcomes. Could it be, perhaps, that teachers of varying fields of study vary in instructional content and therefore in curriculum alignment? Gehrke, Knapp, & Sirotnik (1992) explained, "we do not fully understand the extent and depth of variation within mathematics curriculum" (p. 87). They go on to further explain that factors such as teacher beliefs, decision-making, and subject matter knowledge are factors in determining what is taught. However, more research is needed into how these factors change what is taught in the classroom and whether or not these differences account for variations in curriculum alignment.

Shulman (1986) offered a theoretical framework for understanding and researching the types of knowledge that a teacher possesses. These include both content knowledge and pedagogical content knowledge. In mathematics, these two types of knowledge have been associated with student achievement.

Content Knowledge. Research into the relationship between a teacher's content knowledge of mathematics and student achievement has yielded strong support for the conclusion that students with teachers who have an understanding of mathematics perform better than students of teachers who have less of an understanding of mathematics (Fetler, 1999; Goldhaber & Brewer, 2000; Hawk, Coble, & Swanson, 1985; Hill, Rowan, & Ball, 2005; Monk, 1994; Monk & King, 1994; Wenglinsky, 2002). Indeed, the federal government through its demand for highly qualified teachers stresses the importance of content knowledge by mandating that teachers in schools receiving Title I funding demonstrate knowledge of the subject they teach (NCLB, 2002). Some researchers operationalized content knowledge in terms of whether the teachers majored in mathematics (Fetler, 1999; Goldhaber & Brewer, 2000; Wenglinsky, 2002) while others operationalized content knowledge in terms of the number of mathematics courses taken in both graduate and undergraduate school (Hill, Rowan, & Ball, 2005; Monk, 1994; Monk & King, 1994). Still others operationalize content knowledge in terms of performance on an assessment that measures knowledge of mathematics concepts (Hawk, Coble, & Swanson; Hill, Rowan, & Ball, 2005).

As stated previously, a major in mathematics has been associated with higher student achievement. A study conducted on the mathematics achievement of eighth graders (n = 7,146) found that content knowledge as measured by a major or minor in mathematics was related to student achievement on the National Assessment of Educational Progress (NAEP), with an effect size of .09. The researchers used multilevel structural equation modeling in their research analyses. Another study involving twelfth graders yielded similar results (Goldhaber & Brewer, 2000). Using data from the National Educational Longitudinal Survey researchers obtained data regarding teacher background characteristics. They then used student achievement on subject based tests to determine whether teacher background characteristics were related to student achievement. From the mathematics achievement results of 3,786 students and background information on 2,098 mathematics teachers, researchers found that students who have teachers with a major in mathematics have higher achievement scores than students with teachers without a major in mathematics.

Pedagogical Content Knowledge. Shulman (1986) referred to pedagogical content knowledge as an understanding as the most appropriate ways to teach content. Pedagogical content knowledge has been operationalized as the number of mathematics education courses both at the undergraduate and graduate levels (Begle, 1979; Hill, Rowan, & Ball, 2005; Monk, 1994; Monk & King, 1994) and as a teachers' knowledge of effective teaching practices in mathematics (Hill, Rowan, & Ball, 2005).

In a study of the relationship between mathematics education courses and student achievement, Monk (1994) analyzed the mathematics achievement of 2,829 tenth grade students were drawn from 51 randomly selected school districts in the United States. NAEP mathematics achievement test items were used to determine student achievement. A survey of mathematics teachers (n = 608) of the sampled students asked for background information related to number of mathematics education courses taken in both undergraduate and graduate school. The number of mathematics education courses taken was found to be a predictor of student achievement in mathematics. For each additional course in undergraduate mathematics education courses, mathematics achievement increased .4%.

State Licensure. Mathematics teacher preparation varies greatly within the United States, particularly middle school mathematics preparation (Comiti & Ball, 1996; NCTM, 2000). Middle school teachers may have an elementary license, a middle school license, or a secondary license (Gaskill, 2002). This wide array of types of license leads to issues related to major fields of study, content knowledge, and pedagogical content knowledge. The National Council of Teachers of Mathematics (2005) recommended that middle school teachers have at least an undergraduate minor in mathematics. They also stressed the importance of the pedagogical preparation at the middle school level (NCTM, 2000). Most elementary programs involve little preparation in content knowledge. NCTM (2000) explained that "teachers in the middle need to know much more mathematics than is required in most elementary school teacher-certification programs" (p.1). Conversely, teachers with secondary certification need more pedagogical preparation in how to teach mathematics to middle school students.

At the middle school level, teachers may teach in two or more content areas. A report by Knapp, Shields, and Turnbull (1992) claimed that it is difficult for teachers to excel in teaching more than one subject area. The National Middle School Association (2006) recommended that middle school teachers have "a thorough academic underpinning of content, content pedagogy, and the connections and interrelationships among the fields (disciplines) and other areas of knowledge" (p.4). Both the NCTM and the NMSA call for preparation in both content and pedagogy. NCLB also demands that a teacher have full licensure in the state in which they teach (NCLB, 2002). Therefore, variations in the backgrounds of the preparation and licensure of middle school teachers are useful in examining in terms of instructional content and curriculum alignment.

The type of state licensure has been shown to impact student achievement. Studies in this area focus on whether students with teachers who hold a permanent license perform better than students of teachers with emergency or temporary license (Darling-Hammond & Sykes, 2003; Fidler, 2002; Laczko-Kerr & Berliner, 2001; Qu & Becker, 2003). Other studies focus on in-field versus out-of-field teachers, meaning those who have a license to teach mathematics and those who have a license to teach a subject other than mathematics (Hawk, Coble, & Swanson, 1985; Ingersoll, 1999).

In a study of 2nd and 3rd grade student achievement, Fidler (2002) found that students with teachers who held permanent licensure performed better than students of teachers who held emergency or temporary license. The researcher randomly selected 44 2nd grade teachers and their students and 47 3rd grade teachers and their students in the

Los Angeles Unified School District. The study used hierarchical linear modeling (HLM) to examine the relationship between teacher background characteristics and student achievement. Student achievement on the Stanford Achievement Test served as the criterion variable. After controlling for prior achievement, grade-level, and language classification, researchers concluded that teachers with permanent licensure were more likely to impact student mathematics achievement. Although the impact was not statistically significant, the impact was significant at the .07 level, indicating that the impact was practically significant.

A study which examined the relationship between in-field teaching and student achievement found that students of teachers who were licensed to teach mathematics outperformed students of teachers who were not licensed to teach mathematics (Hawk, Coble, & Swanson, 1985). The researchers matched 18 teachers licensed to teach mathematics with 18 teachers who were not licensed to teach mathematics in grades 6-12. The teachers were in the same school and were matched on course type and ability level of students. Using analysis of variance, the researchers compared the mean scores of the students with in-field teachers to the students with out-of-field teachers. The students with in-field teachers scored significantly higher than students with out-of-field teachers on the Stanford 9 achievement test.

Each of these predictors of student achievement indicates that a teacher's content knowledge, pedagogical content knowledge, and type of state licensure can be related to student achievement. However, the actions taken by these teachers who have more content knowledge than others, or who have more pedagogical content knowledge than others, or who are licensed to teach mathematics is a useful source of inquiry. Indeed, Hill, Rowan, and Ball (2005) explained that "…what knowledgeable teachers do in the classrooms – or how knowing mathematics affects instruction – has yet to be studied and analyzed. Does teachers' knowledge of mathematics affect the decisions they make?" (p.401). Teachers decide instructional content. Their decisions on what content to teach bears directly on curriculum alignment and thus a student's opportunity to learn.

Data Collection Methods

An additional topic to be addressed is how to measure OTL in terms of instructional content. Researchers have employed varying methods and have used different variables in order to determine opportunity to learn. The three main methods used include classroom observation, instructional logs, and surveys to measure the implemented, or taught curriculum (Anderson, 2002; Ball & Rowan, 2004).

The IEA studies, as discussed previously, employed mainly surveys of teachers and document analyses of curriculum guides and textbooks to determine both the intended and the implemented curriculum (Helscher, et al., 2001; Husen, 1967; Robataille & Garden, 1989). The results of these studies were subsequently used to interpret student achievement. Other studies have used student surveys as well (Herman, Klein, & Abedi, 2000; Wang, 1998). Teacher instructional logs and classroom observations also have provided a means for examining OTL (Ball & Rowan, 2004; Rowan, Harrison & Hayes, 2004; Smithson & Porter, 1994). Each of these methods for determining content coverage and thus curriculum alignment has advantages and disadvantages.

Researchers agree that classroom observation is the most preferable method of data collection (Anderson, 2002; Ball & Rowan, 2004). However, classroom observations are time consuming and a costly data collection method when working with a large sample of teachers. Teacher instructional logs are another tool used to collect data regarding content coverage. However, teacher instructional logs also are time consuming for teachers and may be less sustainable over time (Smithson & Porter, 1994; Stevens, Wiltz, & Bailey, 1998). Problems arise in motivating teachers to continue to complete logs over a school year. Finally, surveys provide data regarding instructional content.

Surveys are a viable alternative for collecting data about instructional content, and thus, to OTL. First, studies show that instructional content, as measured through teacher reports, explain student achievement (Gamoran, Porter, Smithson, & White, 1997; Husen, 1967; McDonnell, 1995). Second, teacher reports of instructional content are more teacher friendly than other data collection methods.

A study conducted to determine teacher attitudes toward collecting OTL data indicated that two-thirds of teachers surveyed indicated that surveys were a "teacher friendly" way to collect data (Stevens, Wiltz, & Bailey, 1998). Instructional logs and observations received lower ratings from teachers as to their "teacher friendliness." Time was a major factor in instructional logs receiving less favorable ratings. Factors associated with less favorable ratings for observations included the impact of a negative school atmosphere and the possibility of teachers feeling threatened. The researchers explained that survey results "can be useful in building a strong OTL model that can be taught via staff development to improve teaching practices and hopefully improve students' academic achievement" (Stevens, Wiltz, & Bailey, 1998, p. 17).

Finally, Smithson and Porter (1994) validated the use of surveys by correlating data from teacher surveys, instructional logs, and classroom observations. They found strong to moderate correlations between observations and teacher logs, and teacher logs and teacher surveys leading them to conclude that "we find ample evidence for the viability of using both log and survey instruments for describing learning opportunities and instructional practices" (Smithson & Porter, 1994, p. 15). Therefore, surveys appear to provide useful data for examining instructional content and curriculum alignment.

Recently, a new tool for measuring instructional content has emerged as a viable alternative for measuring opportunity to learn by combining methodologies. The Survey of Enacted Curriculum (SEC) provides a way to compare state assessments, state standards, and actual instruction (Blank, Porter, & Smithson, 2001). This tool applies a common language to all three.

Using document analyses, state assessments and state standards are coded according to predetermined content areas and levels of cognitive demand. Instruction is determined by teacher reports of instructional content. Responses are analyzed according to the same framework as the state assessment and state standards. The match between instruction and assessment, instruction and standards, and standards and assessment can then be determined through an alignment index, which is similar to a correlation coefficient. Other tools, such as the Study of Instructional Improvement (Ball & Rowan, 2004; Rowan, Camburn, & Correnti, 2004; Rowan, Harrison & Hayes, 2004) offer questionnaires to determine the implemented curriculum as well as ways to triangulate data through teacher logs. However, they do not provide ways to determine alignment between instructional content and standards. OTL must be examined at the classroom level. Tools such as the Survey of Enacted Curriculum provide a way to focus discussion on curriculum alignment.

Conclusion

OTL is an educational necessity in today's accountability environment. A goal of education is to ensure that students have every opportunity to achieve academically. Making decisions about student learning without examining instruction will lead to erroneous conclusions, even though an assessment has been shown to be valid measure of state standards. Research shows that instructional content affects student achievement (Dunkin, 1978; Dunkin & Doenau, 1980). Research also shows that teachers with varying background characteristics affect student achievement (Darling-Hammond & Sykes, 2003; Fetler, 1999; Fidler, 2002; Goldhaber & Brewer, 2000; Hawk, Coble, & Swanson, 1985; Hill, Rowan, & Ball, 2005; Laczko-Kerr & Berliner, 2001; Monk, 1994; Qu & Becker, 2003; Wenglinsky, 2002). What is needed is alignment among the intended curriculum, the implemented curriculum, and the attained curriculum. Examining curriculum alignment and the background characteristics of teacher preparation provide a glimpse into whether or not such alignment exists and possibly suggests reasons for variation in curriculum alignment.

CHAPTER III: METHODS

Introduction

This chapter provides descriptions of the sample, instrumentation, and methods of data collection and analysis used in this study. The major purpose of this study was to determine whether selected background characteristics of grade 5-8 Mathematics teachers affect alignment between instructional content and content covered in state standards. Data from an extant database was used to analyze teacher perceptions of instructional content and curriculum alignment in terms of elements related to teacher background characteristics.

Research Questions

1. To what degree does major field of study relate to curriculum alignment?
2. To what degree does type of state licensure of grades 5-8 mathematics teachers relate to curriculum alignment?
3. What is the relationship between content knowledge of grades 5-8 mathematics teachers and curriculum alignment?
4. What is the relationship between pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?
5. What is the relationship between content knowledge and pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

Sample

Data from grades 5 through 8 mathematics teachers who completed the Survey of Enacted Curriculum (SEC) between 2003 and 2005 were used in this study. The sample was limited to teachers who had completed all parts of the survey and for whom analyzed target standards were available. Analyzed target state standards are state standards that fit both the state in which the teacher teaches and the grade the teacher teaches and state standards that have been content analyzed by subject area experts. A listing of the states, grade levels, and state standards used as targets can be found in Appendix A. Teachers from the following twenty states were included in this study: Alabama, California, Idaho, Illinois, Indiana, Iowa, Massachusetts, Maine, Michigan, Mississippi, Montana, New Hampshire, New Jersey, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, and Wisconsin.

Generalizability

The findings in this study are generalizable only to the sample used in the study. The sample involved teachers who volunteered to complete the Survey of Enacted Curriculum (SEC) as part of school improvement efforts and were not a random sample of teachers within their school district or within the state. Therefore, the generalizability of the findings is limited.

Data Collection Methods

Instrumentation

Survey of Enacted Curriculum (SEC)

The SEC collects data regarding teacher perceptions of instructional content, teacher background characteristics and instructional practices. This study utilized only the data gathered from the Survey of Instructional Content (SIC) and teacher background characteristics related to major field of study, licensure, number of refresher and advanced mathematics courses taken, and number of mathematics education courses taken.

The SEC has been in development for more than ten years (Blank, 2001; Gamoran, Porter, Smithson, & White, 1997; Porter, Kirst, Osthoff, Smithson, & Schneider, 1993). Major development on the mathematics and science surveys occurred from 1994 to 1998 through a collaborative initiative between the Council of the Chief State School Officers (CCSSO) and the Wisconsin Center for Education Research (WCER) with support from the National Science Foundation. Subject area experts, assessment specialists, and researchers participated in the development and field-testing of survey items and piloting of survey instruments, thus, supporting the content validity of the survey instrument (Gall, Gall, & Borg, 2003). The basis for survey development included state and national standards, as well as previous survey instruments used in the Third International Study of Math and Science (TIMSS), the National Assessment of Educational Progress (NAEP), and the National Survey of Science and Mathematics Education from Horizon Research (CCSSO, 2005) to collect data regarding instructional content. A field test of the survey instrument was conducted across 11 states in a three-year longitudinal study. The survey instrument was refined based on the analysis of data collected in the longitudinal study (Blank, 2001).

A finding supporting the predictive validity of the survey instrument involves the study of mathematics achievement in high school. In a 1997 study using an earlier version of the SEC, researchers found that instructional content accounted for 20% of the variance in class achievement gains and accounted for 7% of the variance in individual student achievement gains (Gamoran, Porter, Smithson, & White, 1997). Prior student achievement, socio-economic status of the student, and instructional content in class accounted for almost all of the variance in student achievement gains.

A concern with using a survey is the accuracy of the responses. Although it is best to use additional data collection methods to provide convergent evidence for the validity of the responses, the scope of this project will not permit such data collection. A study using an earlier version of the SEC and daily logs to analyze instructional content and practices found sufficient evidence of agreement between teacher reports on the questionnaire and teacher reports on daily logs (Smithson & Porter, 1994). Six of ten mathematical dimensions revealed statistically significant correlations between questionnaire data and teacher log data, ranging in values from .59 to .93. The four nonsignificant dimensions included concepts of number and number sense, number relations, arithmetic and measurement, and probability. Smithson and Porter (1994) reasoned that the first three dimensions listed are difficult to separate because number sense, number relations, and arithmetic and measurement are integrated into other mathematics content, thus, Smithson and Porter (1994) were not surprised at the nonsignificant findings. Seven of eight science dimensions revealed statistically significant correlations between questionnaire data and teacher log data. Therefore, it appears that a teacher's ability to recall a year's worth or a semester's worth of instruction is a viable alternative to daily teacher logs.

The Second International Mathematics Study (SIMS) reached similar conclusions regarding the use of questionnaire data to explain student achievement. McDonnell (1995) explained, "Not only did the OTL data provide a context that permitted more valid interpretations of the SIMS achievement results, but the data also stood on their own as a telling indicator of the status of mathematics curricula internationally and within the United States" (p. 307). The use of the questionnaire alone is a limitation of this study.

However, studies support teacher self-reports as a way of examining the implemented curriculum.

Survey of Instructional Content (SIC)

The SIC, a portion of the SEC was used for teacher perceptions of instructional content (See Appendix B). For each survey topic, mathematics teachers were asked to report amount of instructional time as measured by class periods and the level of cognitive demand employed in a target class over a one-year period. Teachers were encouraged to use any documents that would assist them in recalling instructional content over the one-year period (e.g., lesson plans, pacing guides, instructional units of study). This portion of the SEC requires about 30 minutes for teachers to complete.

Instructional content can be viewed in terms of coarse grain and fine grain. Instructional content included in coarse grain are: number sense/properties/relationships, operations, measurement, algebraic concepts, geometric concepts, and data analysis/probability/statistics. Fine grain data include individual topics within each reporting category. For example, number sense includes topics such as place value, patterns, decimals, percent, etc. In the survey teachers were asked to determine the emphasis given to each fine grain topic. The categories of emphasis include: none or not covered, slight coverage (less than one class or lesson), moderate coverage (one to five classes or lessons), and sustained coverage (more than five classes or lessons). Teachers are also asked to determine the percentage of time that was spent at each level of cognitive demand for each topic. These categories include: no emphasis, slight emphasis (less than 25% of time on this topic), moderate emphasis (between 25% and 33% of time on this topic), and sustained emphasis (more than 33% of time on this topic). Levels of cognitive demand include memorize, perform procedures, demonstrate understanding of mathematical ideas, solve nonroutine problems, and conjecture/generalize/prove.

Content Analysis Coding Procedures

State standards and national standards were analyzed by subject area experts using detailed coding procedures (See Appendix C). These coding procedures were developed, field-tested, and refined over a 25-year period (Porter, 2002). Subject area experts assigned codes to the standards according to content topic and level of cognitive demand. The K-8 content topics include: number sense/properties/relationships, operations, measurement, algebraic concepts, geometric concepts, and data analysis/probability/statistics. The levels of cognitive demand include: memorize, perform procedures, demonstrate understanding of mathematical ideas, solve nonroutine problems, and conjecture/generalize/prove.

The reliability of the content analysis data have been examined in terms of inter-rater reliability. Porter (2002) explained that "the reliability of average ratings across two raters was .70 and across four raters, .82" (p. 10). According to a review of research on the strength of correlation coefficients, values of .70 and .82 represent substantial agreement and, therefore, support the reproducibility of results (Stemler, 2001). Therefore, the inter-rater reliability of the content coding of state standards is acceptable for research purposes.

Data Analyses

Data analyses occurred in two phases. Phase I involved determining curriculum alignment between teacher perception of instructional content and content covered on state standards. Phase II involved comparing and determining the relationship between teacher background and alignment indices.

Phase I: Determining Curriculum Alignment for Survey Respondents

Curriculum alignment served as a key variable in each data analysis. Curriculum alignment was determined by calculating an alignment index value for each respondent in the database. The alignment index value, the proxy variable for curriculum alignment, was determined by comparing teacher reports of instructional content and content analyses of target state standards.

Survey Data Analysis

Survey data were analyzed based on the topics covered and level of cognitive demand. Teachers report the amount of instructional time given to each topic and the level of emphasis for each level of cognitive demand, as described in the previous section. The data were then analyzed and changed into proportions of total instructional time spent on each topic, at varying levels of cognitive demand. Table 4 provides an example of the content covered in classroom instruction at the coarse grain level. The data presented in this figure are simulated data. The proportions have been changed to percentages to show the percentage of total instruction spent on each topic and on each level of cognitive demand.

Table 4

Example of Percentages of Instructional Content from Survey Data Collection

	Level of Cognitive Demand					
Coarse Grain Content Topics	Memorize	Solve Non-Routine Problems/ Make Connections	Perform Procedures	Demonstrate Understanding of Mathematical Ideas	Conjecture, Generalize, Prove	Total
Number sense/properties/relationships	10%	0	5%	0	0	15%
Operations	20%	0	5%	0	5%	30%
Measurement	10%	0	5%	0	10%	25%
Algebraic Concepts	0	0	0	5%	0	5%
Geometric Concepts	0	0	0	5%	0	5%
Data Analysis/Probability/Statistics	0	5%	10%	0	5%	20%
Total	40%	5%	25%	10%	20%	100%

In Table 4, the total percentages of instruction sum to 100% of instructional content. In this example, ten percent of instruction occurred in number sense/properties/relationships at the *memorize* level while 5% of instruction occurred at the *perform procedures* level. Number sense/properties/relationships were not covered at the *demonstrate understanding mathematical ideas, conjecture, generalize, prove, or solve non-routine problems/make connections* levels of cognitive demand. For operations, content was covered at the *memorize* level for 20%, *perform procedures* for 5%, and *conjecture, generalize, prove* for 5% of total instruction. Operations was not covered at the *demonstrate understanding of mathematical ideas* and *solve non-routine problems/make connections* levels of cognitive demand. For measurement, 10% of instruction focused on *memorize* level, 5% at the *perform procedures* level, and 10% at the *conjecture, generalize, prove* level. Instruction did not occur at the *demonstrate understanding of mathematical ideas* and the *solve non-routine problems/make connections* levels of cognitive demand. As for algebraic concepts, 5% of total instruction occurred at the *demonstrate understanding of mathematical ideas* levels. Instruction was not provided in any of the other four levels of cognitive demand for algebraic concepts. Geometric concepts yielded the same results as algebraic concepts with 5% of total instruction spent on geometric concepts at the *demonstrate understanding of mathematical ideas* cognitive level but no instruction at the other four levels of cognitive demand. Finally, 10% of instruction was devoted to Data Analysis/Probability/Statistics at the *perform procedures* level, 5% at the *conjecture, generalize, prove* level, and 5% at the *solve non-routine problems/make connections* levels of cognitive demand.

Content Analysis Data

Data from content analyses were analyzed and transformed into proportions, or percentages identical to that of the survey data. The proportions, or percentages, indicate the proportion or percentage of the mathematics standards that addresses the content at varying levels of cognitive demand. This information provides a means for comparison of teacher reports of content coverage and analysis of state standards. Table 5 provides an example of the content covered on state standards at varying levels of cognitive demand.

Table 5

Example of Percentages of Content Covered on a State Standard

	Level of Cognitive Demand					
Coarse Grain Content Topics	Memorize	Solve Non-Routine Problems/ Make Connections	Perform Procedures	Demonstrate Understanding of Mathematical Ideas	Conjecture, Generalize, Prove	Total
Number sense/properties/ relationships	5%	0	5%	10%	0	20%
Operations	0	5%	10%	0	5%	20%
Measurement	0	0	10%	5%	0	15%
Algebraic Concepts	0	0	0	10%	10%	20%
Geometric Concepts	0	0	5%	10%	0	15%
Data Analysis/Probability/Statistics	0	0	5%	0	5%	10%
Total	5%	5%	35%	35%	20%	100%

In Table 5, the total percentages of the content covered in state standards sums to 100%. Five percent of content on the state standard covered number sense/properties/relationships at the *memorize* level while 5% of the content was covered at the *perform procedures* level. In addition, 10% of the content covered on the state standard was covered at the *demonstrate understanding of mathematical ideas* level of cognitive demand. Number sense/properties/relationships was not covered at the *conjecture, generalize, prove*, or *solve non-routine problems/make connections* levels of cognitive demand. For operations, 10% of the content was covered at *perform procedures* level, 5% at the *conjecture, generalize, prove* level, and 5% at the *solve non-routine problems/make connections* level. Mathematics operations was not covered on state standards at the levels of *memorize* and *demonstrate understanding of mathematical* *ideas.* For measurement, 10% of instruction focused on *memorize* level, 10% of the content on the state standard was written at the *perform procedures* level, and 5% at the *demonstrate understanding of mathematical ideas* level. Measurement was not covered at *memorize, perform procedures,* and *solve non-routine problems/make connections* levels of cognitive demand. As for algebraic concepts, 10% of the content on the state standard was written at the *demonstrate understanding of mathematical ideas* and 10% was written at the *conjecture, generalize, prove* level. Algebraic concepts was not covered at *memorize, perform procedures, or solve non-routine problems/make connections* levels of cognitive demand. For geometric concepts, 5% of the content covered on the state standard focused on the *perform procedures* level and 10% focused on the *demonstrate understanding of mathematical ideas* level of cognitive demand. Geometric concepts were not addressed at the *memorize, conjecture, generalize, prove* level, or at *the solve non-routine problems/make connections* level of cognitive demand. Finally, 5% of state standards focused on Data Analysis/Probability/Statistics at the *perform procedures* level and 5% at the *conjecture, generalize, prove* level of cognitive demand. Data analysis/Probability/Statistics was not covered on the state standard at the *memorize, demonstrate understanding of mathematical ideas,* and *solve non-routine problems/make connections* levels of cognitive demand.

The data yielded from both the instructional content as reported by teachers and the data yielded from the content analyses of state standards yields a means for comparing the instructional content and state standards. This means of comparison is explained in the next section.

Alignment Index

By conducting cell-by-cell comparisons between the content contained in state standards and the teacher reports of instructional content at the fine grain level, alignment between the two were examined. The comparison of the content analysis matrix and the survey data matrix yielded an alignment index. The alignment index is similar to a correlation in that its value ranges from 0 to 1.0, with 1.0 indicating perfect alignment (Blank, Porter, & Smithson, 2001; Porter, 2002). The formula for the alignment index is:

$$\text{Alignment Index} = 1 - \frac{\underline{\Sigma\,[X\text{-}Y]}}{2}$$

The X denotes the proportion for the state standards while the Y denotes the proportion for the teacher survey data. Porter (2002) explained, "Conceptually, the index is the sum of cell-by-cell intersects" (p. 5). The alignment index were used for descriptive and comparison purposes, only.

Phase II: Comparing and Determining the Relationships Between Alignment and Selected Teacher Background Characteristics

The SEC also collects data regarding teacher background characteristics. These data were used to compare groups of teachers in terms of curriculum alignment and to determine relationships between teacher background variables and curriculum alignment. A description of the data analyses conducted for each research question is described below.

Research Question 1: To what degree does major field of study relate to curriculum alignment?

This research question was addressed at both the bachelor's level and at the master's level and beyond. Major field of study at the bachelor's level and major field of study at the master's level and beyond were determined through data collected from items 145 and 146 on the survey. The major fields of study were collapsed into two variables, mathematics major or non-mathematics major. A major in mathematics, mathematics education, and mathematics education and mathematics formed the variable, mathematics major. Major fields of study elementary education, middle school education, and other discipline formed the variable, non-mathematics major. These two variables, mathematics major and non-mathematics major were the independent variables for the data analyses. Mean alignment indices were calculated for each group. The alignment index served as the dependent variable in the analysis. Independent samples *t*-test was then conducted to determine whether teachers with mathematics majors differed significantly from teachers with non-mathematics majors, both at the bachelor's level and at the master's level and beyond. The difference was determined to be significant if $p \leq .05$.

Research Question 2: To what degree does type of state licensure of grades 5-8 mathematics teachers relate to curriculum alignment?

This research question was addressed in two ways. First, the types of state licensure were collapsed into two variables, permanent licensure and emergency or temporary licensure. The types of licensure in the permanent licensure variable included elementary grades, middle grades, secondary mathematics, and secondary other. Permanent licensure and temporary or emergency licensure served as the independent variables in the analysis. Mean alignment indices were calculated for teachers who held permanent licensure and for those who held emergency or temporary certification. The mean alignment index served as the dependent variable in the analysis. Independent samples *t*-test was then conducted to determine whether teachers with full licensure differed from those with emergency or temporary licensure. The difference was determined to be significant if $p \leq .05$.

Second, five total groups were compared to address this research question from item 147 on the survey instrument. On item 147, teachers could indicate all types of licenses that applied so teachers may have chosen more than one type of license. For teachers who indicated that they held more than one type of license, type of licensure was coded according to the most appropriate license for the subject and then for the grade level. Therefore, teachers who listed secondary mathematics license as well as middle level license were coded as holding a secondary mathematics license. Teachers who held both a middle level license and an elementary license were coded as holding a middle level license. Teachers who held both a secondary other and an elementary license were coded as elementary license. Teachers who indicated temporary or permanent license and another type of license were coded according to the subject and grade level of the other licenses they held other than emergency or temporary. It was reasoned that these teachers perhaps had moved to a new state and held a license to teach in another state. They may have needed only minimal coursework to obtain a permanent license.

Mean alignment indices were calculated for teachers with the following types of licensure: emergency or temporary, elementary grades, middle grades, secondary other, and secondary mathematics. An analysis of variance was conducted to determine whether the groups differed significantly in terms of alignment between instructional content and state standards. The alignment index was the dependent variable and the type of state license was the independent variable. If the F-ratio was significant at $p \leq .05$, then post hoc comparisons will be made using the Tukey HSD Test to determine which groups are significantly different from others.

Research Question 3. What is the relationship between content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The number of undergraduate and graduate mathematics courses taken served as proxy variables for content knowledge. Teachers reported the number of refresher courses (e.g., algebra and geometry) and the number of advanced (e.g., calculus and statistics courses) they had taken at both undergraduate and graduate levels on items 148 and 149. Two separate bivariate correlations were conducted to determine the degree of relationship that existed between the number of refresher courses taken and the alignment index and if a relationship existed between the number of advanced courses taken and the alignment index. A Pearson product moment correlation (*r*) was calculated to determine the strength of the relationships. For this research question, the relationship(s) was considered significant if $p \leq .05$. The researcher assumed a linear relationship between the two variables; however, a scattergram was plotted to examine the actual relationship.

Research Question 4. What is the relationship between pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The number of undergraduate and graduate mathematics education courses taken served as the proxy variable for pedagogical content knowledge. Teachers reported the number of mathematics education courses they had taken at both undergraduate and graduate levels on item 150. A bivariate correlation was conducted to determine the degree of relationship that existed between the number of mathematics education courses taken and the alignment index and. A Pearson product moment correlation (*r*) was calculated to determine the strength of the relationships. For this research question, the relationship was considered significant if $p \leq .05$. The researcher assumed a linear relationship between the two variables; however, a scattergram was plotted to determine examine the actual relationship.

Research Question 5. What is the relationship between content knowledge and pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The number of undergraduate and graduate refresher and advanced mathematics courses taken served as the proxy variables for content knowledge and the number of undergraduate and graduate mathematics education courses taken served as the proxy variable for pedagogical content knowledge. A step-wise multiple regression analysis was conducted to determine the relationship between the number of refresher mathematics courses taken by teachers, the number of advanced mathematics courses taken by teachers, and the number of mathematics education courses taken and the alignment index. The alignment index served as the criterion variable and the number of refresher mathematics courses taken, the number of advanced mathematics courses taken, and the number of mathematics education courses taken served as the predictor variables.

Ethical Safeguards and Considerations

Ethical concerns regarding the use of an extant database should mirror those safeguards a researcher would take when collecting data. The first page of the SEC details those safeguards to respondents of the survey. This introduction stressed that the survey was voluntary, that participants could choose to withdraw from the study by not completing the survey, and that the information collected through the survey would remain confidential. Teachers were guaranteed that any information that could identify them and their survey results would not be shared with the school, school district, or state staff and that the information would not be used as part of teacher evaluation. The survey was approved through the University of Wisconsin-Madison School of Education's Human Subjects Committee. The researcher gained approval for the study from the Human Subjects Committee at The College of William and Mary. This study reported alignment at the group level rather than at the individual teacher level and therefore, was in keeping with the safeguards expressed in the first page of the survey.

CHAPTER IV: RESULTS

The purpose of this study was to determine the relationships between selected teacher background characteristics of grades 5-8 mathematics teachers and curriculum alignment. Survey responses to the Survey of Instructional Content (SIC) and the teacher background characteristics portion of the Survey of Enacted Curriculum (SEC) were used to measure instructional content and data results from content analyses of state standards were used to measure content covered in state standards.

A total of 2,037 teachers of the 3,424 teachers in the database was used, a difference of 1,387. Teacher responses were excluded if the SIC and the background characteristics portion of the survey had not been completed. Teachers were also excluded if a content analyzed target state standard could not be determined.

Demographic Data

Grades 5-8 mathematics teachers in 20 different states met the criteria for inclusion in this study. As shown in Table 6, these states included Alabama, California, Idaho, Illinois, Indiana, Iowa, Massachusetts, Maine, Michigan, Mississippi, Montana, New Hampshire, New Jersey, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, and Wisconsin. Table 4.1 shows the number of teachers by state and by grade level. States with the largest percentage of teachers included Illinois with 430 teachers, or 21.1% of the total sample and Idaho with 10.4% of the total sample. States with the smallest percentage of teachers in the sample included Pennsylvania (N=4), Indiana (N=20), and Massachusetts (N=20). Teachers who teach mathematics at grades 5, 6, 7, and 8 were part of the sample. Table 6 shows that 564 or 27.7% taught 5th grade, 600 or 29.5% taught 6th grade, 438 or 21.5% taught 7th grade, and 435 or 21.4% taught 8th grade.

Table 6

Frequency and percentage of teachers participating, by state and grade level

State	Grade Level								Total	
	5		6		7		8			
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Alabama	0	0	41	2	39	1.9	39	1.9	119	5.8
California	0	0	24	1.2	12	.6	0	0	36	1.8
Idaho	69	3.4	70	3.4	35	1.7	37	1.8	211	10.4
Illinois	128	6.3	119	5.8	86	4.2	97	4.8	430	21.1
Indiana	1	.0	6	.3	6	.3	7	.3	20	1.0
Iowa	17	.8	7	.3	0	0	0	0	24	1.2
Maine	57	2.8	47	2.3	38	1.9	45	2.2	187	9.2
Massachusetts	0	0	0	0	8	.4	12	.6	20	1.0
Michigan	25	1.2	50	2.5	51	2.5	0	0	126	6.2
Mississippi	0	0	0	0	0	0	14	.7	14	.7
Montana	23	1.1	29	1.4	23	1.1	30	1.5	105	5.2
New Hampshire	11	.5	4	.2	4	.2	4	.2	23	1.1
New Jersey	8	.4	10	.5	2	.1	6	.3	26	1.3
North Carolina	57	2.8	25	1.2	34	1.7	50	2.5	166	8.1
Ohio	58	2.8	44	2.2	13	.6	11	.5	126	6.2
Oklahoma	73	3.6	42	2.1	33	1.6	26	1.3	174	8.5
Oregon	36	1.8	34	1.7	16	.8	13	.6	99	4.9
Pennsylvania	0	0	2	.1	1	.0	1	.0	4	.2
Texas	0	.0	13	.6	0	0	15	.7	28	1.4
Wisconsin	1	.0	33	1.6	37	1.8	28	1.4	99	4.9
Total	564	27.7	600	29.5	438	21.5	435	21.4	2037	100

A majority of the teachers in the sample held a Bachelor's Degree, with 55% of the participants holding either a BA or a BS degree. More than one third (38%) of the participants held a Master's Degree. Twenty-three (23) teachers in the sample did not respond to this item on the survey and therefore are not included in the description of degree level.

Table 7

Frequency and percentage of teachers participating, by degree level

Degree Level	*N*	%
Does Not Apply	6	.3
BA or BS	1108	55.0
MA or MS	775	38.0
Multiple MA or MS	91	4.5
Ph.D. or Ed.D.	10	.5
Other	24	1.2
Total	2014	100.0

Table 8 shows teacher experience in mathematics for the sample. Twenty-three (23) teachers did not report teacher experience. More than one-quarter (28.4%) of the participants had more than fifteen years experience in teaching mathematics. More than 50% had 8 or fewer years of experience teaching mathematics.

Table 8

Frequency and percentage of teachers participating, by years of mathematics teaching experience

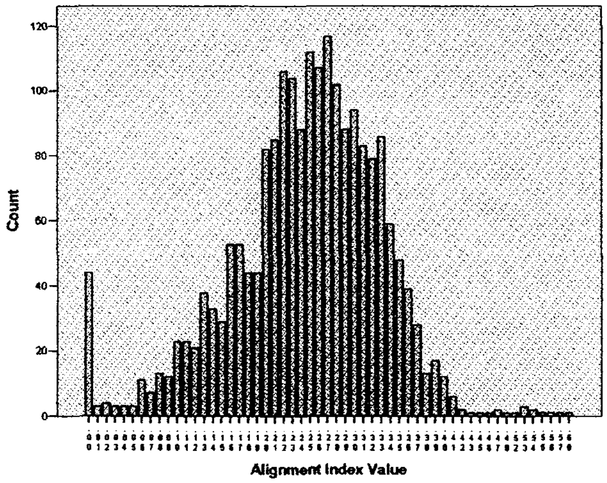
Number of Years	Teaching Experience in Mathematics	
	f	%
Less than a year	215	10.6
1-2 years	193	9.5
3-5 years	389	19.1
6-8 years	259	12.7
9-11 years	187	9.2
12-15 years	192	9.4
More than 15 years	579	28.4
Total	2014	100.0

Analysis of Research Questions

Each research question was addressed using curriculum alignment as a variable in the analysis. Curriculum alignment was measured using the alignment index in each of the analyses. The mean curriculum alignment for the sample was .24 (SD=.09). The range of curriculum alignment was from .00 to .60 among the participants. Figure 3 shows the distribution of alignment index scores among the sample. The shape of the distribution indicates that the alignment index values were normally distributed among the participants.

Figure 3.

Distribution of Alignment Index Values



Research Question 1: To what degree does major field of study relate to curriculum alignment?

This research question was addressed by examining teachers' major field of study at the bachelor's level and at the master's level and beyond. For each level, the analysis was conducted between mathematics major field of study and non-mathematics major field of study. Teachers who indicated that they majored in the following fields of study were grouped in the mathematics major field of study: mathematics, mathematics education, and mathematics education and mathematics and non-mathematics. Teachers who indicated that they majored in the following fields of study were grouped in the non-mathematics major field of study. The results for major field of study at the bachelor's level are presented first.

a) Analysis of Major Fields of study at the Bachelor's Level

The major fields of study were collapsed into two variables, mathematics major and non-mathematics major. Table 9 shows that 70% of the teachers included in the sample majored in mathematics at the bachelor's level. This percentage is similar to a previous study that examined the relationship between mathematics major and student achievement (Wenglinsky, 2002). Wenglinsky found that the 69% of mathematics teachers of eighth grade students majored in mathematics. With an alpha level set at $p \leq .05$ and a two-tailed independent samples *t*-test, the mean alignment index for mathematics majors (M=.24, SD=.08) was not significantly higher than the mean alignment index of non-mathematics majors (M=.25, SD=.09). Therefore, major field of study at the bachelor's level was not significantly related to curriculum alignment. The results of the independent samples t-test are shown in Table 10.

Table 9

Mean Alignment Indices by Two Major Fields of Study at the Bachelor's Level

Major Field of Study	*N*	*M*	*SD*
Mathematics	606	.24	.08
Non-Mathematics	255	.25	.09

Table 10

Independent Samples t-test for Two Major Fields of Study at the Bachelor's Level

t	*df*	*Sig.*	*Mean Difference*
-1.20	859	.23	-.008

Note: Equal variances assumed.

b) Analysis of Major Fields of study at the Master's Level and Beyond

Teachers also provided a major field of study at the master's level and beyond. The major fields of study at the master's level and beyond were collapsed into two variables, mathematics major and non-mathematics major. Table 11 shows that nearly 70% of the teachers included in the sample held amathematics major at the bachelor's level. This percentage is similar to a previous study that examined the relationship between mathematics major and student achievement (Wenglinsky, 2002). Wenglinsky found that the 69% of mathematics teachers of eighth grade students majored in mathematics. With an alpha level set at $p \leq .05$ and a two-tailed independent samples *t*-test, the mean alignment index for mathematics majors (M=.24, SD=.09) was not significantly higher than the mean alignment index of non-mathematics majors (M=.24, SD=.08). Therefore, the major field of study at the master's level in terms of mathematics major or non-mathematics major is not significantly related to curriculum alignment. The results of the independent samples *t*-test are presented in Table 12.

Table 11

Mean Alignment Indices by Major Field of Study at the Master's Level and Beyond

Major Field of Study	*N*	*M*	*SD*
Mathematics	519	.24	.09
Non-Mathematics	222	.24	.08

Table 12

Independent Samples t-test for Major Field of Study at the Master's Level and Beyond

t	*df*	*Sig.*	*Mean Difference*
-.37	739	.71	-.002

Note: Equal variances assumed.

Research Question 2: To what degree does type of state licensure of grades 5-8 mathematics teachers relate to curriculum alignment?

This question was answered in two parts. First, type of state license was collapsed into two groups, emergency or temporary licensure and permanent licensure. Table 13 shows that nearly 97% of the teachers who responded to this item on the survey held permanent licensure. This is slightly higher than previous studies, with samples in which 86% teachers of twelfth grade students and 85.5% of secondary teachers held permanent licensure (Fetler, 1999; Goldhaber & Brewer, 2000). With an alpha level set at $p \leq .05$ and a two-tailed independent samples *t*-test, the mean alignment index for emergency or temporary licensees (M=.23, SD=.09) was not significantly different from the mean alignment index of permanent licensees (M=.25, SD=.09). The results of the independent samples *t*-test are presented in Table 14. The type of state licensure does, however, yield a small effect size ($d = .15$).

Table 13

Mean Alignment Indices by Type of State Licensure

Type of State Licensure	*N*	*M*	*SD*
Emergency or Temporary	52	.23	.09
Permanent	1943	.25	.09

Table 14

Independent Samples T-Test for Type of State License

t	*df*	*Sig.*	*Mean Difference*
1.10	1993	.27	.01

Note: Equal variances assumed.

The next analysis involved an exploratory examination of the five types of state licenses. Of the 2,037 in the sample, 1,995 responded to this item with sufficient sample sizes for each type of license for the analysis. Table 15 shows that more than 51% of the participants held an elementary education license. Only 52, or 3% of the teachers held an emergency or temporary license. As Table 15 shows, the mean alignment index was .23 for emergency or temporary licensees (SD=. 09), .25 for elementary licensees (SD = .08), .24 for middle grades licensees (SD=. 09), .22 for secondary-other licensees (SD=. 09), and .25 for secondary mathematics licensees (SD=. 09). With alpha set at $p \leq .05$, a one-factor between-subjects analysis of variance indicated a significant effect for type of licensure: $F(4,1990) = 4.202, p < .05$. These results are presented in Table 16. Post hoc comparisons using Tukey HSD indicated that teachers with elementary licensure had a significantly higher mean alignment index than teachers who held a secondary-other license. Teachers who held a secondary mathematics licensed also had significantly higher alignment index than teachers who held a secondary-other license. The type of state licensure in this analysis does, however, yield a moderate effect size ($d = .36$). No other significant differences among type of state licensure were indicated by the post hoc comparisons, as presented in Table 17.

Table 15

Mean Alignment Indices by Type of State Licensure

Type of Licensure	*N*	*M*	*SD*
Emergency or Temporary	52	.23	.09
Elementary	1020	.25	.08
Middle Grades	566	.24	.09
Secondary - other	87	.22	.09
Secondary - mathematics	270	.25	.09
Total	1995	.25	.09

Table 16

Analysis of Variance for Type of State Licensure

Source	*SS*	*df*	*MS*	*F*	*Sig.*
Between Groups	.12	4	.03	4.20	.002
Within Groups	14.23	1990	.00		
Total	14.35	1994			

Note: Equal variances assumed.

Table 17

Post Hoc Analysis of Between Groups Variance for Type of State License

Source	*Mean Difference*	*SE*	*Sig.*
Emergency/Temporary			
Elementary	-.02	.01	.57
Middle Grades	-.01	.01	.99
Secondary-other	.01	.02	.91
Secondary-mathematics	-.02	.01	.65
Elementary			
Emergency/Temporary	.02	.01	.57
Middle Grades	.01	.00	.08
Secondary-other	.03	.01	.01*
Secondary-mathematics	.00	.01	1.00
Middle Grades			
Emergency/Temporary	.01	.01	.99
Elementary	-.01	.00	.08
Secondary-other	.02	.01	.28
Secondary-mathematics	-.01	.01	.38
Secondary-other			
Emergency/Temporary	-.01	.02	.91
Elementary	-.03	.01	.01*
Middle Grades	-.02	.01	.28
Secondary-mathematics	-.03	.01	.03*
Secondary-mathematics			
Emergency/Temporary	.02	.01	.65
Elementary	-.00	.01	1.00
Middle Grades	.01	.01	.38
Secondary-other	.03	.01	.03*

*$p < .05$

Research Question 3. What is the relationship between content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The relationship between content knowledge, as measured by a) the number of undergraduate and graduate refresher mathematics courses taken and b) the number of advanced mathematics courses taken, and curriculum alignment was examined. First, the correlation analysis of the relationship between the number of refresher mathematics courses taken and curriculum alignment was addressed.

a) Number of undergraduate and graduate refresher mathematics courses taken

Of the teachers included in this study, 2,033 responded to the item on the survey asking for the number of refresher mathematics courses taken at both the undergraduate and graduate levels. Table 18 shows the frequency of responses. Eighty-one percent (81%) of the responses indicated that teachers in the sample had taken four or fewer refresher mathematics courses.

A bivariate correlation was conducted to determine the extent of a relationship that existed between the two variables. An examination of a scattergram revealed a linear relationship which is required for the Pearson product-moment correlation (Figure 4). With an alpha level set at $p \leq .05$, there was no significant relationship between the number of refresher courses taken (M= 1.64, SD = 1.86) and the alignment index values (M= .25, SD= .09) as presented in Table 19.

Figure 4

Scattergram of Alignment Index Value and Number of Refresher Mathematics Courses Taken

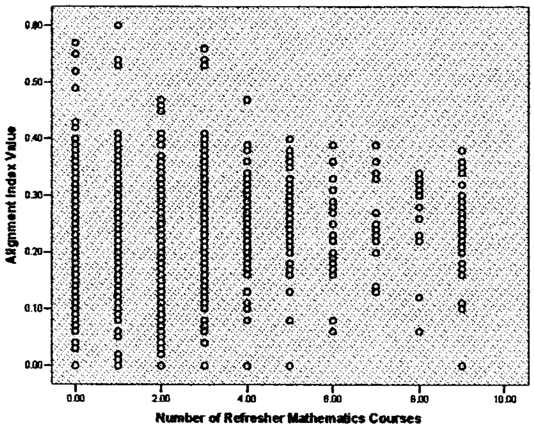


Table 18

Number of Refresher Mathematics Courses Taken

Number of Courses	*N*	%
0	539	26.5
1-2	705	34.7
3-4	395	19.4
5-6	181	8.9
7-8	65	3.2
9-10	48	2.4
11-12	24	1.2
13-14	14	.7
15-16	13	.6
17+	49	2.4
Total	2033	100.0

Table 19

Bivariate Correlation Coefficient Between Number of Refresher Mathematics Courses Taken and Alignment Index Value

	Number of Refresher Mathematics Courses Taken *r*
Alignment Index Values	-.001

b) Number of undergraduate and graduate advanced mathematics courses taken

Next, a bivariate correlation between the number of advanced graduate and undergraduate mathematics courses taken and curriculum alignment was conducted. Of the teachers included in this study, 2,033 responded to the item on the survey asking for the number of advanced mathematics courses taken at both the undergraduate and graduate levels. Table 20 shows the frequency of responses. Eighty percent (80%) of the responses indicated that teachers in the sample had taken four or fewer advanced mathematics courses.

Figure 5

Scattergram of Alignment Index Values and Number of Advanced Mathematics Courses Taken

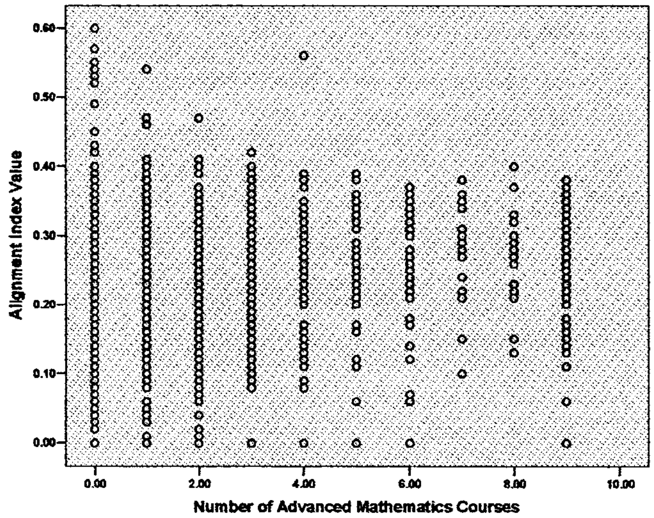


Table 20

Number of Advanced Mathematics Courses Taken

Number of Courses	*N*	%
0	880	43.3
1-2	480	23.6
3-4	260	12.8
5-6	117	5.7
7-8	77	3.7
9-10	64	3.1
11-12	40	2.0
13-14	19	.9
15-16	20	1.0
17+	76	3.7
Total	2033	100.0

A bivariate correlation was conducted to determine the degree of a relationship that existed between the two variables. An examination of a scattergram revealed a linear relationship, which is required for the Pearson product-moment correlation (Figure 5). With an alpha level set at $p \leq .05$, there was a significant relationship between the number of advanced courses taken (M= 1.57, SD = 2.24) and the alignment index values (M= .25, SD= .09). As presented in Table 21, the number of undergraduate and graduate advanced mathematics courses taken and the alignment index value were significantly positively related. The shared variance between the two variables was .4%. Therefore, a positive relationship existed between the number of advanced mathematics courses taken and curriculum alignment. However, the variance accounted for indicated a weak relationship.

Table 21

Bivariate Correlation Coefficient Between Number of Advanced Mathematics Courses Taken and Alignment Index

	Number of Advanced Mathematics Courses Taken *r*
Alignment Index Values	.06*

* Correlation is significant at the .05 level (2-tailed).

Research Question 4. What is the relationship between pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The relationship between pedagogical content knowledge, as measured by the number of undergraduate and graduate mathematics education courses taken, and curriculum alignment was examined. Of the 2,037 in the sample, 100% of the teachers responded to this item on the survey. As indicated in Table 22, 86% of the teachers in the sample responded that they had taken at least five to six mathematics education courses at the undergraduate and/or graduate levels.

Figure 6

Scattergram of Alignment Index and Number of Mathematics Education Courses Taken

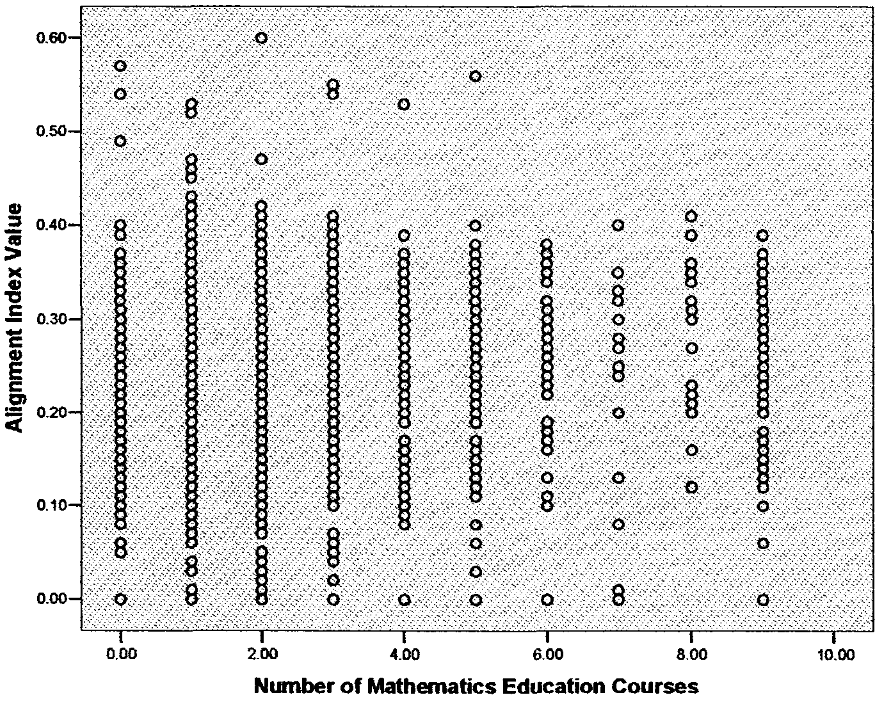


Table 22

Frequency of Number of Mathematics Education Courses Taken

Number of Courses	*N*	%
0	292	14.3
1-2	678	33.3
3-4	466	22.9
5-6	253	12.4
7-8	102	5.0
9-10	83	4.1
11-12	46	2.3
13-14	22	1.1
15-16	23	1.1
17+	72	3.5
Total	2037	100.0

A bivariate correlation was conducted to determine the degree of relationship that existed between the two variables. An examination of a scattergram revealed a linear relationship and not a curvilinear relationship (Figure 6). With an alpha level set at $p \leq .05$, there was no significant correlation between the number of mathematics education courses taken (M=2.19, SD = 2.08) and the alignment index values (M = .245, SD= .085) as shown in Table 23.

Table 23

Bivariate Correlation Coefficient Between Number of Mathematics Education Courses Taken and Alignment Index

	Number of Mathematics Education Courses Taken *r*
Alignment Index Value	.04

Research Question 5. What is the relationship between content knowledge and pedagogical content knowledge of grades 5-8 mathematics teachers and curriculum alignment?

The number of refresher mathematics courses taken, the number of advanced mathematics courses taken, and the number of mathematics courses taken served as the predictor variables and alignment index values served as the criterion variable in the analysis to address research question 5. A stepwise regression analysis was used to examine the collective and individual strength of the relationships. After entering the three predictor variables, the number of refresher mathematics courses taken and the number of mathematics education courses taken were excluded from the model. With an alpha level set at $p \leq .05$, the step-wise regression analysis indicated that the number of advanced mathematics education courses taken was a significant predictor of alignment index values as shown in Table 24. The coefficient of determination (R^2) was .004, meaning that .4% of the variance in curriculum alignment can be predicted from the number of advanced mathematics courses taken. While statistically significant, the variance accounted for does not indicate a strong relationship. Table 24 summarizes the results of the stepwise multiple regression.

Table 24

Summary of Stepwise Regression Analysis for Variable Predicting Alignment Index

Predictor	*B*	*Beta*	*R*	R^2	*Adjusted* R^2	*F*
Number of Advanced Mathematics Courses Taken	.002	.06	.06	.004	.003	7.32*

*$p < .05$

CHAPTER V: SUMMARY, DISCUSSION, AND RECOMMENDATIONS

This chapter provides a summary of research findings. In addition, a discussion focuses on the findings and how they relate to the larger body of research and literature on opportunity to learn, curriculum alignment, and the effects of selected teacher background characteristics. Finally, implications of the research and recommendations for further study are addressed.

Summary of Findings

This study explored the extent to which opportunity to learn was related to selected background characteristics of grades 5-8 mathematics teachers. Opportunity to learn was viewed in terms of curriculum alignment - that is alignment between instructional content and state standards. Specifically, the relationships between curriculum alignment and 1) major field of study both at the bachelor's level and the master's level, 2) type of state licensure, 3) number of refresher and advanced undergraduate and graduate mathematics courses taken, and 4) the number of mathematics education courses taken were examined.

This study used an extant database of teacher responses to the Survey of Enacted Curriculum (SEC). Teacher responses were excluded from the database if they did not meet the following criteria: 1) completed Survey of Instructional Content (SIC) and completed background characteristics and, 2) a target state standard by which to conduct an alignment analyses could be identified. Teacher responses to the SIC were compared to content analyses of state standards, which yielded an alignment index. The alignment index served as the dependent variable in the analyses. After excluding cases for these reasons, 2,037 teachers from 20 different states were included in the sample.

Data analyses included the following statistical techniques: comparison between the means, including independent samples *t*-tests and analysis of variance, bivariate correlations, and a multiple regression.

The findings are summarized as follows:

1. The curriculum alignment of teachers who majored in mathematics either at the bachelor's level or at the master's level was not significantly different from curriculum alignment of teachers without a major in mathematics either at the bachelor's level or master's level.
2. Curriculum alignment of teachers who held a temporary or emergency license was not significantly different from curriculum alignment of teachers who held a permanent license to teach.
3. Curriculum alignment of teachers with either an elementary license or a secondary mathematics license was significantly higher than teachers with a secondary license in a field other than mathematics. Teachers with a temporary or emergency license or a middle level license did not differ significantly from any other group on curriculum alignment.
4. The number of refresher mathematics courses was not significantly correlated with curriculum alignment while the number of advanced undergraduate and graduate mathematics courses were significantly related to curriculum alignment. However, the correlation was so small that the relationship was not practically significant.
5. The number of undergraduate and graduate mathematics education courses taken by teachers was not significantly correlated with curriculum alignment.

Discussion of Findings

The discussion of findings compares the findings of this research study with findings of other research in the field related to teacher background characteristics and curriculum alignment with an emphasis on providing students with the opportunity to learn. The line of inquiry into providing students with opportunities to learn is well-established in the field (Husen, 1967; McDonnell, 1995; Wang, 1998). However, the examination of opportunity to learn in terms of curriculum alignment and teacher background characteristics is not well-developed and therefore the findings from this study must be interpreted with caution.

Opportunity to Learn and Curriculum Alignment

The alignment index provided an avenue for exploring the extent to which students had the opportunity to learn the content contained on state standards. It was reasoned that the more instructional content was aligned with content covered by state standards the more students would have had an opportunity to learn. Students of teachers in this database varied considerably in alignment of instructional content to state standards. The range of curriculum alignment was between .00 and .60, meaning that, depending on the teacher, between 0% and 60% of instructional content teachers reported teaching was aligned with the content on state standards. However, when the teachers were organized into groups for comparison purposes, the range by group is 22-25%. Therefore, the means between the groups varied slightly and so it was not surprising that significant differences were not found and when they were found, those differences were not meaningful.

The relatively low curriculum alignment means were consistent with means found in other studies, which used the alignment index as a comparison value (Blank, Porter, & Smithson, 2001; Smithson & Blank, 2006). For example, in a study of the effects of professional development on curriculum alignment for Grades 6-12 mathematics teachers, Smithson and Blank found curriculum alignment levels at approximately .18 and .21. Therefore, the curriculum alignment means of this study are not an anomaly.

The low curriculum alignment values bring into question whether students in these states are provided opportunities to learn the content contained within state mathematics standards and are performing well on state achievement tests. An examination of recent achievement scores of students within the twenty states included in these analyses indicates that students must be learning mathematics content. A majority of the students in each state scored at or above proficiency on statewide achievement tests (See Appendix D). Although the teachers within the sample are a convenient, volunteer sample, the alignment values may not be indicative of whether or not students would perform well on state statewide achievement tests.

Content Knowledge, Pedagogical Content Knowledge, and Curriculum Alignment

Content knowledge and pedagogical content knowledge were operationalized in terms of major field of study both at the bachelor's level and at the master's level and beyond and by the number of refresher and advanced undergraduate and graduate mathematics courses taken, and the number of mathematics education courses taken. A limitation to this study was the reliance on single indicators of content knowledge and pedagogical content knowledge, which could call into question construct validity. However, these indicators have been used in production function studies to examine the relationship between teacher background characteristics and student achievement (Darling-Hammond & Sykes, 2001; Hill, Rowan, & Ball, 2005; Rowan, Chiang, & Miller, 1997; Shulman, 1987).

To examine content knowledge, major field of study at the bachelor's level and at the master's level and beyond were examined and found to have no significant impact on curriculum alignment. It would seem from the analyses that a teacher's major field of study is not related to providing grades 5-8 mathematics students with opportunities to learn. A limitation to these analyses was the lack of responses to major field of study. For bachelor's level major field of study only 42 % in the sample responded and for Master's level and beyond major field of study only 36% in the sample responded to this item. One would expect a lower rate for respondents at the Masters' level and beyond, as not all teachers have Master's degrees.

After conducting the analyses the researcher realized that the findings could be spurious if a teacher were to have a major in mathematics at the bachelor's level and majored in a non-mathematics field at the master's level. The content knowledge gained as an undergraduate would affect the alignment analysis at the master's level and beyond. Therefore, the researcher decided to conduct an additional analysis in which teachers were coded as to whether they majored in mathematics at the bachelor's level or at the master's level and beyond. This coding resulted in 1087 valid responses or 49% of the total sample. An independent samples *t*-test was conducted to determine whether curriculum alignment differed significantly between those who majored in mathematics at the bachelor's level or at the master's level and beyond and those who did not major in mathematics at either level. The additional analysis revealed that curriculum alignment of mathematics majors either at the bachelor's level or at the master's level and beyond (M=.24, SD=.09) was not significantly different from the curriculum alignment of non-mathematics majors (M=.25, SD=.09).

The findings of this study are inconsistent with the findings of other research studies that have found a stronger relationship between teachers with a mathematics major and student achievement (Goldhaber & Brewer, 1996; Hill, Rowan, & Ball, 2005; Monk, 1994; Wenglinsky, 2000; Wenglinsky, 2002). The No Child Left Behind Act (2001) addresses teacher quality in light of the evidence of content knowledge, specifically at the middle school level. In middle school a teacher may teach mathematics with a wide range of content knowledge. NCLB now requires that middle school teachers have a major in the subject they teach or demonstrate subject matter expertise. This requirement poses major challenges to teachers in middle schools to become "highly qualified" (Alliance for Excellent Education, 2003).

Likewise, the number of refresher mathematics courses and the number of advanced mathematics courses were not related to OTL, which runs counter to research that shows that content knowledge in terms of the number of mathematics courses taken is positively related to student achievement (Hill, Rowan, & Ball, 2005; Monk, 1994). The number of advanced undergraduate and graduate mathematics courses was significantly and positively correlated with curriculum alignment, however, it explained only .4% of the variance, which is not a meaningful amount of explained variance. Monk (1994) showed that the number of undergraduate courses in math was positively related to student achievement. For sophomores, teachers taking mathematics at graduate level had a positive effect on student achievement. Therefore, content knowledge was related to student achievement.

As for pedagogical content knowledge, the number of mathematics education courses was not significantly correlated with curriculum alignment, which is inconsistent with research that supports the importance of pedagogical content training (Frome, Lasater, & Cooney, 2005; Monk, 1994). In a study of the relationship between mathematics education courses taken by teachers and student achievement, Monk (1994) found that the number of mathematics education courses taken by teachers had a positive effect on student achievement at both the sophomore and junior grade levels. The number of graduate mathematics education courses taken by teachers had a small positive effect on student achievement. An analysis showed that undergraduate courses in pedagogy contributed more to student achievement than undergraduate courses in mathematics. Likewise, a study of rural eighth grade students residing in the Southern region of the United States revealed that of 11 measures of teacher quality, only four were significant predictors of student achievement. One of those four significant factors included a major in mathematics education. Researchers concluded, “High quality instruction demands that teachers know their subject …” (Frome, Lasater, & Cooney, 2005, p. 7).

The analyses related to content knowledge and pedagogical content knowledge indicated that positive indicators of student achievement do not relate in the same way to curriculum alignment. The question that arises from this finding is whether curriculum alignment is a positive indicator of student achievement. Further studies linking curriculum alignment to student achievement would illuminate this discussion.

Type of State Licensure and Curriculum Alignment

Research regarding the relationship between type of state license and student achievement supports the conclusion that teachers with a license to teach mathematics are more effective than those who do not have a license to teach mathematics and those who have an emergency or temporary license (Darling-Hammond, Berry, & Thoreson, 2001; Fetler, 1999; Goldhaber & Brewer, 2000; Hawk, Coble, & Swanson, 1985; Laczko-Kerr & Berliner, 2002). The findings of this study suggest that teachers with permanent licensure or temporary/emergency licensure do not differ significantly in terms of curriculum alignment. The type of state licensure does, however, yield a small effect ($d =$ .15). Teachers who are teaching within their field do align their instructional content to state standards more so than do teachers who are teaching out of their field.

In a study of teachers with emergency or temporary license or on waivers, and licensed teachers of mathematics in grades 3 through 8, Laczko-Kerr and Berliner (2002) found that students who had teachers with a permanent license performed significantly better on state achievement tests than students whose teachers had an emergency or temporary license or were on waivers. One reason for the nonsignificant finding of this study could be the researcher's inability to distinguish between those teachers who have a temporary or permanent license and have minimal education coursework or those who lack courses and content knowledge in the subject they are teaching (Darling-Hammond, Berry, & Thoreson, 2001). That is, teachers with a temporary or permanent license could essentially have taken similar mathematics courses and mathematics education courses as those with permanent licensure (Hill, Rowan, & Ball, 2005). A limitation of this study is the inability to address the issue of teachers with temporary or emergency licensure who have content knowledge and pedagogical content knowledge.

Teachers who teach at the middle school level can be licensed to teach mathematics and yet have different types of licenses (Gaskill, 2002; National Forum to Accelerate Middle-Grades Reform, 2002). For example, a teacher could hold an elementary license and be licensed to teach multiple subjects from kindergarten through eighth grade. In the same state a teacher could hold a secondary mathematics license and be licensed to teach mathematics in grades 5 through 12. A teacher could also either hold a middle level license or a middle level endorsement. The types of licenses vary by state, which further confounds the issue of whether the type of license is related to teachers' curriculum alignment.

The study did find that the curriculum alignment of teachers with an elementary license and teachers with a secondary mathematics license was significantly higher than teachers with a secondary certificate in a field other than mathematics. Cohen's *d* also indicates a moderate effect of state licensure on curriculum alignment ($d = .36$). This finding is consistent with research that has found that teachers with a license to teach mathematics is positively related to student achievement and those who have a license in another subject negatively related to students' mathematics achievement (Hawk, Coble, & Swanson, 1985; Ingersoll, 1999).

A small scale study of in-field and out-of-field teachers of grades 6-12 mathematics found significant differences between teachers licensed to teach mathematics (n=18) versus teachers not licensed to teach mathematics (n=18) (Hawk, Coble, & Swanson, 1985). An analysis of variance revealed that students with teachers who were licensed in mathematics performed better on the Mathematics Stanford Achievement Tests than students with teachers who were not licensed in mathematics. Also, an independent samples *t*-test revealed that teachers with math licensure scored significantly higher than teachers not licensed to teach mathematics on a measure of teachers' mathematical knowledge. Arguably, teachers with an elementary license have likely received some training in mathematics teaching and teachers with a secondary mathematics license possess both the content knowledge and the pedagogical content knowledge to teach mathematics.

Conclusions

The research findings of this study were perplexing. Research regarding selected teacher background characteristics and student achievement has indicated strong, positive relationships between the two variables (Darling-Hammond, Berry, & Thoreson, 2001; Darling-Hammond & Sykes, 2001; Fetler, 1999; Goldhaber & Brewer, 2000; Hawk, Coble, & Swanson, 1985; Hill, Rowan, & Ball, 2005; Laczko-Kerr & Berliner, 2002; Rowan, Chiang, & Miller, 1997; Shulman, 1987). If curriculum alignment is to be an indicator of student achievement, then it was expected that indicators of student achievement would be indicators of curriculum alignment as well. This was not the case. However, numerous confounding issues could have influenced the results of this study.

Sample

The database consisted of a non-random sample of teachers from 20 states who volunteered to complete the survey. Although this study relies on teacher reports from volunteers and does not attempt to generalize to a target population, the findings nonetheless can be useful in the examination of the relationship of content knowledge, pedagogical content knowledge, and state licensure to curriculum alignment. Further studies that employ random sample procedures are needed.

Measuring Curriculum Alignment

The measure of curriculum alignment relied on data from both teacher self-reports of instructional content and content analyses of state standards. This study relied on teacher perceptions of the instructional content they teach over the school year. Concerns with self-reports include the respondents understanding of terminology on the survey instrument, self-report bias, memory, social desirability, and veracity of responses (Gall, Gall, & Borg, 2003; Wiersma, 1995). The SEC requires teacher to recall the number of classes spent on a given topic during the school year as well as the percentage of those classes spent on the topic at a given level of cognitive demand. The ability of teachers to recall instructional content with such great specificity and so long after the fact may factor into the relatively low alignment means (Porter & Smithson, 2001). Teachers may also provide answers that they perceive as desirable, given the current state of the standards movement. Further studies into the validity of teacher reports from a year-long period of teaching are necessary.

Another critical element to this study was the reliance on the alignment index. The alignment index is similar to a correlation but ranges in value from 0 to 1. An advantage of the alignment index includes the ability to compare crucial elements of alignment, including both the instructional content and content covered on state standards. Alignment values ranged from .00 to .60. Therefore, variation among teachers' alignment was present in the sample. However, the mean alignment indices did not vary across comparison groups. Further study is needed into the use of the alignment index itself and methods for measuring alignment.

The Intended Curriculum

Another concern regarding curriculum alignment is the teachers' familiarity with the state standards. In a study of the effects of professional development similar alignment means were found, with curriculum alignment increasing from Year 1 to Year 3 of the study (Smithson & Porter, 2006). Both the comparison group and the treatment group showed an increase in alignment of instructional content to state standards; however, there was no significant difference between the two groups. These findings suggest that familiarity with the standards can increase alignment. Therefore, curriculum alignment may increase over time merely due to experience with the standards and from pressure to do some from administration.

The state mathematics standards themselves present a factor of variability that was not controlled in this study. In selected states such as Illinois, Maine, Montana, New Jersey, Pennsylvania, and Wisconsin, state mathematics standards are written for grade bands, meaning standards are written to cover more than one grade level and therefore are more general. Other states have standards written for each grade level and thus are more specific in nature. Table 25 shows the states included in the analysis and the type of state standard by grade band or by grade level. Therefore, some standards may be more broadly written and others written more specifically (Reys, Dingman, Sutter, & Teuscher, 2005).

The researcher was curious as to whether curriculum alignment values would be influenced by the specificity of state mathematics standards. An exploratory analysis was conducted to determine if curriculum alignment of teachers in states with grade band mathematics standards was significantly different from teachers in states with grade level mathematics standards. With an alpha level set at $p \leq .05$ and a two-tailed independent samples *t*-test, the mean curriculum alignment for teachers teaching in states with grade band mathematics standards (M=.27, SD=.00) was significantly higher than the mean for teachers teaching in states with grade level mathematics standards (M=.23, SD=.00), $t(2035) = -9.34$, $p < .05$. Therefore, one possible explanation for the lack of significant findings could be the variability in the specificity of state mathematics standards. It would seem that alignment values of teachers in states with grade band mathematics standards are a function of the language of the standards. Further study within one state would help address the issue of the differences between types of state mathematics standards.

Table 25

Type of State Mathematics Standard, Grade Band or Grade Level

States with Grade Band Mathematics Standards	States with Grade Level Mathematics Standards
Illinois	Alabama
Iowa*	California
Maine	Idaho
Montana	Indiana
New Jersey	Maine
Pennsylvania	Massachusetts
Wisconsin	New Hampshire
	North Carolina
	Ohio
	Oklahoma
	Oregon
	Texas

*Note: Iowa has core content standards and benchmarks that are guidelines for use by school districts in developing their own standards.

Another factor affecting curriculum alignment is the link between the school district curriculum and the state mathematics standards. The school district curricula may or may not be aligned with standards and if teachers are using the school district curriculum as their guide their curriculum alignment may be correspondingly low. Therefore, a study within one school district in which the curriculum is aligned with state mathematics standards would mitigate this confounding potentially factor.

Teacher Motivation

Teachers' personal and professional goals may also conflict with the state standards, and therefore the teachers' motivation to align with the state standards might be adversely influenced (Cimbricz, 2002; Grant, 2000). A qualitative study of the impact of the Maryland state standards movement revealed that middle school teachers stayed with their traditional curriculum rather than change instruction to align more closely with state standards because the teachers were more concerned with providing students with the knowledge and skills that the teachers felt the students needed to be successful in high school (Firestone, Mayrowetz, & Fairman, 1998). In an interview, one teacher remarked that "his job is to 'get them ready for algebra. That's my personal opinion. You know, not to get them ready to pass the MEAs [Maryland Educational Assessment]. That's not what I'm here for" (Firestone, Mayrowetz, & Fairman, 1998, p. 107). Therefore, the teachers' personal goals impact decisions on what and how to teach.

Recommendations

1. Further research into the ability of teachers to recall a year's worth of mathematics instruction with the level of specificity required to calculate the alignment index is warranted in order to investigate the validity of teacher self-reports.
2. Examine the relationship between teacher background characteristics and curriculum alignment with a random sample within one state and within one school district to negate differences between level of specificity in state mathematics standards and alignment of school district mathematics curriculum to state mathematics standards and to have access to student demographics in order to control for student level differences.
3. Replicate a research study (Gamoran, et al., 1997) that found that instructional content is a significant predictor of student achievement and conduct a research study into the predictive validity of the alignment index.

4. Conduct a longitudinal study to determine whether curriculum alignment increases over time due to familiarity with state standards.

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Appendix A

Target State Standards, by State and Grade Level

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
Alabama (2005)	6	Alabama Standard Grade 6 (2005)
	7	Alabama Standard Grade 7 (2005)
	8	Alabama Standard Grade 8 (2005)
California (2005)	5	California Standard Grade 5 (2003)
	6	California Standard Grade 6 (2003)
	7	California Standard Grade 7 (2003)
Idaho (2004)	5	Idaho Standard Grade 5 (2004)
	6	Idaho Standard Grade 6 (2004)
	7	Idaho Standard Grade 7 (2004)
	8	Idaho Standard Grade 8 (2004)
Illinois (2004)	5	Illinois Standard Grades 5-8 (2003)
	6	Illinois Standard Grades 5-8 (2003)
	7	Illinois Standard Grades 5-8 (2003)

Appendix A (cont'd)

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
	8	Illinois Standard Grades 5-8 (2003)
Indiana (2005)	5	Indiana Standard Grade 5 (2002)
	6	Indiana Standard Grade 6 (2002)
	7	Indiana Standard Grade 7 (2002)
	8	Indiana Standard Grade 8 (2002)
Iowa (2005)	5	Iowa Standard Grade 8 (2002)
	6	Iowa Standard Grade 8 (2002)
Maine (2004)	5	Maine Intermediate Standard (2004)
	6	Maine Intermediate Standard (2004)
	7	Maine Intermediate Standard (2004)
	8	Maine Intermediate Standard (2004)
Massachusetts (2004)	7	Massachusetts Standard Grade 7 (2004)
	8	Massachusetts Standard Grades 7-8 (2004)

Appendix A (cont'd)

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
Michigan (2004)	5	Michigan Standard Grade 5 (2004)
	6	Michigan Standard Grade 6 (2004)
	7	Michigan Standard Grade 7 (2004)
Mississippi (2004)	8	Mississippi Standard Grade 8 (2004)
Montana (2005)	5	Montana Standard Grade 8 (2005)
	6	Montana Standard Grade 8 (2005)
	7	Montana Standard Grade 8 (2005)
	8	Montana Standard Grade 8 (2005)
New Hampshire (2004, 2005)	5	New Hampshire Standard Grade 5 (2005)
	6	New Hampshire Standard Grade 6 (2005)
	7	New Hampshire Standard Grade 7 (2005)

Appendix A (Cont'd)

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
	8	New Hampshire Standard Grade 8 (2005)
New Jersey (2004)	5	New Jersey Standard Grade 8 (2004)
	6	New Jersey Standard Grade 8 (2004)
	7	New Jersey Standard Grade 8 (2004)
	8	New Jersey Standard Grade 8 (2004)
North Carolina (2004, 2005)	5	North Carolina Standard Grade 5 (2005)
	6	North Carolina Standard Grade 6 (2005)
	7	North Carolina Standard Grade 7 (2005)
	8	North Carolina Standard Grade 8 (2005)
Ohio (2005)	5	Ohio Indicators Grade 5 (2005)
	6	Ohio Indicators Grade 6 (2005)

Appendix A (Cont'd)

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
	7	Ohio Indicators Grade 7 (2005)
	8	Ohio Indicators Grade 8 (2005)
Oklahoma (2004, 2005)	5	Oklahoma Standards Grade 5 (2004)
	6	Oklahoma Standards Grade 6 (2004)
	7	Oklahoma Standards Grade 7 (2004)
	8	Oklahoma Standards Grade 8 (2004)
Oregon (2004, 2005)	5	Oregon Standard Grade 5 (2004)
	6	Oregon Standard Grade 6 (2004)
	7	Oregon Standard Grade 7 (2004)
	8	Oregon Standard Grade 8 (2004)
Pennsylvania (2005)	6	Pennsylvania Standard Grade 8 (2003)
	7	Pennsylvania Standard Grade 8 (2003)

Appendix A (Cont'd)

State (Survey Year)	Grade Level	State Standard Target (Standard Year)
	8	Pennsylvania Standard Grade 8 (2003)
Texas (2003, 2005)	6	Texas Standard Grade 6 (2003)
	8	Texas Standard Grade 8 (2003)
Wisconsin (2004, 2005)	5	Wisconsin Standard Grade 8 (2002)
	6	Wisconsin Standard Grade 8 (2002)
	7	Wisconsin Standard Grade 8 (2002)
	8	Wisconsin Standard Grade 8 (2002)

Appendix B

Council of Chief State School Officers
Wisconsin Center for Education Research

SURVEYS OF ENACTED CURRICULUM®

Survey Of Instructional Practices

Teacher Survey

Grades K-8

Mathematics

Thank you for agreeing to participate in this survey of instructional practice and content. This survey is part of a collaborative effort to provide education researchers, policymakers, administrators, and most importantly, teachers like yourself with comparative information about instruction in districts participating in the SEC Collaborative or associated initiatives from states and districts around the country. To learn more about the surveys of enacted curriculum and their use in other projects, please visit the project website; http://www.secsurvey.org

Your participation in this survey is voluntary. If you choose to participate, your personal information will remain strictly confidential. Information that could be used to identify you or used to connect you to individual results will not be shared with staff in your school, district or state. Individual respondents are never identified in any reports of results. The questionnaire poses no risk to you and there is no penalty for refusal to participate. You may withdraw from the study simply by returning the questionnaire without completing it, without penalty or loss of services or benefits to which you would be otherwise entitled.

If you have any questions regarding your rights as a research participant, please contact the University of Wisconsin-Madison School of Education's Human Subjects Committee office at (608) 262-2463.

A joint project of the Council of Chief State School Officers and the Wisconsin Center for Education Research, with funding support from the National Science Foundation and participating states and districts. Limited Copyright.

Please provide the following information:
(Note: Your personal information will be kept confidential.)

Name: ______________________________

Email address: ______________________________
(required for on-line access to individual results)

District: ______________________________

School: ______________________________

Date: ______________________________

Providing your name and email address will allow you to gain access to your individual results along with results for your school and/or district.

☐ ______ ☐ ______ ☐ ______

Instructions for Selecting the Target Class --

Mathematics Instruction *-- For all questions about classroom practices please refer only to activities in the mathematics class that you teach. If you teach more than one mathematics class, select the first class that you teach each week. If you teach a split class (i.e. the class is split into more than one group for mathematics instruction) select only one group to describe as the target class.*

Please read each question and the possible responses carefully, and then mark your response by filling in the appropriate circle in the response section. A pen or pencil may be used to complete the survey.

1 Which of these categories best describes the way classes at this school are organized?

① Departmentalized Instruction
② Taught by Subject Area Specialist (non-departmental)
③ Self-contained
④ Team taught

2 If your school is departmentalized, or you are a subject area specialist, how many different mathematics courses do you currently teach?

⓪ ① ② ③ ④ ⑤ ⑥ ⑦
(Number of courses taught)

3 Which term best describes the target class, or course, you are teaching?

⓪ Other
① Elementary Math
② Middle School Math
③ Pre-algebra
④ Algebra
⑤ Integrated Math
⑥ Geometry
⑦ Trigonometry
⑧ Advanced Math
⑨ Calculus

TARGET CLASS DESCRIPTION

4 Indicate the grade level of the majority of students in the target class.

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	①	②
K	1	2	3	4	5	6	7	8	9	10	11	12

5 How many students are in the target class?

⓪ 10 or less
① 11 to 15
② 16 to 20
③ 21 to 25
④ 26 to 30
⑤ 31 or more

6 What percentage of the students in the target class are **female**? (Estimate to the nearest ten percent.)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Less than 10	10	20	30	40	50	60	70	80	90+ %

7 What percentage of the students in the target class are **not** Caucasian?
(Estimate to the nearest ten percent.)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Less than 10	10	20	30	40	50	60	70	80	90+ %

8 *During a typical week*, approximately how many hours will the target class spend in mathematics instruction?

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
(Number of instructional hours)

9 What is the average length of each class period for this targeted mathematics class?

⓪ Not applicable
① 30 to 40 minutes
② 41 to 50 minutes
③ Varies due to block scheduling or integrated instruction
④ 51 to 60 minutes
⑤ 61 to 90 minutes
⑥ 91 to 120 minutes

10 How many weeks total will the target mathematics class/course meet for this school year?

	⓪	①	②
Total # weeks =	1 to 12	13 to 24	25 to 36

11 Estimate the achievement level of the majority of students in the target class, based on national standards.

① High Achievement Levels

② Average Achievement Levels

③ Low Achievement Levels

④ Mixed Levels of Achievement

12 What percentage of students in the target class are Limited English Proficient (LEP)?
(Estimate to the nearest ten percent.)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Less than 10	10	20	30	40	50	60	70	80	90+ %

13 What is considered most in scheduling students into this class?

⓪ Ability or Achievement
① Limited English Proficiency
② Teacher Recommendation
③ Parent Request
④ No one factor more than another
⑤ Student selects

HOMEWORK (work assigned to be done *outside of class*)

Answer the following questions with regard to your target class:

14 How often do you usually assign mathematics homework to be done outside of class?

- ⓪ Never (Skip to # 18)
- ① Less than once per week
- ② Once or twice per week
- ③ 3-4 times per week
- ④ Every day

15 How many minutes does the typical student spend on a normal homework assignment completed outside of class?

- ⓪ I do not assign homework
- ① Less than 15 minutes
- ② 15-30 minutes
- ③ 31-60 minutes
- ④ 61-90 minutes
- ⑤ More than 90 minutes

16 Does homework done outside of class count towards student grades?

- ⓪ Never
- ① Usually does not
- ② Usually does
- ③ Always does

17 How often do you assign homework to be completed in a small group outside of class?

- ⓪ Never
- ① Less than once per week
- ② Once or twice per week
- ③ 3-4 times per week
- ④ Every day

***AMOUNT OF HOMEWORK TIME** (for the school year)*

0 - None
1 - Little *(10% or less of homework time for the school year)*
2 - Some *(11-25 % of homework time for the school year)*
3 - Moderate *(26-50% of homework time for the school year)*
4 - Considerable *(50% or more of homework time for the school year)*

What percentage of the time that students in the target class spend on mathematics homework done *outside of class* do you expect them to:

	None	Little	Some	Moderate	Considerable
18 Complete computational exercises or procedures from a textbook or worksheet.	⓪	①	②	③	④
19 Solve word problems from a textbook or worksheet.	⓪	①	②	③	④
20 Explain their reasoning or thinking in solving a problem, using several sentences.	⓪	①	②	③	④
21 Work on a demonstration or proof of their mathematics work.	⓪	①	②	③	④
22 Collect data as part of mathematics homework.	⓪	①	②	③	④
23 Work on an assignment, report, or project that takes longer than one week to complete .	⓪	①	②	③	④
24 Solve novel or non-routine mathematical problems.	⓪	①	②	③	④

INSTRUCTIONAL ACTIVITIES IN MATHEMATICS

Listed below are questions about the types of activities that students in the target class engage in during mathematics instruction. For each activity, you are asked to estimate the relative amount of time a typical student will spend engaged in that activity during classroom instruciton over the course of a school year. The activities are not necessarily mutually exclusive; across activities, your answers will undoubtedly greatly exceed 100%. Consider each activity on its own, estimating the range that bests indicates the relative amount of mathematics instructional time that a typical student spends over the course of a school year engaged in that activity.

AMOUNT OF INSTRUCTIONAL TIME ***(for the school year)***

0 - None
1 - Little *(10% or less of instructional time for the school year)*
2 - Some *(11-25 % of instructional time for the school year)*
3 - Moderate *(26-50% of instructional time for the school year)*
4 - Considerable *(50% or more of instructional time for the school year)*

How much of the total mathematics instructional time do students in the target class:

		None	Little	Some	Moderate	Considerable
25	Watch the teacher demonstrate how to do a procedure or solve a problem.	⓪	①	②	③	④
26	Read about mathematics in books, magazines, or articles (**not** textbooks).	⓪	①	②	③	④
27	Take notes from lectures or the textbook.	⓪	①	②	③	④
28	Complete *computational exercises or procedures* from a textbook or a worksheet.	⓪	①	②	③	④
29	Present or demonstrates solutions to a math problem to the whole class.	⓪	①	②	③	④
30	Use manipulatives (for example, geometric shapes or algebraic tiles), measurement instruments (for example, rulers or protractors), and data collection devices (for example, surveys or probes).	⓪	①	②	③	④
31	Work *individually* on mathematics exercises, problems, investigations, or tasks.	⓪	①	②	③	④
32	Work *in pairs or small groups* on math exercises, problems, investigations, or tasks.	⓪	①	②	③	④
33	Do a mathematics activity with the class outside the classroom.	⓪	①	②	③	④
34	Use computers, calculators, or other technology to learn mathematics.	⓪	①	②	③	④
35	Maintain and reflect on a mathematics portfolio of their own work.	⓪	①	②	③	④
36	Take a quiz or test.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME ***(working individually)***

0 - None
1 - Little *(10% or less of individual work time on mathematical exercises, problems or tasks)*
2 - Some *(11-25 % of individual work time on mathematical exercises, problems or tasks)*
3 - Moderate *(26-50% of individual work time on mathematical exercises, problems or tasks)*
4 - Considerable *(50% or more of individual work time on mathematical exercises, problems or tasks)*

When students in the target class work *individually* on mathematics exercises, problems, investigations, or tasks, how much time do they:

		None	Little	Some	Moderate	Considerable
37	Solve *word problems* from a textbook or worksheet.	⓪	①	②	③	④
38	Solve non-routine mathematical problems (for example, problems that require novel or non-formulaic thinking).	⓪	①	②	③	④
39	Explain their reasoning or thinking in solving a problem, using several sentences orally or in writing.	⓪	①	②	③	④
40	Apply mathematical concepts to "real-world" problems.	⓪	①	②	③	④
41	Make estimates, predictions or hypotheses.	⓪	①	②	③	④
42	Analyze data to make inferences or draw conclusions.	⓪	①	②	③	④
43	Work on a problem that takes at least 45 minutes to solve.	⓪	①	②	③	④
44	Complete or conduct proofs or demonstrations of their mathematical reasoning.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME ***(in pairs or small groups)***

0 - None
1 - Little *(10% or less of instructional time in pairs or small groups)*
2 - Some *(11-25 % of instructional time in pairs or small groups)*
3 - Moderate *(26-50% of instructional time in pairs or small groups)*
4 - Considerable *(50% or more of instructional time in pairs or small groups)*

When students in the target class work *in pairs or small groups* on math exercises, problems, investigations, or tasks, how much time do they:

		None	Little	Some	Moderate	Considerable
45	Solve *word problems* from a textbook or worksheet.	⓪	①	②	③	④
46	Solve non-routine mathematical problems (for example, problems that require novel or non-formulaic thinking).	⓪	①	②	③	④
47	Talk about their reasoning or thinking in solving a problem.	⓪	①	②	③	④
48	Apply mathematical concepts to "real-world" problems.	⓪	①	②	③	④
49	Make estimates, predictions or hypotheses.	⓪	①	②	③	④
50	Analyze data to make inferences or draw conclusions.	⓪	①	②	③	④
51	Work on a problem that takes at least 45 minutes to solve.	⓪	①	②	③	④
52	Complete or conduct proofs or demonstrations of their mathematical reasoning.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME (using hands-on materials)

0 - None
1 - Little *(10% or less of instructional time using hands-on materials)*
2 - Some *(11-25 % of instructional time using hands-on materials)*
3 - Moderate *(26-50% of instructional time using hands-on materials)*
4 - Considerable *(50% or more of instructional time using hands-on materials)*

When students in the target class use *hands-on materials*, how much time do they:

		None	Little	Some	Moderate	Considerable
53	Work with manipulatives (for example, counting blocks, geometric shapes, or algebraic tiles) to understand concepts.	⓪	①	②	③	④
54	Measure objects using tools such as rulers, scales, or protractors.	⓪	①	②	③	④
55	Build models or charts.	⓪	①	②	③	④
56	Collect data by counting, observing, or conducting surveys.	⓪	①	②	③	④
57	Present information to others using manipulatives (for example, chalkboard, whiteboard, posterboard, projector).	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME (using calculators, computers or other ed. tech.)

0 - None
1 - Little *(10% or less of instructional time using calculators, computers, or other ed. tech.)*
2 - Some *(11-25 % of instructional time using calculators, computers, or other ed. tech.)*
3 - Moderate *(26-50% of instructional time using calculators, computers, or other ed. tech.)*
4 - Considerable *(50% or more of instructional time using calculators, computers, or other ed. tech.)*

When students in the target class are engaged in activities that involve the use of *calculators, computers, or other educational technology* as part of mathematics instruction, how much time do they:

		None	Little	Some	Moderate	Considerable
58	Learn facts	⓪	①	②	③	④
59	Practice procedures	⓪	①	②	③	④
60	Use sensors and probes	⓪	①	②	③	④
61	Retrieve or exchange data or information (for example, using the Internet or partnering with another class)	⓪	①	②	③	④
62	Display and analyze data	⓪	①	②	③	④
63	Develop geometric concepts (for example, using simulations)	⓪	①	②	③	④

ASSESSMENTS

For items 64-71, indicate how often you use each of the following when assessing students in the target mathematics class.

		Never	1 - 4 times per year	1 - 3 times per month	1 - 3 times per week	4 - 5 times per week
64	Objective items (for example, multiple choice, true/false).	⓪	①	②	③	④
65	Short answer questions such as performing a mathematical procedure.	⓪	①	②	③	④
66	Extended response item for which student must explain or justify solution.	⓪	①	②	③	④
67	Performance tasks or events (for example, hands-on activities).	⓪	①	②	③	④
68	Individual or group demonstration, presentation.	⓪	①	②	③	④
69	Mathematics projects.	⓪	①	②	③	④
70	Portfolios.	⓪	①	②	③	④
71	Systematic observation of students.	⓪	①	②	③	④

INSTRUCTIONAL INFLUENCES

For items 72-81, indicate the degree to which each of the following influences what you teach in the target mathematics class.

		Not Applicable	Strong Negative Influence	Somewhat Negative Influence	Little or No Influence	Somewhat Positive Influence	Strong Positive Influence
72	Your state's curriculum framework or content standards.	⓪	①	②	③	④	⑤
73	Your district's curriculum framework or guidelines.	⓪	①	②	③	④	⑤
74	Textbook / instructional materials.	⓪	①	②	③	④	⑤
75	State tests or results.	⓪	①	②	③	④	⑤
76	District tests or results.	⓪	①	②	③	④	⑤
77	National mathematics education standards.	⓪	①	②	③	④	⑤
78	Your experience in pre-service preparation.	⓪	①	②	③	④	⑤
79	Students' special needs.	⓪	①	②	③	④	⑤
80	Parents/community.	⓪	①	②	③	④	⑤
81	Preparation of students for the next grade or level.	⓪	①	②	③	④	⑤

CLASSROOM INSTRUCTIONAL PREPARATION

For items 82-91, please indicate how well prepared you are to:

		Not Well Prepared	Somewhat Prepared	Well Prepared	Very Well Prepared
82	Teach mathematics at your assigned level.	⓪	①	②	③
83	Integrate mathematics with other subjects.	⓪	①	②	③
84	Provide mathematics instruction that meets mathematics content standards (district, state, or national).	⓪	①	②	③
85	Use a variety of assessment strategies (including objective and open-ended formats).	⓪	①	②	③
86	Teach problem solving strategies.	⓪	①	②	③
87	Teach mathematics with manipulatives, such as counting blocks or geometric shapes.	⓪	①	②	③
88	Teach students with physical disabilities.	⓪	①	②	③
89	Teach classes with students with diverse abilities.	⓪	①	②	③
90	Teach mathematics to students from a variety of cultural backgrounds.	⓪	①	②	③
91	Teach mathematics to students who have Limited English Proficiency.	⓪	①	②	③

TEACHER OPINIONS

Please indicate your opinion about each of the statements below:

		Strongly Disagree	Disagree	Neutral / Undecided	Agree	Strongly Agree
92	Students learn mathematics best when they ask a lot of questions.	⓪	①	②	③	④
93	It is important for students to learn basic mathematics skills before solving problems.	⓪	①	②	③	④
94	I am supported by colleagues to try out new ideas in teaching mathematics.	⓪	①	②	③	④
95	I am required to follow rules at this school that conflict with my best professional judgment about teaching and learning mathematics.	⓪	①	②	③	④
96	Mathematics teachers in this school regularly observe each other teaching classes.	⓪	①	②	③	④
97	Mathematics teachers in this school trust each other.	⓪	①	②	③	④
98	It's OK in this school to discuss feelings, worries, and frustrations with other mathematics teachers.	⓪	①	②	③	④
99	Mathematics teachers respect other teachers who take the lead in school improvement efforts.	⓪	①	②	③	④
100	It's OK in this school to discuss feelings, worries, and frustrations with the principal.	⓪	①	②	③	④
101	The principal takes personal interest in the professional development of the teachers.	⓪	①	②	③	④

PROFESSIONAL DEVELOPMENT ACTIVITIES IN MATHEMATICS EDUCATION

In answering the following items, consider all the professional development activities related to mathematics content or mathematics education that you have participated in between ***June 1st of last year and May 31st of this year****. Professional development refers to a variety of activities intended to enhance your professional knowledge and skills, including in-service training, teacher networks, course work, institutes, committee work, and mentoring. In-service training is professional development offered by your school or district to enhance your professional responsibilities and knowledge. Workshops are short term learning opportunities that can be located in your school or elsewhere. Institutes are longer term professional learning opportunities, for example, of a week or longer in duration.*

How Often?		How many hours?	
⓪ Never	③ 3-4 times	⓪ N/A	③ 16-35
① Once	④ 5-10 times	① 1-6 hrs.	④ 36-60
② Twice	⑤ > 10 times	② 7-15 hrs.	⑤ 61+ hrs.

	How Often?	How many hours?
102 For the time period referenced above, how often, and for how many total hours, have you participated in *workshops or in-service training related to mathematics or math education* ?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤
103 For the time period referenced above, how often, and for how many total hours, have you participated in *summer institutes related to mathematics or math education* ?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤
104 For the time period referenced above, how often have you attended *college courses related to mathematics or math education* and about how many hours did you spend in class?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤

Between June 1st of last year and May 31st of this year, how frequently have you engaged in each of the following activities related specifically to the teaching and learning of mathematics?

	Never	Once or **twice a year**	Once or **twice a term**	Once or twice a **month**	Once or twice a **week**	**Almost daily**
105 Attended conferences related to mathematics or math education.	⓪	①	②	③	④	⑤
106 Participated in a teacher study group.	⓪	①	②	③	④	⑤
107 Participated in a teacher network or collaborative of teachers supporting professional development.	⓪	①	②	③	④	⑤
108 Acted as a coach or mentor to other teachers or staff in your school.	⓪	①	②	③	④	⑤
109 Received coaching or mentoring.	⓪	①	②	③	④	⑤
110 Participated in a committee or task force focused on curriculum and instruction.	⓪	①	②	③	④	⑤
111 Engaged in informal self-directed learning (for example, discussion with colleague about math or math education topics, read a journal article on math or math education, use the internet to enrich knowledge and skills).	⓪	①	②	③	④	⑤

Thinking again about all of your professional development activities in mathematics or mathematics education between June 1st of last year and May 31st of this year, how often have you:

		Never	Rarely	Some times	Often
112	Observed demonstrations of teaching techniques.	⓪	①	②	③
113	Led group discussions.	⓪	①	②	③
114	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	⓪	①	②	③
115	Reviewed student work or scored assessments.	⓪	①	②	③
116	Developed assessments or tasks as as part of a formal professional development activity.	⓪	①	②	③
117	Practiced what you learned and received feedback as part of a professional development activity.	⓪	①	②	③
118	Received coaching or mentoring in the classroom.	⓪	①	②	③
119	Given a lecture or presentation to colleagues.	⓪	①	②	③

Thinking about all of your professional development activities between June 1st of last year and May 31st of this year, indicate how often they have been:

		N/A	Never	Rarely	Some times	Often
120	Designed to support the school-wide improvement plan adopted by your school.	⑨	⓪	①	②	③
121	Consistent with your mathematics department or grade level plan to improve teaching.	⑨	⓪	①	②	③
122	Consistent with your own goals for your professional development.	⑨	⓪	①	②	③
123	Based explicitly on what you had learned in earlier professional development activities.	⑨	⓪	①	②	③
124	Followed up with related activities that built upon what you learned as part of the activity.	⑨	⓪	①	②	③

Between June 1st of last year and May 31st of this year, have you participated in professional development activities in mathematics or mathematics education in the following ways?

	No	Yes
125 I participated in professional development activities with most or all of the teachers from my school.	⓪	①
126 I participated in professional development activities with most or all of the teachers from my department or grade level.	⓪	①
127 I participated in professional development activities *not* attended by other staff members from my school.	⓪	①
128 I discussed what I learned with other teachers in my school or department who did *not* attend the activity.	⓪	①

How much *emphasis* did your professional development activities in math or math education place on the following topics?

	None	Slight	Moderate	Great
129 State mathematics content standards (for example, what they are and how they are used).	⓪	①	②	③
130 Alignment of mathematics instruction to curriculum.	⓪	①	②	③
131 Instructional approaches (for example, use of manipulatives).	⓪	①	②	③
132 In-depth study of mathematics or specific concepts within mathematics (for example, fractions).	⓪	①	②	③
133 Study of how children learn particular topics in mathematics.	⓪	①	②	③
134 Individual differences in student learning.	⓪	①	②	③
135 Meeting the learning needs of special populations of students (for example, second language learners; students with disabilities).	⓪	①	②	③
136 Classroom mathematics assessment (for example, diagnostic approaches, textbook-developed tests, teacher-developed tests).	⓪	①	②	③
137 State or district mathematics assessment (for example, preparing for assessments, understanding assessments, or interpreting assessments).	⓪	①	②	③
138 Interpretation of assessment data for use in mathematics instruction.	⓪	①	②	③
139 Technology to support student learning in mathematics.	⓪	①	②	③

TEACHER CHARACTERISTICS

	Female	Male
140 Please indicate your gender.	①	②

141 Please indicate your ethnicity/race.

Indicate all that apply

① American Indian or Alaska Native
② Asian
③ Black or African American
④ Hispanic or Latino
⑤ Native Hawaiian or Other Pacific Islander
⑥ White

	Less than 1 year	1 - 2 years	3 - 5 years	6 - 8 years	9 - 11 years	12 - 15 years	More than 15 years
142 How many years have you taught mathematics prior to this year?	⓪	①	②	③	④	⑤	⑥
143 How long have you been assigned to teach at your current school?	⓪	①	②	③	④	⑤	⑥

	Does not apply	BA or BS	MA or MS	Multiple MA or MS	Ph.D. or Ed.D.	Other
144 What is the highest degree you hold?	⓪	①	②	③	④	⑤

145 What was your major field of study for the bachelors degree?

① Elementary Education
② Middle School Education
③ Mathematics Education
④ Mathematics
⑤ Mathematics Education **and** Mathematics
⑥ Other Disciplines (includes other Education fields, Science, History, English, Foreign Languages, etc.)

146 **If applicable**, what was your **major field** of study for the **highest degree you hold** beyond a bachelors degree?

① Elementary Education
② Middle School Education
③ Mathematics Education
④ Mathematics
⑤ Mathematics Education **and** Mathematics
⑥ Other Disciplines (includes other Education fields, Science, History, English, Foreign Languages, etc.)

147 What type(s) of state certification do you currently have?

Indicate all that apply

① Emergency or Temporary Certification
② Elementary Grades Certification
③ Middle Grades Certification
④ Secondary certification in a field **other** than mathematics
⑤ Secondary Mathematics Certification

FORMAL COURSE PREPARATION

Please indicate the number of *quarter or semester courses* that you have taken at the undergraduate or graduate level in each of the following areas:

		(Number of courses)									
		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17+
148	Refresher mathematics courses (e.g., algebra, geometry)	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
149	Advanced mathematics courses (e.g., calculus, statistics)	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
150	Mathematics Education	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

This is the end of the Instructional Practices portion of the survey. Please continue on to complete the Instructional Content portion. Thank you.

Council of Chief State School Officers
Wisconsin Center for Education Research

SURVEYS OF ENACTED CURRICULUM ®

Survey Of Instructional Content
Teacher Survey
Grades K-8
Mathematics

The following pages request information regarding topic coverage and your expectations for students in the target mathematics class **for the current school year.** The content matrix that follows contains lists of discrete topics associated with mathematics instruction. The categories and the level of specificity are intended to gather information about content across a wide variety of programs. It is not intended to reflect any recommended or prescribed content for the grade level and may or may not be reflective of your local curriculum.

Please read the instructions on the next two pages carefully before proceeding.

Step 1: Indicate topics not covered in this class

Begin by reviewing the entire list of topics identified in the topics column of each table, noting how topics are grouped. After reviewing each topic within a given grouping, if none of the topics listed within that group receive any instructional coverage, circle the "<None>" in the "Time on Topic" column for that group. For any individual topic which is not covered in this mathematics class, fill in the circled "zero" in the "Time on Topic" column. (Not necessary for those groups with "<None>" circled.) Any topics or topic group so identified will not require further response. [Note, for example, that the class described in the example below did not cover any topics under "Instructional Technology" and so "<None>" is circled.]

Step 2: Indicate the amount of time spent on each topic covered in this class

Examine the list of topics a second time. This time note the amount of coverage devoted to each topic by filling in the appropriately numbered circle in the "Time on Topic" column based upon the following codes:

0 = None, not covered	
1 = Slight Coverage	(less than one class/lesson)
2 = Moderate Coverage	(one to five classes/lessons)
3 = Sustained Coverage	(more than five classes/lessons)

Step 1 **Step 2**

Time on Topic		*High School Math Topics*	*Expectations for Students in Mathematics*				
<none>	1	**Number Sense / Properties / Relationships**	**Memorize Facts, Definitions, Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems, Make Connections**
⓪①●③	101	Place value	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
●①②③	102	Whole numbers	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②●	103	Operations	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
●①②③	104	Fractions	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①●③	105	Decimals	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①●③	106	Percents	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
●①②③	107	Ratio, proportion	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②●	108	Patterns	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
●①②③	109	Real numbers	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
[✓ <none>]	6	**Instructional Technology**	**Memorize Facts, Definitions, Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems, Make Connections**
⓪①②③	601	Use of calculators	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②③	602	Graphing calculators	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②③	603	Computers and internet	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③

Step 3: Indicate relative emphasis of each student expectation for every topic taught

The final step in completing this section of the survey concerns your expectations for what students should know and be able to do. For each topic area, please provide information about the relative amount of instructional time spent on work designed to help students reach each of the listed expectations by filling in the appropriately numbered circle using the response codes listed below. (Note: To the left of each content sheet you will find a list of descriptors for each of the five expectations for students.)

0 = No emphasis	(Not an expectation for this topic)
1 = Slight emphasis	(Accounts for less than 25% of the time spent on this topic)
2 = Moderate emphasis	(Accounts for 25% to 33% of the time spent on this topic)
3 = Sustained emphasis	(Accounts for more than 33% of the time spent on this topic)

Note: A code of "3" should typically be given for only one, and no more than two expectation categories within any given topic. No expectation codes should be filled-in for those topics for which no coverage is provided (i.e., circled "0" or "<None>").

Step 3

Time on Topic		*High School Math Topics*	*Expectations for Students in Mathematics*				
<none>	1	**Number Sense / Properties / Relationships**	**Memorize Facts, Definitions, Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems, Make Connections**
⓪①●③	101	Place value	⓪①②●	⓪①②●	⓪①●③	⓪●②③	⓪●②③
●①②③	102	Whole numbers	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②●	103	Operations	⓪①●③	⓪①●③	●①②③	⓪①●③	⓪①②③
●①②③	104	Fractions	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①●③	105	Decimals	⓪①●③	⓪●②③	●①②③	⓪①②●	⓪●②③
⓪①●③	106	Percents	⓪①●③	⓪①●③	⓪①●③	⓪①●③	●①②③
●①②③	107	Ratio, proportion	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②●	108	Patterns	⓪●②③	⓪●②③	⓪①②●	⓪●②③	⓪①②●
●①②③	109	Real numbers	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
[✓ <none>]	6	**Instructional Technology**	**Memorize Facts, Definitions, Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems, Make Connections**
⓪①②③	601	Use of calculators	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②③	602	Graphing calculators	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③
⓪①②③	603	Computers and internet	⓪①②③	⓪①②③	⓪①②③	⓪①②③	⓪①②③

Expectations for Students in Mathematics

Memorize Facts/ Definitions/ Formulas

Recite basic mathematics facts

Recall mathematics terms & definitions

Recall formulas and computational procedures

Perform Procedures

Use numbers to count, order, denote

Do computational procedures or algorithms

Follow procedures/instructions

Solve equations/formulas/routine word problems

Organize or display data

Read or produce graphs and tables

Execute geometric constructions

Demonstrate Understanding of Mathematical ideas

Communicate mathematical ideas

Use representations to model mathematical ideas

Explain findings and results from data analysis strategies

Develop/explain relationships between concepts

Show or explain relationships between models, diagrams, and/or other representations

Conjecture/ Generalize/ Prove

Determine the truth of a mathematical pattern or proposition

Write formal or informal proofs

Recognize, generate or create patterns

Find a mathematical rule to generate a pattern or number sequence

Make and investigate mathematical conjectures

Identify faulty arguments or misrepresentations of data

Reason inductively or deductively

Solve Non-routine Problems/ Make Connections

Apply and adapt a variety of appropriate strategies to solve non-routine problems

Apply mathematics in contexts outside of mathematics

Analyze data, recognize patterns

Synthesize content and ideas from several sources

Response Codes
Time on Topic

0 = None
(Not Covered)

1 = Slight coverage
(Less than one class/lesson)

2 = Moderate coverage
(One to five classes/lessons)

3 = Sustained coverage
(More than five classes/lessons)

Response Codes
Expectations for Students

0 = No emphasis
(Not a performance goal for this topic)

1 = Slight emphasis
(Less than 25% of time on this topic)

2 = Moderate emphasis
(25% to 33% of time on this topic)

3 = Sustained emphasis
(More than 33% of time on this topic)

Time on Topic		*K-8 Grade Mathematics Topics*	*Expectations for Students in Mathematics*				
<none>	1	**Number Sense / Properties / Relationships**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	101	Place value	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	102	Whole numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	103	Operations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	104	Fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	105	Decimals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	106	Percents	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	107	Ratio, proportion	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	108	Patterns	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	109	Real numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	110	Exponents, scientific notation	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	111	Factors, multiples, divisibility	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	112	Odds, evens, primes, composites	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	113	Estimation	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	114	Order of operations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	115	Relationships between operations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	116	Mathematical properties (e.g., distrbutive property)	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

<none>	2	**Operations**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	201	Add, subtract whole numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	202	Multiplication whole numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	203	Division whole numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	204	Combinations of add, subtract, multiply, divide by whole numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	205	Equivalent fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	206	Add, subtract fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	207	Multiply fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	208	Divide fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	209	Combinations of add, subtract, multiply, divide fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	210	Ratio, proportion	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	211	Representations of fractions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	212	Decimal equivalent to fraction	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	213	Add, subtract decimals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	214	Multiply decimals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	215	Divide decimals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	216	Combinations of add, subtract, multiply, divide decimals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

Time on Topic		*K-8 Grade Mathematics Topics*	*Expectations for Students in Mathematics*				
<none>	3	**Measurement**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	301	Use of measuring instruments	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	302	Theory (arbitrary, standard units, unit size)	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	303	Conversions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	304	Metric (SI) system	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	305	Length, perimeter	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	306	Area, volume	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	307	Surface Area	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	308	Direction, Location, Navigation	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	309	Angles	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	310	Circles (e.g,. pi, radius, area)	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	311	Mass (weight)	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	312	Time, temperature	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	313	Money	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	314	Rate	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	315	Range	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
<none>	4	**Algebraic Concepts**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	401	Absolute value	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	402	Use of variables	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	403	Evaluation of formulas, expressions, equations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	404	One-step equations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	405	Coordinate Plane	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	406	Patterns	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	407	Multi-step equations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	408	Inequalities	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	409	Linear, non-linear relations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	410	Rate of change/slope/line	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	411	Operations on polynomials	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	412	Factoring	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	413	Square roots & radicals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	414	Operations on radicals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	415	Rational expressions	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	416	Functions and relations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	417	Quadratic equations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	418	Systems of equations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	419	Systems of inequalities	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	420	Matrices, determinants	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	421	Complex numbers	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

Time on Topic		*K-8 Grade Mathematics Topics*	*Expectations for Students in Mathematics*				
<none>	5	**Geometric Concepts**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	501	Basic terminology	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	502	Points, lines, rays, and vectors	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	503	Patterns	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	504	Congruence	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	505	Similarity	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	506	Triangles	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	507	Quadrilaterals	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	508	Circles	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	509	Angles	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	510	Polygons	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	511	Polyhedra	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	512	Models	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	513	3-D relationships	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	514	Symmetry	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	515	Transformations (e.g., flips, turns)	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	516	Pythagorean Theorem	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	517	Simple trigonometric ratios	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

<none>	6	**Data Analysis / Probability / Statistics**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	601	Bar graph, histogram	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	602	Pie charts, circle graphs	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	603	Pictographs	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	604	Line graphs	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	605	Stem and Leaf plots	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	606	Scatter plots	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	607	Box plots	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	608	Mean, median, mode	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	609	Line of best fit	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	610	Quartiles, percentiles	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	611	Sampling, Sample spaces	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	612	Simple probability	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	613	Compound probability	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	614	Combinations and permutations	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	615	Summarize data in a table or graph	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

Time on Topic	*K-8 Grade Mathematics Topics*	*Expectations for Students in Mathematics*				
<none>	7 **Instructional Technology**	**Memorize Facts/ Definitions/ Formulas**	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Generalize, Prove**	**Solve Non-Routine Problems/Make Connections**
⓪ ① ② ③	701 Use of calculators	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	702 Graphing calculators	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③
⓪ ① ② ③	703 Computers and internet	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③	⓪ ① ② ③

END OF SURVEY

Thank you for your participation!

Appendix C

Coding Procedures
for Curriculum Content Analyses

Materials included in this packet:

Rating Sheet
Comments & Suggestions worksheet
Subject Topic List
Categories of Student Expectations (Cognitive Demand) List

Introduction

Thank you for your participation in this content analysis workshop. Your assistance will assist us in collecting descriptive information about the subject matter content contained in the assessments and standards documents to be analyzed. Our goal is to content analyze several state standards and assessments using a two-dimensional taxonomy for describing subject matter content.

The data collected will be summarized into content maps and graphs that can be used to highlight the relative emphasis of academic content embedded in these curriculum related documents. The resulting content maps and graphs permit graphic comparisons of teacher reports of instructional content with locally relevant assessment instruments or standards. Content analysis will also serve to support alignment analyses into the relationships between instruction, assessment and standards. Results will be used to support the information needs of participating states, districts and schools, and will also be used in analyses associated with several NSF funded studies being conducted in the states and districts represented at this workshop.

Coding Dimensions

Topics

Each assessment item is to be rated on two intersecting dimensions. The first dimension relates to subject topic. Topic lists are organized by grade band and subject. The appropriate topic lists are contained in this packet, covering K-8 and High School curriculum content. The topic lists are organized at two levels. The more general level identifies content areas (e.g. Number Sense, Measurement, Algebraic Concepts in math; or Energy, Biochemistry, Genetics in science, etc.) Within each of these content areas are listed some number of topics associated with that content area. You will note that each topic has a three- or four-digit number listed to its left. This number is the 'topic code' and is to be entered on the rating sheet to identify the particular topic(s) associated with a given assessment item or standard strand or goal. Though each content area also has a number code associated with it, most coding is done at the fine grain, or topic level that most content coding is to be done. Exceptions to this rule are discussed in the coding conventions section below.

Expectations for Students (Cognitive Demand)

In addition, assessment items are coded in terms of the expectations for student performance (or cognitive demand) targeted by a given item or standard. Your packet contains a list of cognitive expectations for the appropriate subject(s), organized into five categories. Each category is defined using a list of descriptors to identify the types of cognitive demand associated with a given category of student expectation. It should be noted that the descriptors listed for each category are not exhaustive, but intended to be illustrative of the types of activities associated with each category. Unlike the topic list, raters are not asked to code at this fine-grain level of cognitive demand descriptors. Cognitive demand is coded only at the broader categorical level of student expectation. Each category is given a letter designation (B-F) to be used for coding purposes.

Procedures

1. *Pre-coding Exercise*

A sample set of assessment items will be content analyzed individually by each rater using the coding procedures described below. These sample items and their related content codes will then be discussed by each rating team in order to establish a common understanding and set of coding conventions for conducting the content analyses of the various documents. Note the coding conventions listed at the end of this handout. Any additional conventions agreed upon by your team should be noted in the "Comments & Suggestions Worksheet" located in you packet.

2. *Rating Form Identification*

Please make sure that you complete the information listed at the top of each rating form. This includes:

- District/State (as applicable)
- Assessment Name (e.g. Terra Nova, SAT-9, or relevant state assessment)
- Rater# (refer to the label on your folder)
- Subject (mathematics, science or language arts)
- Test Form (if applicable)
- Rating form page # (if more than two rating forms are required)

3. *Coding Procedures.*

Below is an excerpted line from the sheet you will record content codes on.

Item Number	Content Code 1		Content Code 2		Content Code 3	
	Topic Code 1	Expectation Code 1	Topic Code 2	Expectation Code 2	Topic Code 3	Expectation Code 3
1	503	B				

The correct way to record a content code (**503B**) is illustrated in the column in the above table labeled **Content Code 1**. Note that the number for the Sub-Topic and the letter for the Student Expectation are placed in separate cells. Every content code should consist of both a topic number and a cognitive demand letter, even if one or the other repeats a previous code for that item.

Every item should be given at least 1 content code. **Up to three separate *topic by expectation* combinations** may be selected for any one assessment item, and up to six ***topic by expectation* combinations** may be coded for standards and/or other curriculum materials. For example, an assessment item might relate to two distinct topic areas, while involving only one student expectation category. In that case, the coder would enter two different topic codes in cells **Topic Code 1** and **Topic Code 2** on the Coding Sheet, but would enter the same expectation code in cells **Expectation Code 1** and **Expectation Code 2**. As another example, an item might be coded with three distinct topic by expectation combinations, with perhaps one topic being associated with two types of expectations, while a second topic is associated with yet a third category of expectation. Such an example might be coded as follows:

Item Number	Content Code 1		Content Code 2		Content Code 3	
	Topic Code 1	**Expectation Code 1**	**Topic Code 2**	**Expectation Code 2**	**Topic Code 3**	**Expectation Code 3**
1	103	B	103	D	102	C

Again, up to 3 topic by expectation combinations may be coded for each assessment item, and six combinations for each standard strand or curriculum materials section. Should an coding item be so complex as to suggest more than these limits, select the most dominant elements of the item to code up to the accepted limit of content codes.

Coding Conventions

Occasionally items are difficult to code with the taxonomy. The following coding conventions have been established to cover most situations.

1. If you determine that an item or standard cannot be associated with a specific topic in the taxonomy, then:

   If the content to code fits a general content area, but is ***not specific enough to identify a particular topic***, use the code for the major content area, (e.g., "**200**" for "Measurement" in mathematics, or "**500**" for "Science & Technology" in science).

   If the content pertains to a ***specific topic not listed in the taxonomy***, use the code for the most appropriate content area, and add "**90**" for the last two digits, (e.g., "**290**" for "Measurement" in mathematics, or "**590**" for "Science & Technology" in science).

   Use the Topic code "**000**"cases where you determine there is ***no appropriate content code whatsoever in the topic list*** that fits a given item or standard.

   Use the Topic code "**999**" in cases where you determine the item ***refers to content out of subject area*** (e.g., science content on a mathematics test).

2. If you determine that an item or standard ***cannot be associated with a specific category of cognitive demand***, enter a "Z" in the cognitive demand cell.

3. If you use any of the above conventions, please include a suggestion for an additional content area, topic or cognitive demand descriptor on the ***Comments & Suggestions worksheet*** in you packet. This will assist us in considering future revisions to the taxonomies. (Please be sure return the "Comments and Suggestions" worksheet to one of the workshop staff before leaving.)

4. **If your coding team establishes additional conventions for coding items, please note these as well on the Comments & Suggestions worksheet.**

Comments & Suggestions Worksheet

Please use this sheet to note any coding conventions you or your group utilize that are not already listed in your handouts.

You may also use this sheet to identify suggestions for:

- additional content areas
- additional sub-topics within a content area
- additional student expectation categories
- additional cognitive demand descriptors within a current student expectation category
- other comments or suggestions you may have

Coding Conventions:

Additional (recommended) Content Areas & Sub-topics (do not use these for coding purposes)

	Content Area	Sub-Topic	

Additional (recommended) Student Expectations and Cognitive Demand Descriptors

	Student Expectation Category	Cognitive demand descriptor	

Other Comments and Suggestions:

Rater: ________ Subject: ____________ Form: Page of

	Itm. Desig./Nbr.	Content Code 1			Content Code 2			Content Code 3		
			TPC1	CGD1		TPC2	CGD2		TPC3	CGD3
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	Itm. Desig./Nbr.	Content Code 1			Content Code 2			Content Code 3		
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K-12 Mathematics Content Areas

100	**Nbr. sense /Properties/ Relationships**	**900**	**Data Diplays**
200	**Operations**	**1000**	**Statistics**
300	**Measurement**	**1100**	**Probability**
400	**Consumer Applications**	**1200**	**Analysis**
500	**Basic Algebra**	**1300**	**Trigonometry**
600	**Advanced Algebra**	**1400**	**Special Topics**
700	**Geometric Concepts**	**1500**	**Functions**
800	**Advanced Geometry**	**1600**	**Instructional Technology**

K-12 MATHEMATICS TAXONOMY

August 2004

100	**Nbr. sense /Properties/ Relationships**
101	Place value
102	Whole numbers
103	Operations
104	Fractions
105	Decimals
106	Percents
107	Ratio, proportion
108	Patterns
109	Real numbers
110	Exponents, scientific notation
111	Factors, multiples, divisibility
112	Odds/evens/primes/composites/square nbrs.
113	Estimation
114	Nbr. Comparisons (order, relative size, inverse, opposites, equivalent forms, scale)
115	Order of operations
116	Computational Algorithms
117	Relationships between operations
118	Number Theory, non base-ten systems
119	Mathematical properties (e.g., distr. property)
190	Other
200	**Operations**
201	Add, subtract whole numbers
202	Multiplication whole numbers
203	Division whole numbers
204	Combinations of operations on whole numbers
205	Equivalent/non-equivalent fractions
206	Add, subtract fractions
207	Multiply fractions
208	Divide fractions
209	Combinations of operations on fractions
210	Ratio, proportion
211	Representations of fractions
212	Equivalence of decimals, fractions, %
213	Add, subtract decimals
214	Multiply decimals
215	Divide decimals
216	Combinations of operations on decimals
217	Computing with percents
218	Computation with exponents, radicals
290	Other

300	**Measurement**
301	Use of measuring instruments
302	Theory (arbitrary, standard units, unit size)
303	Conversions
304	Metric (SI) system
305	Length, perimeter
306	Area, volume
307	Surface Area
308	Direction, Location, Navigation
309	Angles
310	Circles (e.g,. pi, radius, area)
311	Mass (weight)
312	Time, temperature
313	Money
314	Derived measures (e.g. rate/speed)
315	Calendar
390	Accuracy, Precision
400	**Consumer Applications**
401	Simple interest
402	Compound interest
403	Rates (e.g., discount, commission)
404	Spreadsheets
490	Other: ____________________
500	**Basic Algebra**
501	Absolute value
502	Use of variables
503	Eval. of formulas, expressions, equations
504	One-step equations
505	Coordinate Plane
506	Patterns
507	Multi-step equations
508	Inequalities
509	Linear, non-linear relations
510	Rate of change/slope/line
511	Operations on polynomials
512	Factoring
513	Square roots & radicals
514	Operations on radicals
515	Rational expressions
515	Multiple representations
590	Other:

600	**Advanced Algebra**
601	Quadratic equations
602	Systems of equations
603	Systems of inequalities
604	Compound Inequalities
605	Matrices, determinants
606	Conic sections
607	Rational, negative exponents/radicals
608	Rules for exponents
609	Complex numbers
610	Binomial theorem
611	Factor / remainder theorem
612	Field properties of real number system
613	Multiple representations
690	Other
700	**Geometric Concepts**
701	Basic terminology
702	Points, lines, rays, segments and vectors
703	Patterns
704	Congruence
705	Similarity
706	Parallels
707	Triangles
708	Quadrilaterals
709	Circles
710	Angles
711	Polygons
712	Polyhedra
713	Models
714	3-D relationships
715	Symmetry
716	Transformations (e.g., flips, turns)
717	Pythagorean Theorem
790	Other
800	**Advanced Geometry**
801	Logic, reasoning, proof
802	Loci
803	Spheres, cones, cylinders
804	Coordinate Geometry
805	Vectors
806	Analytic Geometry
807	Non-Euclidean Geometry
808	Topology
890	Other:

900	**Data Diplays**
901	Summarize data in a table or graph
902	Bar graph, histogram
903	Pie charts, circle graphs
904	Pictographs
905	Line graphs
906	Stem and Leaf plots
907	Scatter plots
908	Box plots
909	Line Plots
910	Classification, venn diagrams
911	Tree Diagrams
990	Other
1000	**Statistics**
1001	Mean, median, mode
1002	Variablility, standard deviation
1003	Line of best fit
1004	Quartiles, percentiles
1005	Bivariate distribution
1006	Confidence intervals
1007	Correlation
1008	Hypothesis testing
1009	Chi Square
1010	Data Transformation
1011	Central Limit Theorem
1090	Other
1100	**Probability**
1101	Simple probability
1102	Compound probability
1103	Conditional probability
1104	Empirical probabiolity
1105	Sampling, Sample spaces
1106	Independent/dependent events
1107	Expected value
1108	Binomial distribution
1109	Normal curve
1190	Other

1200	**Analysis**
1201	Sequences and series
1202	Limits
1203	Continuity
1204	Rates of change
1205	Maxima, minima
1206	Differentiation
1207	Integration
1290	Other: ________________
1300	**Trigonometry**
1301	Basic ratios
1302	Radian measure
1303	Right triangle trigonometry
1304	Law of Sines, Cosines
1305	Identities
1306	Trigonometric equations
1307	Polar coordinates
1308	Periodicity
1309	Amplitude
1390	Other: ________________
1400	**Special Topics**
1401	Sets
1402	Logic
1403	Mathematical induction
1404	Linear programming
1405	Networks
1406	Iteration, recursion
1407	Permutations combinations
1408	Simulations
1409	Fractals
1490	Other

1500	**Functions**
1501	Notation
1502	Relations
1503	Linear
1504	Quadratic
1505	Polynomial
1506	Rational
1507	Logarithmic
1508	Exponential
1509	Trigonometric / circular
1510	Inverse
1511	Composition
1590	Other: ________________
1600	**Instructional Technology**
1601	Use of calculators
1602	Use of graphing calculators
1603	Use of computers & internet
1604	Computer programming
1690	Other

Cognitive Demand Categories for Mathematics

B	C	D	E	F
Memorize	**Perform Procedures**	**Demonstrate Understanding**	**Conjecture, generalize, prove**	**Solve non-routine problems, make connections**
Recite basic mathematics facts	Use numbers to count, order or denote	Communicate mathematical ideas	Determine the truth of a mathematical pattern or proposition	Apply & adapt a variety of appropriate strategies to solve problems
Recall mathematics terms and definitions	Do computational procedures or algorithms	Use representations to model mathematical ideas	Write formal or informal proofs	Apply mathematics in contexts outside of mathematics
Recall formulas and computational procedures	Follow procedures/instructions	Explain findings and results from data analysis	Analyze data	Recognize, generate or create patterns
	Make measurements, do computations	Develop/explain relationships between concepts	Find a mathematical rule to generate a pattern or number sequence	Synthesize content and ideas from several sources
	Solve equations/formulas, routine word problems	Explain relationships btwn. models, diagrams, & other representations	Identify faulty arguments or misrepresentations of data	
	Organize or display data Read or produce graphs and tables		Reason inductively or deductively	
	Execute geometric constructions		Use spatial reasoning	

Appendix D

Percentage of Student at Meets or Exceeds Proficiency Level in State Mathematics Achievement Testing, by State and Grade Level

State (Test Results Year)	Grade Level	% of students who met or exceeded proficiency level in state mathematics achievement testing
Alabama[1] (2005)	6	66
	7	57
	8	63
California [2] (2005)	5	67
	6	67
	7	54
Idaho[3] (2004)	5	56
	6	59
	7	63
	8	59
Illinois[4] (2004)	8	56
Indiana[5] (2005)	5	58
	6	60
	7	59
	8	56
Iowa[6] (2005)	8	74

Appendix D (cont'd)

State (Test Results Year)	Grade Level	% of students who met or exceeded proficiency level in state mathematics achievement testing
Maine[7] (2004)	8	22
Massachusetts[8] (2004)	8	39
Michigan[9] (2004)	8	63
Mississippi[10] (2004)	8	53
Montana[11] (2005)	8	63
New Hampshire[12] (2005)	10	39
New Jersey[13] (2004)	8	62
North Carolina[14] (2005)	6	90
	7	85
	8	85
Ohio[15] (2005)	7	58
	6	60
Oklahoma[16] (2004)	8	77

Appendix D (cont'd)

State (Test Results Year)	Grade Level	% of students who met or exceeded proficiency level in state mathematics achievement testing
Oregon[17] (2005)	8	59
Pennsylvania[18] (2005)	8	63
Texas[19] (2003)	6	79
	8	72
Wisconsin[20]	8	73

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[1] Alabama State Department of Education, http://www.alsde.edu/Accountability/preAccountability.asp
[2] California Department of Education, http://star.cde.ca.gov/star2005/viewreport.asp
[3] Idaho State Department of Education, http://www.sde.state.id.us/dept/testreports.asp#standards
[4] Illinois Department of Education, http://www.isbe.state.il.us/assessment/isat.htm
[5] Indiana Department of Education, http://www.doe.state.in.us/istep/2005/welcome.html
[6] Iowa Department of Education, http://www.state.ia.us/education/fis/pre/coer/index.html
[7] Maine Department of Education, http:// www.maine.gove/education/mea/edmea.htm
[8] Massachusetts Department of Education, http://www.doe.mass.edu/mcas/results.html
[9] Michigan Department of Education, http://www.michigan.gov/mde
[10] Mississippi Department of Education, http://orsap.mde.k12.ms.us:8080/MAARS/index.jsp
[11] Montana Office of Public Instruction, http://www.opi.state.mt.us/
[12] New Hampshire Department of Education, http://www.ed.state.nh.us/education/doe/organization/curriculum/Assessment/NHEIAP.htm
[13] New Jersey State Department of Education, http://www.state.nj.us/njded/schools/achievement/2005/gepa/
[14] North Carolina Department of Public Instruction, http://www.dpi.state.nc.us/accountability/testing
[15] Ohio Department of Education, http://www.ode.state.oh.us/proficiency/results.asp
[16] Oklahoma State Department of Education, http://www.sde.state.ok.us/home/defaultie.html
[17] Oregon Department of Education, http://www.ode.state.or.us
[18] Pennsylvania Department of Education, http://www.pde.state.pa.us/a_and_t/site/default.asp
[19] Texas Education Agency, http://www.tea.state.tx.us/student.assessment/index.html
[20] Wisconsin Department of Public Instruction, http://dpi.wi.gov/oea.spr_kce.html