ANALYZING HOW GRADE FOUR TEACHERS PLAN TO TEACH INQUIRY-BASED CURRICULUM MATERIALS AND THE INFLUENCES ON THEIR PREPARATION OF MATHEMATICS LESSONS

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Doctor of Philosophy

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by

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The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

ANALYZING HOW GRADE FOUR TEACHERS PLAN TO TEACH INQUIRY-BASED CURRICULUM MATERIALS AND THE INFLUENCES ON THEIR PREPARATION OF MATHEMATICS LESSONS

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ABSTRACT

This study documented how Grade 4 teachers plan to teach from an inquiry-based mathematics curriculum, and identified specific influences on planning. Previous studies of instructional decision-making yielded a framework for researching lesson planning and informed the design of this investigation. Participants in this study were 18 teachers from four schools in three districts that adopted the *Investigations in Number, Data, & Space* curriculum. Qualitative analysis of interview transcripts, surveys, and lesson plans was conducted using a framework to identify primary codes for processes and influences on teachers' planning.

Results indicate that collaboration influenced the content teachers planned to teach as they discussed *Investigations*-related issues, determined Grade-Level Expectations (GLEs) to be taught, and/or exchanged activities for teaching. Whether they collaborated through district-sponsored meetings, school-level planning, or by personal choice, teachers ultimately created lesson plans individually. Although many teachers were misinformed about the requirements of *No Child Left Behind*, GLEs and mandatory testing programs influenced the content and sequencing of lessons and, for some, determined their curriculum. Teachers who considered *Investigations* to be an effective curriculum that addressed the GLEs supplemented sparingly, while those who perceived "holes" in the curriculum supplemented extensively. Most teachers recorded minimal information in their lesson plan due to time constraints and a limited understanding of curriculum features.

This study yielded a refined framework for researching teacher planning but

additional studies are needed to validate the framework. Finally, implications are offered for (1) Accountability Awareness, (2) Understanding Educational Policy, (3) Teacher Development Programs, and (4) Professional Development.

CHAPTER 1: BACKGROUND AND STATEMENT OF THE PROBLEM

Teaching has traditionally been an autonomous profession. Teachers have access to a plethora of resources and tools to draw upon when they plan and implement lessons in mathematics. On a daily basis, each teacher uses his/her own knowledge, experience, and beliefs to ultimately decide what gets taught in the classroom. Historically, teachers have made decisions about what mathematics is going to be taught, how long to spend on mathematics for the day, and how much time to devote to specific content (Fernandez & Cannon, 2005; Livingston & Borko, 1990; Putnam, Heaton, Prawat, & Remillard, 1992).

In recent years, preparing to teach mathematics has become more complex. First, teachers have access to more resources that support instruction including print materials, technology tools, (e.g., Internet, computers, virtual manipulatives), and manipulatives than years past. The availability of more resources translates into more decisions on what to use, when to use them, and for what purposes. Second, the *No Child Left Behind Act of 2001* (*NCLB*) has facilitated "stronger accountability" at the state and local levels and placed additional reporting burdens on teachers. As a result, teachers are being held to more stringent standards of accountability for their teaching, as well as their students' learning. Policy issues, curriculum, standards, assessment, as well as other influences challenge teachers' autonomy from the national level, through the district level, and down to the local level. Where teachers may have in the past been able to close their doors and teach in isolation, the level of accountability that exists today places teachers, schools, and entire districts under more scrutiny. Therefore, teachers are arguably put into a position where they need to invest more time preparing to teach mathematics lessons to

their students than they had spent in the past (Fernandez, 2005; Fernandez & Cannon, 2005).

The existing body of research related to teachers' decision making and planning, was conducted prior to *NCLB* and the introduction of mathematics curricula based on the National Council of Teachers of Mathematics' (NCTM) Standards and *NCLB*. In addition, the existing research literature is based on studies conducted in the context of literacy instruction, and even more specifically, forming student learning groups. Even though some planning issues were raised from this research base, it is likely that there are many more sources of influence today on planning than those that existed 20 to 30 years ago. Leinhardt (1989) defined planning as follows:

> The complex cognitive skill of teaching involves (a) assembling known pieces of organized behaviors, namely, action systems or schemas, into effective sequences that meet particular goals; (b) assembling appropriate goals to meet larger teaching objectives; and (c) doing both of these in a way that attends to specific constraints in the total system. We refer to this collection of skills as planning. (Leinhardt, 1989, p. 53)

To further delineate the definition of planning, any processes that teachers go through in order to prepare mathematics lessons are considered *planning* for this study. This includes reading curriculum materials, consulting other print resources, talking with colleagues, referencing personal beliefs or knowledge, creating formal or informal notes regarding the goals for lessons, choosing content to implement, determining order and methods for instruction, and noting any other prompts or suggestions for reference during implementation.

Influences on Planning

When elementary teachers prepare instructional lessons in mathematics, they are faced with many decisions. Foremost, teachers must decide what specific mathematics content to include and what activities or tasks students will need to experience in order to learn and understand that content. But additional influences may impact how teachers plan. A limited body of research identifies possible influences on teachers' decisions and planning procedures in mathematics (Barr, 1988; Borko, Livingston, & Shavelson, 1990; Fi, 2003; Good & Grouws, 1989; Senk, Beckmann, & Thompson, 1997; Shavelson & Borko, 1979; Weiss, Knapp, Hollweg, & Burrill, 2002; Yinger, 1980). However, much of this literature does not address the specific procedures teachers follow when planning, or how specific influences affect teachers' planning; merely that such influences exist.

Teachers may be influenced in their planning decisions by any number of authorities, including but not limited to: (1) national, state, or district policies (Berliner, 2005; US Department of Education, 2004); (2) assessment practices at the national, state, or district level (Linn, Baker, & Betebenner, 2002; S. Thompson, 2001; Travers, 1987); (3) mathematics standards (American Federation of Teachers (AFT), 1999; National Council of Teachers of Mathematics, 1989, 2000, 2006; B. J. Reys, Dingman, Sutter, & Teuscher, 2005); (4) state and/or district curriculum grade level expectation frameworks (B. J. Reys et al., 2005); and (5) textbooks and accompanying activities (Good & Grouws, 1989; Remillard, 2000; Tarr, Chavez, Appova, & Regis, 2005; Venezky, 1992). The relative authority these components possess in relation to teachers' instructional decision-making is heretofore not well documented. Moreover, previous research has focused on these sources individually, not in connection with one another. That is, prior

research has not addressed how teacher planning is affected by a combination of these components, or other factors not identified here. Therefore, it is plausible that several of these factors may interact to influence how teachers plan instruction.

At many levels (national, state, and local), educational policy has significant impact on teachers' actions (Allington, 2000; Bjork, 2003; Grossman, Stodolsky, & Knapp, 2004). Recently, *NCLB* mandated that states create standards documents outlining Grade-Level Expectations (GLEs) for student learning (B. J. Reys, 2006a; US Department of Education, 2004) and document progress in meeting such standards. Thus, states have developed annual mandatory assessments aligned with curriculum standards, required by all students in Grades 3 through 8 to document levels of Adequate Yearly Progress (AYP) (Linn et al., 2002; US Department of Education, 2004). Ultimately, the goal of *NCLB* is to increase student achievement by increasing levels of accountability through mandatory testing of students in Grades 3 through 8, and High School[1].

Another potential source of influence on teachers' planning is the result of changes to the school mathematics curriculum in the United States. Results of the Second International Mathematics Study (SIMS) indicated students in the United States were not demonstrating high levels of success relative to their peers in other nations (Baker, 1993; Travers, 1986; Westbury, 1992). Further analysis attributed low achievement of U.S. students to the curriculum experienced by the students in classrooms. Namely, the U.S. curriculum was characterized as a "mile wide and an inch deep" (W.H. Schmidt,

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[1] The decision to test beyond Grade 8 is made individually by state and must occur at least once between Grades 10-12.

McKnight, & Raizen, 1997b). In response to these problematic features, the NCTM published *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), thus providing standards of what to teach in mathematics, and suggestions for how to teach the content. Subsequent to the results from international studies and the release of the NCTM standards, the National Science Foundation (NSF) funded the development of several projects designing curricula modeling these standards. The NSF funded curricula development projects at each level: elementary, middle, and high school (Hirsch, 2007). These standards-based, or *inquiry-based* curriculum materials as I refer to them, resulted in three elementary curricula being published (National Research Council, 2004), including *Investigations in Number, Data, and Space* (Russell, Tierney, Mokros, Goodrow, & Murray, 1997), referred to hereafter as *Investigations*.

Given that *Investigations* materials represent a departure from traditional elementary school curricula in terms of content emphasis and pedagogical orientation, there was awareness among the authors that teachers using inquiry-based materials would need to plan differently. "These materials differ in substantive ways from traditional textbooks" (Trafton, Reys, & Wasman, 2001, p. 259). To address these differences, the implementation guide that accompanies the *Investigations* materials provides a list of differences between traditional and inquiry-based materials. Table 1 includes the suggested list of characteristics of "old-style" mathematics classrooms as well as the "new" reform classrooms, as described by the *Investigations* authors. This table illustrates the significant pedagogical differences in the *Investigations* curriculum teachers need to consider when planning to teach mathematics lessons; "Compare the

notable features of the old style of elementary mathematics classroom and the class environment many educators are now striving to create" (Russell et al., 1997, p. 4).

Table 1

Characteristics of old-style versus new mathematics classrooms as identified by Investigations' authors (Russell et al., 1997, p. 4)

In the old-style mathematics class, students	In the new mathematics class, students
• worked alone	• work in a variety of groupings—as a whole class, individually, in pairs, and in small groups
• focused on getting the right answer	• consider their own reasoning and the reasoning of other students
• recorded by only writing down numbers	• communicate about mathematics orally, in writing, and by using pictures, diagrams, and models
• completed as many problems as quickly as possible	• thoughtfully work on a small number of problems during a class session, sometimes working on a single problem for one or several sessions
• used a single, prescribed procedure for each type of problem	• use more than one strategy to double-check
• used only pencil and paper, chalk and chalkboard as tools	• use cubes, blocks, measuring tools, calculators, and a variety of other materials

In addition to changes in mathematics curriculum materials, state departments of education have developed content standards to provide teachers guidance with regard to what mathematics content teachers should include when planning lessons (B. J. Reys, 2006a; B. J. Reys et al., 2005). Moreover, some states such as Missouri specify a "Depth-of-Knowledge" component for each standard. "The Depth-of-Knowledge identifies the highest level at which the expectation will be assessed, based on the demand of the GLE. Depth-of-Knowledge levels include: Level 1-recall; Level 2-skill/concept; Level 3-

strategic thinking; and Level 4-extended thinking" (Missouri Department of Elementary and Secondary Education, 2008, p. 1). Thus, Missouri teachers will now be held accountable for providing instruction on specific topics at greater depths of knowledge.

Although state curriculum frameworks influence the composition of textbook content, teachers may choose to skip lessons from the textbook when planning (McNaught, Tarr, & Grouws, 2008). Research has demonstrated that teachers generally rely on the textbook to help guide their lesson planning (Good & Grouws, 1989; Grouws & Smith, 2000; Tarr et al., 2005; Venezky, 1992) and that textbooks are considered the ultimate authority in some states (Sewell, 2005). However, another body of research asks, "Do textbooks dictate the content of mathematics instruction in elementary schools? In a word, no" (Freeman & Porter, 1989, p. 404). Therefore, there is not consensus within the research literature regarding the influence of textbooks and curriculum materials on students' Opportunity to Learn (OTL) (Floden, 2002). According to Floden, four components are the basis for students OTL: (1) the cognitive demand of the content, (2) the coherence of the curriculum, (3) the pacing of the curriculum, and (4) the exposure to the content.

Another consideration regarding lesson planning is related to teacher preparation. Teacher Development Programs are markedly different (P. M. Taylor & Ronau, 2006). "Teacher preparation in the United States is highly variable in structure, and probably in content" (Floden & Philipp, 2004, p. 173). Floden and Philipp note that research has not addressed teacher education in mathematics, specifically the content focus of course work, who should teach the courses, and the characteristics of teachers leaving the courses.

One such characteristic is that teachers could be classified as *traditional* based upon their pedagogical orientations and beliefs about how students learn. Traditional teaching methods include more direct-instruction of rules, facts, and skills, as well as teachers passively providing information to students through lecture formats and reliance upon telling students how to do mathematics procedures (Raymond, 1997). By way of contrast, *nontraditional* teachers share more student-centered instructional beliefs and use problems to drive instruction, with students working together to formulate solutions that make sense to them related to the assigned tasks (Raymond, 1997). Because these two groups have philosophical differences in how to teach mathematics, their process for planning may be notably different as well.

Yet another consideration is how teachers plan and whether there are differences between those who plan individually versus teachers who are members of a collaborative planning team. There may also be differences in how teachers plan based on their years of experience. The "expert" versus "novice" comparison has been made in previous research regarding other issues of teaching, but with little comparison of how these two groups plan to teach mathematics (Leinhardt, 1989; Livingston & Borko, 1990).

Finally, there is a need to consider whether school-level influences exist, both from the district and individual school site perspectives (Good, Grouws, & Mason, 1990). These potential influences include a principal's beliefs about curriculum enactment or the perceived importance of preparing students for district- or state-mandated assessments. Some districts also provide pacing guides for teachers to reference and follow throughout the year, which may have significant influence on *what* gets planned, as well as on *whether* teachers plan in the first place. Professional development that teachers attend

may provide some insight and influence on what teachers plan as well. Moreover, peers and colleagues may influence a teacher's beliefs about teaching, and the influence of parents' or other outside groups on teacher actions cannot be ignored.

Statement of the Problem

Given the authority of *NCLB* and its influence on states and districts throughout the nation, there is a need to understand how this federal law directly impacts teachers. Due to increased levels of accountability resulting from the *NCLB* legislation, teachers today are facing more pressure to increase student achievement in mathematics. This study seeks to document the processes that Grade 4 teachers go through when planning to teach mathematics lessons and the influences of these policies on their planning. Also, design structures integrated within inquiry-based mathematics curricula represent a departure from traditional approaches to teaching and learning mathematics and make planning to teach *Investigations* different from traditional curricula (Russell et al., 1997), creating a need to understand how such programs affect teachers' planning. However, there is not a current body of research that addresses what specifically influences teachers' planning processes related to NSF-funded, inquiry-based mathematics curricula such as *Investigations*.

Teachers are also exposed to many more resources to assist them in planning and implementing instruction. We need to better understand what influences teachers' mathematics planning and how it is influenced in today's political environment. We also need to better understand what teachers perceive as the authority when they plan lessons, and what influences these authorities have over their planning procedures. Identifying

planning processes and influences on planning will inform and help teacher educators and professional development facilitators prepare and support preservice and practicing teachers.

Much of the research base for teacher planning was conducted in the 1970s and 1980s; an educational era that was markedly different than the current era, the existing expectations, and the most recent accountability issues. "There seems to be widespread agreement … on the value of planning" (Zahorik, 1970, p. 143). This message may still be true today, but there does not exist a body of current research to support this claim. Remillard (2000) reported in her study that textbooks can influence the organization of mathematics content, but the focus of her work was on the enactment of curricula materials and their influence. Related to this issue is the fact that a framework does exist, which describes a process for teacher planning (Shavelson & Stern, 1981). However, the conceptual framework was developed through investigating how literacy teachers planned for group instruction and what characteristics were important when forming instructional groups. Moreover, this framework does not include any factors related to more recent phenomena in education including standards, assessment, or policy related to *NCLB* as listed above. Shavelson and Stern (1981) suggest that more research needs to link teachers' intentions in planning to their behaviors in implementation in order to help educate teachers. "In order to understand teaching, we must understand how thoughts get carried into actions" (p. 457). The current study did not focus on the implementation process, but I acknowledge teaching and interacting with their students during lessons may influence teachers' future plans.

Researchers have documented how teachers using the *Investigations* curriculum implement their curriculum in Kindergarten through Grade 5 (Mokros, 2003), as well as documenting student learning with this specific curriculum (National Research Council, 2004; Senk & Thompson, 2003). However, recent research studies have not investigated teachers' planning processes, nor teacher beliefs and experiences as influences on planning. Moreover, it is unknown whether teachers are familiar with recent policy documents (state and district learning expectations and frameworks) as well as if and how these documents influence planning.

Purpose of the Study

The primary purpose of this study is to document how Grade 4 teachers using inquiry-based, elementary curriculum materials prepare to teach mathematics lessons. Specifically, this study will explore planning to use the *Investigations* curriculum. This includes understanding the process of planning that takes place, creating and defining common language that describes teachers' planning processes, and documenting the lesson planning processes currently used by teachers. In the past, one planning component that existed in teacher development programs was Bloom's Taxonomy model (Bloom, 1984). This model included several cognitive levels of student development that teachers were to focus upon. Teachers were encouraged to ask questions at each level, in order to promote student learning.

Another model typically introduced to preservice teachers includes the work presented by Madeline Hunter. The Hunter model includes a detailed, scripted outline that teachers can follow when creating a lesson plan. Although some materials developed

for preservice teacher education in recent years have addressed lesson planning in relation to problem-based curricula (R. E. Reys, Lindquist, Lambdin, & Smith, 2007), the extent of their use is unknown. Therefore, one component of this study is to explore if and how teachers are consulting models or planning frameworks and document the extent of their use in planning.

The second purpose of this study is to determine what influences teachers as they plan mathematics lessons. These influences might include standards and GLEs, policy issues related to *NCLB*, national, state, or local assessment programs, textbooks, and/or the mathematics content being taught. The goal is to identify influences on teachers' planning to better understand how to prepare preservice teachers, support the work of current teachers by informing professional developers of teachers' planning processes, and document how Grade 4 teachers' beliefs influenced planning.

Rationale for Studying Grade 4 Teachers

This study will focus on only Grade 4 *Investigations* teachers. The decision to include only one grade level was based on several reasons. Rather than include a smaller sample from multiple grade levels, I decided to focus on one grade level to have a large enough sample to draw some conclusions. In the state of Missouri, large-scale, state sponsored assessments under *NCLB* are first administered in Grade 3. Grade 3 teachers were excluded from the study because they may feel additional pressure to prepare students for this assessment, which may influence their planning. Similarly, Grade 5 teachers were excluded because they often feel pressure to prepare students for success in

middle grades mathematics, which may be an additional influence on planning that may not be found at other grade levels.

As a result, I decided to study Grade 4 teachers. I had two years of teaching experience at the fourth grade level. As I interviewed teachers for the study, I anticipated that I would be better able to connect with the participants based on that experience. Furthermore, the choice to study Grade 4 teachers was influenced by the fact that both the Trends in Mathematics and Science Study (TIMSS) and the National Assessment of Educational Progress (NAEP) were conducted at Grade 4. I decided to use items from the questionnaires used in these two studies create some of my data collection tools.

Conceptual Framework

The research design for this study was influenced by previous, but limited, research on teacher planning. This research includes a framework created by Shavelson and Stern (1981) who investigated how teachers prepared for literacy instruction and student grouping. "In order to understand the behavior of teachers, then, it is essential to know (a) their goals, (b) the nature of the task environment confronting them, (c) their information-processing capabilities, and (d) the relationship between these elements" (Shavelson & Stern, 1981, p. 461). Shavelson and Stern presented a conceptual domain for evaluating the process teachers go through to make decisions, judgments, and their behaviors (See Figure 1), based studies focused on teacher decision-making.

According to Shavelson and Stern's (1981) framework, there are two paths teachers might proceed through as they plan instruction. The first path is influenced by: (1) Antecedent Conditions, (2) Teacher Characteristics, (3) Teacher Cognitive Processes,

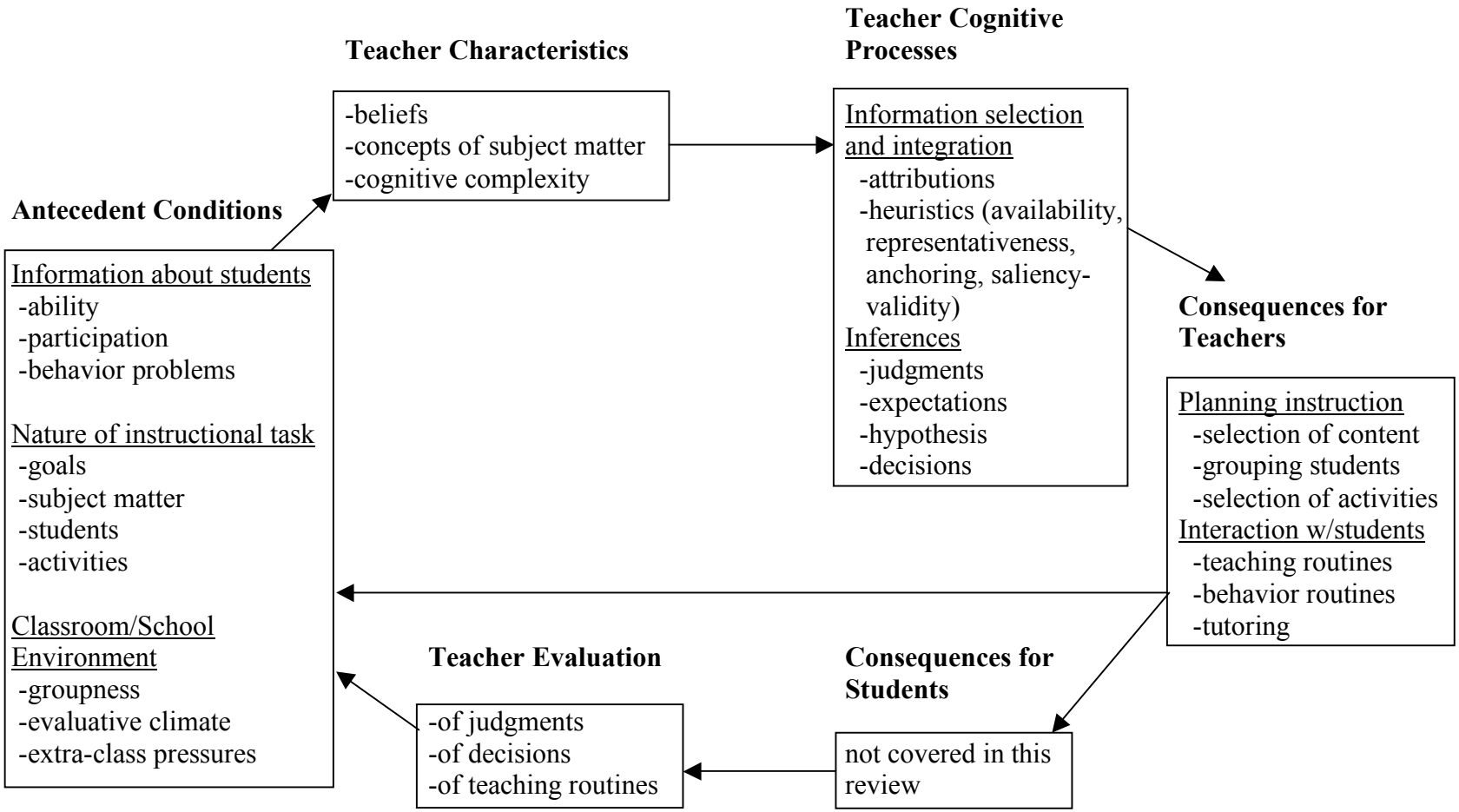

Figure 1. Conceptual domain for research on teacher judgments, decisions, and behavior (Shavelson & Stern, 1981, p. 461).

and (4) Consequences for Teachers. The arrow from (4) Consequences for Teachers to (1) Antecedent Conditions represents what happens in classrooms where teachers do not reflect on implementation to plan the next lesson. The lower loop, including (5) Consequences for Students and (6) Teacher Evaluation, represents the reflection process teachers use to determine how events that occurred during the previous lesson affect the next lesson. Although I am interested in how reflection affects teachers' preparation for future lessons, this study will primarily focus on the first loop, including what occurs *prior to* each day of instruction.

Research Questions

Given the authority of *NCLB* and its mandates on states and districts, there is a need to understand how this federal law directly impacts teachers. Due to increased levels of accountability resulting from the *NCLB* legislation, teachers are facing more pressure to increase student achievement in mathematics. This study seeks to document the processes that Grade 4 teachers go through when planning to teach mathematics lessons and the influences of these policies on their planning.

Design structures integrated within inquiry-based mathematics curricula represent a departure from traditional approaches to teaching and learning mathematics and therefore may make planning to teach *Investigations* (Russell et al., 1997) different than planning for traditional curricula, creating a need to understand how such programs affect teachers' planning. This study is designed to address two questions:

(1) What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?

(2) What factors (e.g., beliefs, experience, policy, curriculum, etc.) influence Grade 4 teachers' lesson preparation when using an inquiry-based curriculum?

Definition of Terms

In this section, key vocabulary being used throughout this study are identified and defined.

Planning

Planning includes any processes that teachers go through in order to prepare mathematics lessons. This includes consulting resources, talking with colleagues, referencing personal beliefs or knowledge, and creating formal or informal notes about the goals for lessons, the content to be taught, and the order and methods for instruction.

Lesson Plan

For this study, a lesson plan includes any written or recorded document that a teacher creates in preparation of their mathematics lesson(s). This document could be handwritten or typed on a computer and might include the four attributes first suggested by Tyler (1950): (a) statement of lesson objectives, (b) specific activities, (c) organized routines, and/or (d) assessment tasks and procedures, written as simple notes or detailed instructions that are used to guide the teacher during implementation of the lesson(s). Although lesson plans may include pages of the teacher's edition, student worksheets, and supplemental resource pages, alternatively they might be represented merely by *teacher notes* that make reference to the planned use of these materials to teach mathematics.

Curriculum

In this study, the term "curriculum" is used to represent organized materials that are created to guide instruction in classrooms (Remillard, 2005; Venezky, 1992). In the case of this study specifically, the curriculum adopted by all three districts was the *Investigations* curriculum, which provided the basis of instructional materials from which teachers could plan their mathematics lessons. These materials include a teacher's edition, as well as any ancillary materials (e.g., implementation guides, planning suggestions, assessment resources, included manipulatives, and CD resources) specifically written to complement the activities in *Investigations*.

Grade-Level Expectations (GLEs)

The majority of states have designated specific learning goals for students at particular grade levels. These "Grade-Level Expectations" (GLEs) describe the specific goals that make up the intended curriculum (B. J. Reys, 2006a).

Supplemental Resources

For this study, resources or materials *not included* with the *Investigations* curriculum are considered supplementary. Theses resources may be in print form, such as the NCTM's *Navigations* books (Chapin, Koziol, MacPherson, & Rezba, 2003; Cuevas & Yeatts, 2001; Gavin, Belkin, Spinelli, & Marie, 2001), may be found on the Internet (e.g., the NCTM's *Illuminations* web site, http://illuminations.nctm.org/), or could include previously adopted curriculum materials that were replaced by *Investigations*, but still exist in classrooms.

Limitations of the Study

One limitation of this study is that a large portion of the documentation required to answer the research questions was collected from teachers' self-reports (Porter, 2002) of how they plan mathematics lessons, as well as their beliefs and philosophies regarding teaching. Although this method provided teachers the opportunity to be open and truthful, some teachers may not have been comfortable admitting they modified their curriculum, modified scope and sequences, and/or possibly disregarded local, state, and/or national educational policies when planning.

A second limitation was the restriction of using only school districts and Grade 4 *Investigations* teachers from one state. While there were several districts to choose from, my perspective and analyses only account for Grade 4 teachers from three of about 50 districts who adopted the *Investigations* curriculum in the state. While many have now adopted the second edition materials, the results of this study are not generalizable to all elementary teachers, *Investigations* users, or all users of inquiry-based curricula. Rather, the study helps identify hypotheses for future study.

Another limitation of the study regards getting "inside the heads" of teachers as they plan. Since the researcher did not have an established relationship with each participant, teachers may have been inclined to be guarded in their responses. Since I was not able to assume a "fly on the wall" position in the classroom, I was limited to what teachers were willing to say during interviews and to report on the survey. Also, some teachers were reluctant to create a written record when they planned, created minimal plans, or just copied textbook pages for their plans. In these cases, I did not have access

to written artifacts for subsequent analysis. Artifact collection was limited by teachers' willingness and comfort in planning.

Significance of the Study

The influence of *NCLB* on U.S. students and teachers appears to be significant based on conversations with educators, policy makers, and curriculum developers. However, there is little understanding of *NCLB*'s explicit influence on teachers' planning of mathematics lessons. Therefore, one outcome of this study is a set of hypotheses based on a small sample of Grade 4 teachers. While previous research has focused on the effects of the *Investigations* curriculum related to student achievement and implementation of the curriculum, little is known about teachers' planning of *Investigations* lessons. As noted above, the research related to planning in mathematics education is limited, and at the same time, decades old. Another contribution of this study is application and refinement of the existing framework related to how teachers plan.

Summary

Elementary mathematics teachers are held to higher levels of accountability than ever before. *NCLB* mandated the establishment of learning expectations in every state, as well as mandatory testing programs for elementary Grades 3-8. At the same time, a greater variety of textbooks exist, including inquiry-based materials and textbooks aligned with NCTM standards. This study investigated how a sample of Grade 4 teachers who used the *Investigations in Number, Data, and Space* curriculum prepared to teach mathematics lessons. The study also addressed other influences on what is taught,

including local, state, and national policy, as well as teachers' beliefs and experiences. Finally, this study illuminates processes teachers go through when preparing to teach, and how teachers plan mathematics lessons.

Organization of this Dissertation

The pages that follow are organized to provide the reader a rationale for this study, the methods used to carry out this study, the results of the study, and possible implications for the field. In chapter 2, I provide a comprehensive review of literature related to teacher planning. In chapter 3, I explain the methodology including the processes of data collection and analysis that was used throughout the study. In chapter 4, I outline the results from the study, highlighting what I discovered through the research conducted with teachers and their planning processes. In the final chapter, I discuss the key findings and implications.

CHAPTER 2: REVIEW OF LITERATURE

The primary goal of this study is to understand what influences teachers' lesson planning. This chapter is designed to provide readers with an overview of the existing literature related to preparation of mathematics lessons at the elementary school level. The research cited is organized in four categories: (1) influences of curriculum materials, (2) policy influences on planning, (3) planning and teacher decision-making, and (4) the conceptual domain for researching teacher planning.

Research suggests a need to study teacher planning behaviors in order to understand the process of teaching (Castro, 2006; Jackson, 1966). Planning for teachers is very different than other professional fields where planning is considered to be more linear in nature. For example, "In fields such as architecture, engineering, and computer science, planning is often characterized as a process wherein a sequence of steps is taken to achieve a particular outcome" (Castro, 2005). Teachers are not afforded the luxury of such simplicity. Instead, planning for instruction includes considering a topic in mathematics, determining what goals are to be reached through instruction, identifying specific activities that might be used, planning the implementation of those activities, and considering assessment for the activity to determine what goals have been met. Throughout the entire process, it is critical to understand that each phase is reliant on the other and is quite fluid. In the end, teachers are attempting to engage students in mathematics, but at the same time trying to anticipate what will happen as well as potential modifications that may be necessary to meet the needs of a variety of children.

"In essence it is the teacher that plans the 'learning trajectories' of the students" (Fi, 2003, p. 26). Based on this complexity, variation in levels of planning is expected.

"Teachers and classrooms rarely function effectively without some kind of planning" (Yinger, 1980, p. 107). Although this statement appeared over 25 years ago, the message is still true today, as is this more recent quote, "Planning lies at the heart of good teaching" (R. E. Reys et al., 2007, p. 51). Prior to teaching a lesson, some amount of planning has occurred. While some teachers might plan at great length and write extensive ideas on paper, others may only prepare notes to themselves in the margins of their teachers' editions as reminders of what they plan on teaching, sometimes referred to as "planbook planning" (McCutcheon, 1980, p. 6). These notes can include bullet points, page numbers, and a sentence or two about specific lesson issues or activities. Reys et al. (2007) suggest experienced teachers typically choose not to write full, detailed lesson plans. On the other hand, teachers may write detailed lesson plans that encompass multiple pages and include everything from scripts for teaching, lists of materials, specific references to worksheets, pages, timelines for the lesson, and notes about other classroom structures. "Scripts are specific plans for dealing with specific topics that allow teaches to unpack the mathematical content for pedagogy" (Fi, 2003, p. 27). This may be especially true of beginning teachers who lack experience and feel compelled to write more detailed notes. No matter what level of preparation occurs, planning takes times and influences the activity of the classroom.

Mathematics teachers have access to many resources that could possibly influence their lesson planning. The most common influencing resource may be the district-adopted textbook. Komoski (1978) and McCutcheon (1980) separately reported about 90% of the

mathematics activities used by teachers were based directly on the teacher's guide. This supports Bagley's (1931) research that classified the American education system as "textbook material reproduction." Reliance on textbooks is still true today (Remillard, 2000; Tarr et al., 2005; Venezky, 1992), but is not the only influencing factor on teachers' planning. Other factors may include student needs (Merriman, 1976), materials and resources available to the teacher for instruction (P. H. Taylor, 1970), or assessments (Paris, 2000), including day-to-day assessments, as well as high-stakes or large-scale assessments. Materials that teachers rely on to provide activities for mathematics can include, but are not limited to, the district-adopted curriculum, supplemental resources, state standards and learning expectations, or resources teachers collect or find at conferences or on the Internet.

As Dossey (2003) notes, "Teachers [do] not always implement the curriculum that was intended" (p. 1467). Teachers may choose to modify, adapt, omit, or review topics throughout the school year. If teachers are teaching content they feel will be assessed with high-stakes testing, then the curriculum they implement will likely be based directly on the assessment and not include other related topics. If teachers believe a topic is not necessary to implement because it is not assessed, they may choose to remove it from the curriculum. Dossey (2003) reported that 13-year old students' opportunity to learn specific content such as geometry varied as much as 30% to 70% from school to school, based on teachers' decisions.

Curriculum Influences on Planning

As noted in the National Research Council's (NRC) *On Evaluating Curricular Effectiveness* (2004), the role of curriculum is vital to educational practice. The mathematics lessons that teachers and students follow everyday are sometimes created by the teacher, sometimes come directly from a published curriculum, and in many cases are a mixture of the two. No matter what the planning process entails, the implemented lesson is a result of the teacher making decisions about what information is to be presented to the students. "They [curricula] provide a crucial link between standards and accountability measures. They shape and are shaped by the professionals who teach with them. Typically, they also determine the content of the subjects being taught" (National Research Council, 2004, p. 1).

Teachers Use of Textbooks

William Brownell (1954) noted in the early 1900s that mathematics learning, "consisted largely in memorization. Teachers, relying pretty much upon what was in the textbook, showed pupils what to do and then relied upon abundant bodies of practice to produce mastery" (p. 1). While some teachers employ different methods of instruction, teachers' reliance on the textbook and the authority associated with the textbook remains a steady influence in the planning and teaching of mathematics (Castro, 2006; Herbel-Eisenmann, in press; Olson, 1980; Sewell, 2005; Tarr et al., 2005; Travers, 1987; Venezky, 1992).

Textbooks have long been considered an authority. As Herbel-Eisenmann (in press) notes, mathematics textbooks in secondary school and beyond typically offer the answers to the odd problems in the back, giving the textbook a perceived authoritative

position. This allows students to interact with the textbook when they are outside of the classroom, and to get feedback on how well they are achieving. More importantly, for teachers, parents, and school administrators, the textbook "represents a message from the larger mathematical community about what students should learn in their school mathematics experience" (p. 36).

The *textbook as authority* belief is apparent in teacher education programs, as well. Venezky (1992) suggests that elementary teachers in particular are trained to rely on the textbook, and not to create their own curriculum. There exists an expertise in designing textbooks that is above and beyond what is expected of classroom teachers at any level, including the actual design of activities, as well as field-testing materials and aligning them to data regarding student learning (B. J. Reys & Reys, 2006). The other reason is that "textbooks provide a limited content expertise for a topic, plus a logical sequencing and a variety of pedagogical supports: activities, questions, test items, and sometimes summaries of expected student difficulties and misconceptions" (p. 442).

"Research has long documented that textbooks, particularly mathematics textbooks, are a prominent tool used by teachers" (Chavez, Chval, Reys, & Tarr, in press, p. 30). This includes teachers using the textbook to determine what mathematics content should be presented, in what order the information should be presented, and activities for presenting the material. While some teachers may adapt the activities based on experience, in general, teachers use their textbook to present a majority of the activities they implement in mathematics.

Research has also noted that the lack of a national curriculum leaves teachers relying on the textbook to inform their decisions on what content to teach (Freeman et al.,

1983). Freeman et al. attempted to identify a consensus of topics that should be taught by examining the content in Grade 4 textbooks. Reys et al. (2006) produced similar results when analyzing the content of state standards for Grade 4 attempting to identify consensus on the topics that should be taught. Together, these two studies suggest there is no national consensus to what mathematics should be taught at a particular grade in the US. While some states allow districts autonomy in choosing textbooks, other states dictate lists of textbooks districts can choose to use (Sewell, 2005). Finn and Ravitch (2004) reported 21 such states which determine lists of textbooks districts and schools can adopt.

Ball and Cohen (1996) studied teacher decision-making and the role of curriculum materials. "Not only are curriculum materials well-positioned to influence individual teachers' work but, unlike many other innovations, textbooks are already "scaled up" and part of the routine of schools" (p. 6). Textbooks influence teachers because they provide a scope of topics, as well as the sequence in which to teach these topics. However, some teachers use professional autonomy to select lessons, omit lessons, and adapt lessons from their textbook. Ball and Cohen refer to this as "a gap between curriculum developers' intentions for students and what actually happens in lessons" (p. 6), and suggest several reasons that teachers plan different lessons than what their textbooks suggest.

First, some teachers are proud to say they do not use textbooks. These teachers believe they are expressing their autonomy as a professional, as well as their distrust that someone who has never met their students can create lessons for them. The second reason is that teachers feel the materials do not align to their own instructional philosophies, and

therefore they change the lessons or choose not to use the textbook in lieu of making their own lessons. Thirdly, some teachers may not understand the content of the textbook lessons, so their planning decisions are based on their own knowledge and experiences. In elementary classrooms, where teachers are not required to be content specialists, this may be more prevalent than in secondary classrooms. Finally, teachers may choose to plan without textbooks because the teacher materials provided with textbooks are overwhelming. The amount of material, the pages of teacher notes, and the need to pull it all together causes some teachers to consider just the content of the student textbook, and plan other forms of lessons around the given tasks. For this to change, Ball and Cohen (1996) suggest teachers need to *see* the resources as useful and understand how to use them when planning. "If we want the intended curriculum best to contribute to the enacted one, we must find ways to design the first with the second clearly in view" (p. 14).

Investigations in Number, Data, and Space

An NRC committee was charged with evaluating the quality of studies that researched the effectiveness of the 13 NSF sponsored mathematics curriculum in relation to student achievement, which included three at the elementary level. One of the three elementary programs is the *Investigations in Number, Data, and Space*, published by Scott-Foresman and designed at TERC in Cambridge, Massachusetts. *Investigations* "is designed to provide a coherent, comprehensive curriculum for Grades K-5 that allows all students to explore important mathematical ideas" (Mokros, 2003, p. 109). Four specific content strands are highlighted throughout the program: (1) number, (2) data, (3) geometry, and (4) the mathematics of change. Under each strand, students experience

meaningful problems that are designed to, "connect all students with mathematics" (p. 113), one of the authors' goals of the *Investigations* curriculum. The other goals include students' development of mathematical thinking and justification, revisiting of specific mathematics content, and guiding and supporting teacher learning. Overall, the *Investigations* curriculum is a comprehensive program that was written to be a primary source of content and pedagogy in Kindergarten through Grade 5 classrooms.

The NRC's report (2004) identified 19 studies that examined the *Investigations* curriculum, including five comparative analyses, one case study, and two content analyses. Two more studies were classified under the NRC's category of synthesis, and the final nine research studies were categorized under background or informative studies. Overall, I found no studies that considered how teachers prepared to implement lessons from the *Investigations* curriculum. Although several studies have researched the effects of *Investigations* on student achievement (Flowers, 1998; Goodrow, 1998; Mokros, 2003; Mokros, Berle-Carman, Rubin, & Wright, 1994; National Research Council, 2004), none has explored how teachers prepared to teach the curriculum. A subset of *Investigations* studies was designed to determine how students using the curriculum scored on a particular assessment when compared to students using another curriculum. However, the number of studies available is relatively small. Mokros (2003) notes, "These [three] were the only rigorous studies of the *Investigations* curriculum that had been conducted at the time this chapter was written" (p. 115).

Supplemental Resources

For the purpose of this study, all materials that are found outside of the district-adopted textbook materials are considered supplemental resources. Many textbooks

include worksheets, reading packets, manipulatives that match specific lessons, and other resources that are part of the curriculum package. However, there are also other resources that teachers tend to refer to. Some of these materials are available at teacher stores or educational outlets in shopping centers and on-line. A walk-through of the exhibition hall at the NCTM's Annual Conference will demonstrate the mass quantity of supplemental materials that exist in mathematics, at all grade levels, beyond the textbook and its accompanying materials. Finally, some teachers also rely on previous district-adopted curricula materials for mathematics activities. These materials include *old* textbooks and worksheets that were previously used by the school before *Investigations* was purchased as the school curriculum by school administration.

While some teaches rely on the textbook, other teachers rely on supplemental materials for instruction. These materials include worksheets, review packets, computer software, or activities found on the Internet. Travers (1987) noted that 51% of the teachers in his study reported using supplemental materials, and another 38% of the teachers used locally created materials, usually developed by teachers within the district at professional development workshops or teacher work days. Other materials included films and laboratory materials, cited by about 15% of the teachers. This study was conducted prior to the influx of mathematics materials based on the NCTM Standards. It is likely that this data may be different for teachers in today's political context. Furthermore, why teachers decide it is necessary to deviate from the district-adopted textbook is unknown.

Influence of Policies

In 2002, the United States Congress passed the *No Child Left Behind Act of 2001*. This landmark education reform focuses on improving student achievement and closing the achievement gaps that exist among gender, race, and other ability groups in the nations' schools. The focus and requirements of *NCLB* have received praise from many people associated with education.

> States and school districts have consistently praised NCLB's requirement for the disaggregation of test data by subgroups of students, because it has shone a light on the poor performance of students who would have gone unnoticed if only general test data were considered. (Jennings & Rentner, 2006, p. 111)

One of the most important components of the *NCLB* legislature is the mandated system of accountability imposed at the state level. "NCLB is clearly having a major impact on American public education. There is more testing and more accountability. Greater attention is being paid to what is being taught" (Jennings & Rentner, 2006, p. 113). The goal is, "having every child make the grade on state-defined education standards by the end of the 2013-2014 school year" (US Department of Education, 2004, p. 1). As suggested by Goertz (2005), accountability is the basis of *NCLB* and states can do little to avoid its influences:

> There has been considerable discussion in the policy, political, and research communities about the type and extent of flexibility states have in responding to the requirements of the *NCLB* Act. Regarding accountability, some provisions allow no flexibility … States now have to hold schools and districts accountable separately for reading and mathematics. (p. 76)

In order to accomplish this goal, states developed specific GLEs and benchmark assessments for measuring progress, and states are required to test *all* students (Goertz, 2005). In the past, states had been allowed to exempt English Language Learners (ELL)

students, or special education students, based on certain criteria that these students had to meet to qualify for exemption status. Such exemptions are no longer the case, as "Most students with disabilities and all ELLs must be held to the same standards and proficiency targets as other students" (Goertz, 2005, p. 81).

State Standards and GLEs

Under *NCLB* legislation, states were required to create standards or GLEs that spell out what students should learn, Kindergarten through Grade 12. "Taking federal funds under *NCLB* requires that states actually set standards and enforce them … The standards are the state's assurance that they will do the job of educating children" (US Department of Education, 2004, p. 3). While these standards were designed to provide structure to student learning, each state was given the autonomy to design their own set of standards and/or GLEs for the students within their education systems.

In 2004, Missouri developed and adopted the *K-12 Mathematics Grade Level Expectations* (GLEs) in response to *NCLB* legislation. In the spring of 2008, DESE made available a new set of GLEs for Missouri teachers to consider. The *Version 2.0: Mathematics Grade- and Course-Level Expectations* document provides an update to the 2004 document, although many GLEs remained the same. "It is essential to include all expectations in your course or grade level curriculum, as they are important components in the understanding and learning of mathematics" (Missouri Department of Elementary and Secondary Education, 2008, p. 1). As noted in the chapter 1, this new document includes a new component designed to further assist teachers, a Depth-of-Knowledge level for each GLE. These Depth-of-Knowledge levels are based on the demands of the GLEs and will be used to indicate at what level assessment of expectations will occur.

"The Depth of Knowledge identifies the highest level at which the expectation will be assessed, based upon the demand of the GLE" (p. 1). These new components will require teachers who may already be familiar with the GLEs to revisit the document and analyze the Depth-of-Knowledge levels for the GLEs at their grade level(s).

High-Stakes and Large-Scale Assessments

According to Jennings and Rentner (2006), schools are paying more attention to curriculum alignment with standards, specifically with instruction and assessment in mind. "The most common improvements are greater alignment of curriculum and instruction with standards and assessments" (p. 110). The influence of assessment on elementary teachers' planning of mathematics tasks is directly related to high-stakes and large-scale assessments. "It has long been know that large scale assessments … influence teaching and learning" (Stump, Eggleton, Roach, & Roebuck, 2006, p. 206). Large-scale assessments include the national and international assessments such as the National Assessment of Educational Progress (NAEP) or the Trends in International Mathematics and Science Study (TIMSS). While these assessment results may not reach the individual student directly, they affect district and school policy. High-stakes assessments include the *NCLB*-mandated state assessments at Grades 3 through 8, and at least once between grades 10 and 12. Some states have created new assessments, while others have adopted national assessments such as the Stanford-9. Another group of states has created variations and/or combinations of the two. No matter how states are assessing students, there is evidence that *NCLB* requirements are influencing teachers' decisions on what content to teach (Linn et al., 2002). Schools are making "more use of test data to modify instruction" (Jennings & Rentner, 2003, p 110).

The pressure to do well on high-stakes assessments is extremely high for teachers, and it is not surprising that some teachers may be *teaching to the test*. "The emergence of high-stakes accountability policies has intensified the debate over whether state-mandated assessment is a useful instrument for changing educational practice" (Bauer, 2000, p. 2). Some researchers have suggested that political pressure may cause teachers to focus on ways to increase student test scores at the cost of teaching for understanding (Darling-Hammond, 1988; McNeil, 1988; Shepard, 2000).

Another consideration of high-stakes testing is the results, and what happens to schools that do not make their Adequate Yearly Progress (AYP) in specific tested categories. "Under *NCLB*, schools that do not make AYP for [two] years are identified for improvement" (Goertz, 2005, p. 83). According to Jennings and Rentner (2006), the number of schools not making AYP has leveled off over the past several years under NCLB. "About 10% of all schools have been labeled as 'in need of improvement' for not making AYP, though these are not always the same schools every year" (p. 111). Urban districts tend to report higher numbers of schools not meeting AYP goals than do suburban and rural districts, but overall, the number of schools not meeting AYP goals is lower than originally predicted (Jennings & Rentner, 2006). However, "small schools … are in greater danger of being mislabeled as 'in need of improvement' than large schools due to the volatile nature of school-level reporting" (Reeves, 2003, p. 4). Reeves suggests that rural districts are facing *unique challenges* under *NCLB* requirements and will, "require assistance and guidance from federal and state policymakers to effectively build the local capacity necessary to comply with *NCLB*" (p. 1). There will be an opportunity to explore the differences in rural and suburban schools in this study.

In summary, *NCLB* has ushered in greater emphasis on state standards and assessments and these are affecting the actions of district administrators and teachers. Since Missouri has recently revised its standards, they will need to be reconsidered by teachers when planning for instruction. These *NCLB*-based influences need to be understood as they relate to teacher planning. Finally, the differences of the effects of *NCLB* in rural and urban schools need to be taken into consideration.

Planning and Teacher Decision-Making

As early as 1979 and through the early 1990s, studies focused on teachers' decision-making processes (Ball & Cohen, 1996; Borko & Cadwell, 1982; Borko & Shavelson, 1983; Borko, Shavelson, & Stern, 1981; Shavelson & Borko, 1979). However, much of this research focused on the decisions that teachers made when forming instructional groups in literacy classes. Few studies explored instructional decision-making as it relates to mathematics. Below, I summarize several of the studies from this era and discuss the need to enrich this area of research on teacher planning.

In a key study published more than 35 years ago, Zahorik (1970) articulated the importance of planning, stating, "There seems to be widespread agreement not only on the value of planning, but also on the substance and the format of plans" (p. 143). Zahorik explained teachers are expected to plan lessons for their students, including goals or objectives for learning, activities to be used including materials and management issues, and assessments that allow the teacher to understand what students learned or did not understand. Zahorik's study reported on the planning and teaching of 12 Grade 4 teachers who were divided into two groups, those who planned and those who did not.

Teachers who planned were given two weeks to plan a 30-minute lesson, while those who did not plan were given instructions on what to teach about five minutes before the lesson began. A neutral topic (credit cards) was identified in order to eliminate issues related to content specific planning.

All lessons were observed with researchers looking for specific behaviors demonstrated by the teachers related to introduction of new topics, encouragement of students, and interactions where teachers were questioning students to think deeper about topics. One compelling finding was that teachers' sensitivity to students' responses varied markedly between the two groups. "Once the teacher decides what outcomes he wants from the lesson and how he will achieve them, he sets out to produce these outcomes regardless of what the pupils introduce into the teaching-learning situation" (Zahorik, 1970, p. 150). In other words, the teachers that planned became very rigid in their lessons, not varying from their plans, while teachers who did not plan addressed more issues that students introduced and encouraged more open thought regarding the lesson ideas. Zahorik notes that it is impossible for teachers to go into classrooms everyday unprepared to teach, as this would lead to unproductive learning in the long run. At the same time, he calls into question the importance of planning. He asks are teachers considering student thinking and interaction when they are planning, or do they create rigid scripts and schedules for teaching?

In a synthesis of research on teacher decision-making and planning, Shavelson and Borko (1979) stated, "Only recently have teachers' intentions, goals, judgments, and decisions been admitted as a legitimate part of research on teaching" (p. 183). They noted that previous research had focused on teacher characteristics such as attitudes and

interests and their effects on student achievement. Shavelson and Borko suggested a decision-making paradigm that includes teacher characteristics and their influence on teacher decision-making. Teachers combine their knowledge of students' characteristics with their own personal beliefs about teaching strategies and activities they feel will be most beneficial for their students. This process, referred to as *preactive teaching*, is the planning that takes place before lesson implementation. The authors focused on preactive teaching (planning, material preparation, and grading of previous student work to inform planning), the decisions teachers made, and how these decisions affected instruction specifically related to grouping students.

Shavelson and Borko (1979) identified several student characteristics for teachers to consider when grouping students: achievement, class participation, classroom behavior, student social abilities and cooperation, as well as work habits of each student and their self-concept. They suggested teachers needed to be more aware of their strategies for making decisions as this leads to more effective instruction. Grouping decisions have an impact on instruction and need to be addressed when considering teacher planning and decision-making.

Borko, Shavelson, and Stern (1981) addressed an additional component of the decision-making paradigm. The authors reported teachers' motives, beliefs, goals, and knowledge needed to be taken into account when addressing the decision-making process. Teachers combine their knowledge of students' characteristics with their own personal beliefs about teaching strategies and activities they feel will be most beneficial for their students. Borko et al. (1981) reviewed four studies that addressed teachers' preactive teaching procedures as they related to forming groups within classrooms. They

noted teachers considered several student characteristics when planning groups, but also considered content related characteristics (Borko et al., 1981). "While teachers have at their disposal a wide variety of information about students, they apparently combine selected pieces of this information into reasonably accurate estimates of student abilities for forming groups" (p. 458). Borko et al. also reported other factors that influenced teachers' planning such as student success in other content areas (e.g., science, language arts, or social studies), availability of resources, and class size.

Berliner (1986) described the need to consider teaching strategies used by expert and novice teachers. His research focused on why teachers chose to do a homework review when class began. Berliner reviewed several studies related to this idea and noted the similarities and differences between experts and novices in how they used the activity. Berliner argues, "For example, because these kind of studies give us information about the routines, scripts, and schema used by experts, we are helped in identifying the buggy routine or script, or the ill-formed schemata, that might be characteristic of less expert or novice teachers" (Berliner, 1986, p. 6). He noted that we should not just observe expert teachers, we need to, "also ask them to tell you what they are seeing, thinking, doing, and feeling" (p. 8) in order to gather the most beneficial data possible.

Borko and Livingston (1989) also addressed expert versus novice teachers' instruction. The authors suggested two conceptual frameworks they employed for determining patterns in teacher planning, teaching, and self-reflection. "The first framework is the characterization of teaching as a complex cognitive skill determined, in part, by the nature of a teacher's knowledge system … The second framework describes teaching as improvisational performance" (pp. 473-474). Borko and Livingston recorded

how teachers use pedagogical reasoning in planning and teaching. Experts were typically more discriminating in how they used information, while novices used anything that was available as a "safety net." When pedagogical reasoning, as well as pedagogical content knowledge, was explored, novices tended to have disconnected planning and instructional practices. Improvisational performance included the teacher working from loose guidelines versus rigid scripts of information. Therefore, the teacher had to rely on their own strengths, experiences, and bags-of-tricks to make the lesson work. Because novice teachers have less experience, experts tended to be stronger improvisational performers and can work from loose lesson planning, versus very detailed notes and plans.

Borko and Livingston's (1989) research concluded that experts were better at informal planning and teaching from these plans. Although many experts noted going through a rehearsal of the lesson, this was not consistently done before lessons. Instead, the expert teachers would think about their plans at irregular times, sometimes a week ahead of time, others just hours before class. Novice teachers had similar written lesson plans, although they contained more details about time and materials management than expert plans. However, the process by which novice teachers created their plans was very different than the experts who relied on the fact that they had taught the lessons before. Novices could only look ahead a couple of pages, or a week at the most for planning. This made many novices lose sight of the entire unit and its goals sometimes. Overall, novice teachers struggled to plan and implement lessons because of inexperience. Although, "we know little about the process by which novices become experts" (Borko & Livingston, 1989, p. 495) and need to continue research in this area.

Shavelson (1983) highlighted the need for research on decision-making at the planning stage because he argues that these decisions ultimately control the majority of the key components of the implemented lessons, such as the activity or task, the goals, the materials, and the lesson structure. However, few studies have focused primarily on the planning of instruction. "While most research has found activities to be of central importance in plans, little is know about how activities are constructed" (Shavelson, 1983, p. 405).

Borko and Shavelson (1983) made specific recommendations for teacher education based on a synthesis of research regarding teachers' decision-making. They argued that teacher planning is a complex process, and teachers have to attempt to balance cognitive goals for students with social and motivational goals. "While research tells us a fair amount about the elements in teachers' plans … much less is known about the planning process" (Borko & Shavelson, 1983, p. 212). The authors noted a need to support teachers as decision-makers and give them the tools to realize they are reasonable decision-makers in their own classrooms. According to Borko and Shavelson, we need to make teachers aware of the authority they have to make decisions when planning instruction, as well as how their decisions might affect their classroom, their students, their school, and their future decisions. It is also important for teachers to realize that their planning process should be modifiable. Teachers who create yearly plans in September, or even weekly and daily plans, need to understand the importance of reflecting on their plans and making adaptations that meet their students' needs in the classroom daily.

Conceptual Domain for Researching Teacher Planning

This section describes the framework that was utilized to inform the design of this study. In a pivotal study for my research, Shavelson and Stern (1981) provided a comprehensive review of research on teacher planning up to that time. Shavelson and Stern proposed the creation of models for teachers to better understand how to plan and implement content. "In order to understand teaching, we must understand how thoughts get carried into actions" (p. 457). The authors suggested six possible methods for collecting data focused on teachers cognitive processes of planning and teaching: (1) policy-capturing, (2) lens-modeling, (3) process-tracing, (4) stimulated recall, (5) case studies, and (6) ethnographies. The framework provided by Shavelson and Stern (1981) is the result of several studies that employed each of these six methods (Borko & Cadwell, 1982; Borko et al., 1981; Shavelson, 1983; Shavelson & Borko, 1979). Although most of this research focused on literacy planning, the methods employed during their research were not necessarily content-specific.

Based on this work, Shavelson and Stern (1981) present a conceptual domain for evaluating the process that teachers go through in making decisions, judgments, and their behaviors (See Figure 1). I briefly highlight each component below. "In order to understand the behavior of teachers, then, it is essential to know (a) their goals, (b) the nature of the task environment confronting them, (c) their information-processing capabilities, and (d) the relationship between these elements" (p. 461).

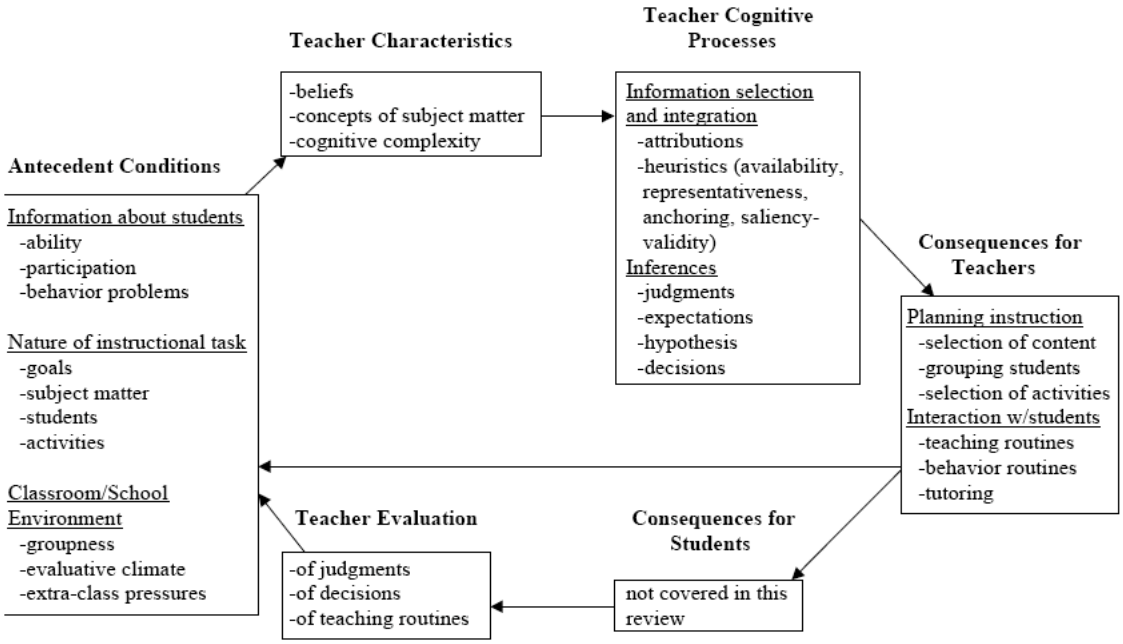

Figure 1. Conceptual domain for research on teacher judgments, decisions, and behavior (Shavelson & Stern, 1981, p. 461).

Explanation of the Framework Components

Shavelson and Stern (1981) present a cyclical order to the decision-making process, noting that the process happens sequentially. The Antecedent Conditions are the issues that could, with or without teachers' awareness, impose on their decisions. The Information for students section is the student characteristics that teachers consider when thinking about students. The authors cite approximately 30 studies and report the specific cues that were used by teachers in forming decisions based on student characteristics. Nature of instructional task refers to the components that make up the activities teachers plan to use for instruction. Classroom/school environment concerns issues that happen in both places. This includes the physical and social aspects of the classroom that influence teachers' decisions, as well as the external pressures provided from school administration or parents (Shavelson & Stern, 1981). However, Antecedent Conditions do not include

recent changes in education, including *NCLB* or the reformed mathematics curricula and standards of the 1990s and 2000s, potential sources of influence to supplement the framework.

The next piece of the model is Teacher Characteristics, including the teachers' beliefs about teaching, decision-making, student responsibility, academic skills, content, and what effective instruction may look like. Shavelson and Stern (1981) report that teachers with more experience typically had a skills-oriented conception of teaching and were less progressive in their decision-making than less experienced teachers, who typically represented more student-centered approaches to instruction. The other key beliefs that had an impact on teacher decision-making were teachers' perceptions of the association of student socioeconomic status (SES), and student ability. Teachers usually associated high SES with high-ability and low SES with low ability. Finally, two types of planners emerged from teacher characteristics, "*incremental planners*—those who proceed in a series of short steps, based on day-to-day information, focusing on activities, and *comprehensive planners*—those who develop an abstract, general scheme over the long run" (p. 469).

The next section, Teacher Cognitive Processes, is the combination of the antecedent conditions and the teacher characteristics, and the decisions teachers make based upon student characteristics and their beliefs about education. Once these decisions have been made, they lead directly into the Consequences for Teaching. This portion of the model is based on the premise that teachers' behavior is guided by their thoughts, judgments, and decisions from the teacher cognitive processes. Here the actual lessons are planned and implemented by the teachers. It is important to note that there is an arrow

from this box back to the original antecedent conditions. As mentioned previously, research has shown that some teachers' do not wander from their specific ideas and plans, and therefore they do not consider the last two sections of the model. Comprehensive planners could fall into this routine, where incremental planners typically proceed through Consequences for Students and the Teacher Evaluation of their process, decisions, planning, implementation, and student results from the process.

Shavelson and Stern (1981) did not highlight the characteristics for *consequences for students* in the article. Since this study is not conducting observations of classrooms and recording of student actions, the aforementioned missing characteristics are inconsequential. However, *teacher evaluation* will be examined through this research. Specifically, what are the judgments and decisions that are made after a lesson has been implemented? Although observations are not being conducted, interview questions will be asked to address what content was planned, implemented, reflected upon, and how student interactions influenced subsequent lesson plans. This reflection process needs to be considered as an influence because teachers may change their lesson plans for the next day based on student reactions to the lesson.

Traditional Versus Nontraditional Teachers

Because this study is designed to explore the preparation of teachers using the inquiry-based curriculum *Investigations*, a nontraditional approach to mathematics content and pedagogy at the elementary level, Raymond's (1997) research on the differences between traditional and nontraditional teachers is particularly relevant. Raymond's work provides specific characteristics associated with traditional and nontraditional beliefs, organized into four categories: (1) the nature of mathematics, (2)

learning mathematics, (3) teaching mathematics, and (4) for categorizing mathematics teachers' practice (See Appendix A). In each component, Raymond identifies these characteristics to categorize her subjects as traditional, primarily traditional, an even mix of traditional and nontraditional, primarily nontraditional, and nontraditional. These frameworks will be applied throughout the data analysis.

Hierarchy of Planning Levels

The final issue to consider from the research review conducted by Shavelson and Stern (1981) is the hierarchical dimension of planning time. According to the authors, there are five levels at which teachers plan. The beginning level is *daily*, usually completed by individual teachers. This includes the task used for the particular day, the schedule and script the teacher and students will follow, and any assessment that might be built into the lesson. The next level is *weekly* planning, which may happen individually or in groups. Teachers tend to keep daily plans in a lesson-planning book that reflect goals to be accomplished by the end of a week. Weekly plans are not typically more detailed than daily plans.

Groups or individual teachers can also complete *monthly* plans. Monthly plans typically include whole units and are more general than weekly plans, including materials that need to be gathered for the entire month, or general goals from which weekly and daily plans will be created. The fourth level of planning is *term* planning. This level highlights the content that a teacher wants to complete before a grading period ends, or specific ideas that deal with seasonal themes. Finally, *yearly* planning is typically done at the end of one year, over the summer, or just before the school year begins. Major school goals could be considered, as well as general themes that might be used for term or

monthly planning. Some yearly planning is done at the administrative level and handed down to teachers to use in their classrooms.

Brown (1988) built upon previous research by documenting different levels of planning by teachers. Brown includes only four levels of planning in her study: (1) yearly plans, (2) unit plans, (3) weekly plans, and (4) daily plans. Table 2 provides a summary of each stage suggested by Brown (1988). Both studies provide a basis from which to consider how teachers plan at different levels. Similar to Shavelson and Stern's frameworks, Brown's work did not consider standards, GLEs, *NCLB*, and other issues from recent changes in mathematics education that occurred after her research was published.

Table 2

Framework for analyzing teacher planning levels (Brown, 1988, pp. 75-76)

Levels of Planning	Goals	Sources	Form	Factors that Influence
Yearly	[1] To assess the adequacy of the scheduling of activities and content, supplemental instructional materials, classroom management policies, and textbooks [2] To plan how to integrate suggested innovations into established curriculum [3] To outline first week's and first term's activities	Unit file folders Textbooks School calendar District curriculum guide State competency objectives	Mostly mental Sketchy outline of first week and term	Successes/failures during previous school year District/school innovative program and workshops District curriculum guide content State competency objectives Textbook content and availability Student interest Classroom management School calendar Prior experience Homogeneous ability grouping
Unit	To plan sequence of topics, activities/ materials that will cover district curriculum guide content	Unit file folders Textbooks School calendar District curriculum guide State competency objectives Audiovisual aids Supplemental textbooks and workbooks	List/notes in planbook outlining topic, corresponding textbook page numbers and activities	District curriculum guide content State competency objectives Availability of materials Student interest Nature of the subject matter Textbook content Prior experience School calendar Homogeneous ability grouping

Levels of Planning	Goals	Sources	Form	Factors that Influence
Weekly	To plan a variety of activities for the next week in the context of school schedule interruptions	Unit file folders Textbooks School calendar District curriculum guide State competency objectives Audiovisual aids Unit plan	List/notes in planbook outlining day-to-day activities and assignments	District curriculum guide content State competency objectives Availability of materials Student interest Schedule interruptions Student performance during previous week Textbook content Activity flow Prior experience Homogeneous ability grouping Classroom management School calendar
Daily	[1] To decide how to interweave pervious day's lesson into next day's lesson [2] To set up classroom for next day [3] To plan procedural details of activities [4] To plan next day's homework assignment	Unit plan Weekly plan Textbooks A-V [audio-visual] aids Students' homework assignments	Notes in planbook and on paper listing homework assignment, activities, and textbook pages to cover	District curriculum guide content State competency objectives Availability of materials Student interest Schedule interruptions Student interest in yesterday's lesson Student disposition as class enters room Prior experience Classroom management Activity flow Textbook content Homogeneous ability grouping

Summary

I conclude this chapter noting that differences in teacher planning and the influences on the decisions teachers make represent substantial gaps in the research. This study will focus on defining and documenting planning procedures for elementary teachers who use *Investigations* and attempt to address some of the gaps in the current literature. First, the decision-making paradigm and framework were created from research related to reading/literacy, and they need to be adapted for mathematics. Second, the framework and previous research do not include the policy issues that are related to *NCLB*. Third, the framework does not take into consideration inquiry-based curricula and how teachers plan differently to implement these curricula. Therefore, the framework needs to be updated to reflect other possible influences on teachers' lesson preparation.

I believe another gap in the research literature is related to mathematics specific content. While I found very few articles specifically addressing mathematics, the few I did find were quite specific. For example, Ball and Cohen (1996) focused on new mathematics curricula materials influencing teacher decision-making. A final gap in the existing literature is a lack of studies that focus exclusively on lesson planning. That is, most of the research on curriculum is focused on implementation. This study seeks to understand the influences on teacher planning.

Overall, curricula play an important role in the mathematics tasks that are implemented in elementary classrooms. Teachers also need to prepare lessons differently for the *Investigations* curriculum than if they were teaching with traditional (Raymond, 1997) methods or curricula. The research related to curriculum does not explore how teachers plan lessons for implementation. There is also a void in the current research

regarding how teachers' beliefs and philosophies of education affect how they plan to implement inquiry-based lessons.

CHAPTER 3: METHODOLOGY

The primary purpose of this study was to understand what influences the planning processes of *Investigations* teachers' in Grade 4 and to document how teachers use inquiry-based, elementary curriculum materials to prepare to teach mathematics lessons. This included understanding the processes of planning that take place and documenting these processes currently used by teachers. Raymond (1997) and Thompson (1992) suggest that research needs to examine teachers' beliefs and conceptions of mathematics as they are related to their instructional practice. In this study, I explored these ideas by determining the influences that exist and how they affect Grade 4 teachers' preparation of mathematics lessons from the *Investigations* curriculum. Specifically, this study was designed to answer the following two research questions:

(1) What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?

(2) What factors (e.g., beliefs, experience, policy, curriculum) influence Grade 4 teachers' lesson preparation when using an inquiry-based curriculum?

The design of the study, including the selection of participants, data sources, instruments, and data analysis processes, are described in this chapter.

Subject Selection and Participants

To seek access to participants for my study, I submitted a request to and received approval from the Campus Institutional Review Board (IRB). In order to identify

Missouri school districts that were using *Investigations*, I relied on the Coordinator of the *Investigations in Number, Data, and Space* Leadership Seminar, held in Columbia, Missouri in July 2007. The Coordinator keeps an up-to-date list of Missouri school districts using *Investigations* and provided me with a list of about 50 school districts across the state that had adopted the *Investigations* curriculum for their elementary mathematics program. From this list, I identified seven school districts within reasonable proximity of my residence to approach regarding participation[2].

In addition to location, I considered the number of years that *Investigations* had been the primary curriculum in each district. In particular, I did not want to study school districts that had recently (i.e., in the past two years) begun implementing *Investigations*. Instead, districts that were engaged in full implementation, at least three years using the curriculum, were sought. A third consideration was that all participating schools needed to be using the first edition *Investigations* materials. Second edition materials became available in Fall 2007, and several districts in Missouri soon began implementing these updated *Investigations* curriculum materials. However, I felt the changes to the *Investigations* curriculum made these schools similar to schools implementing a curriculum for the first time, therefore in violation of my second criteria.

A fourth criterion was the consideration of the school environment, specifically whether the environment was supportive of collaborative planning. I wanted to be able to

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[2] No districts that had sent teachers to attend the summer seminar were approached to participate in the study because the majority of teachers at the Leadership Seminar were using the 2nd edition of *Investigations*, in conflict with one criterion for participation.

understand the differences in planning that occur in collaborative situations versus isolation, where the number of potential influences on teachers' preparation increases by virtue of working together. I sought schools offering collaborative planning opportunities for their teachers, as well as schools that were not providing these opportunities. This information was provided by district coordinators and principals, and confirmed through data collection. Moreover, I wanted to identify schools with teachers who might fall along the full spectrum of traditionally orientated to nontraditional (Raymond, 1997). Based on the stated criteria, three school districts were identified and a total of four school principals agreed to allow me access into their schools (District A included two of 19 possible elementary schools). All Grade 4 teachers in the four schools were invited to participate in the study.

District A

District A is a large, urban school district in Missouri from which two schools were selected and whose teachers were solicited to participate. There are approximately 8,000 total students in 19 elementary schools. (During the 2007-2008 school year, each of the two schools enrolled approximately 115 students in Grade 4). Nearly 30% of students qualify for the free/reduced lunch program, with School 1 averaging around 15% and School 2 averaging almost 50%. School 1 has a majority of Caucasian students (75%), but also has approximately 10% African-American and 10% Asian students. Although School 2 is similar with about 70% Caucasian students, the majority of remaining students is African-American (25%).

The District Mathematics Coordinator for Grades K-5 identified two specific schools as possible participation sites based on the principals' support of research

conducted in their schools. School 1 is regarded by the Mathematics Coordinator as a "high performing school" and has consistently met AYP goals in mathematics for the past 5 years. School 2 has met AYP goals in mathematics three of the last five years and was specifically suggested because the Mathematics Coordinator and school principal perceived the Grade 4 team to be collaborative in the planning for mathematics instruction. Although the principal in both schools did not expect teachers to turn in lesson plans regularly, lesson plans were collected for professional evaluations.

Both Schools 1 and 2 have Math Coaches, a new addition for the 2007-2008 academic year. The Math Coach's role was to provide ongoing support at each site by meeting with teachers to discuss mathematics, as well as providing resources when teachers needed them. Specifically, District A Math Coaches performed four major duties, namely to: (1) coach teachers and improve instruction through observing and co-teaching, (2) continue learning and developing understanding about how children learn, (3) manage and evaluate the *Investigations* program in District A, and (4) provide leadership and professional development throughout the district. The primary goal of the Math Coaches was to help create new instructional practices to increase student achievement and understanding of mathematics, and to sustain those practices throughout the district.

District A had adopted the *Investigations* curriculum nine years previous and provided ongoing inservices for teachers regarding the curriculum. Overall, District A teachers were afforded opportunities to collaborate regularly, both through district-sponsored professional development, as well as at the school level through planning, and there was an expectation from district administration, the Mathematics Coordinator, and

principals that teachers would participate in these opportunities in some capacity. Teachers at School 1 participated primarily in district-sponsored collaboration, while teachers at School 2 met regularly, once a week, after school to plan their lessons together.

District B

District B was a rural district and included only one school, School 3, which contained the only Grade 4 classrooms in the entire district. Collectively there were only approximately 2,000 students in District B, with only about 120 students in Grade 4. Approximately 55% of students in School 3 qualify for the free/reduced lunch program and, is the population is predominately Caucasian (98%). It is worth noting that School 3 did not meet AYP status in Mathematics for the Individualized Education Program (IEP) subgroup in the previous year. Curriculum Coaches had been used in previous school years for both mathematics and language arts, however the school district decided not to continue with Curriculum Coaches in the 2007-2008 school year. At School 3, teachers met once a week, on a flexible schedule when time during the school day permitted, but no other support for teachers using the *Investigations* curriculum was provided in the four years since its adoption. The principal at School 3 did not require teachers to submit lesson plans beyond professional evaluations.

District C

District C contained only one school with Grade 4 classrooms in a small, rural district. District C enrolled almost 2,500 total students in the entire district, and 125 students in Grade 4. School 4 contains approximately 60% of students who qualify for the free/reduced lunch program and is mostly comprised of Caucasian students (75%),

with another 15% Hispanic and 8% African-American students. During the 2007-2008 academic year, School 4 was in school improvement for not meeting AYP status in Mathematics for the entire school. No Curriculum Coordinator or Math Coaches existed in District C now, or in the past, and the principal at School 4 did not require teachers to submit lesson plans beyond professional evaluations.

Teachers in School 4 did not have collaboration opportunities, as the district provided no ongoing support for teachers using the *Investigations* curriculum, which had been adopted four years ago. However, School 4 was designated as an "enhancing Missouri's Instructional Networked Teaching Strategies" (eMINTS) building because the school had purchased classroom sets of computers, approximately one computer for every two students. Therefore, School 4 teachers were trained through the eMINTS program, about 180 hours of professional development to use technology for teaching all subjects in their classroom.

Participants

The number of Grade 4 teachers who agreed to participate from three school districts was 18 out of 24 possible participants. Table 3 provides information about the number of teachers at each school who agreed to participate, as well as the number who declined participation. All non-participating teachers declined to participate at the beginning of the study with one exception. After the study had begun, one of the three declining teachers at School 4 chose to opt out of participating, citing "personal reasons."

Table 3

Number of participants at each site and the number of teachers who declined participation

District	School	Number of Participants	Number of Non-Participating Teachers
District A	School 1	3	2
District A	School 2	4	1
District B	School 3	7	0
District C	School 4	4	3

The number of years of experience teaching as well as years of experience with the *Investigations* curriculum varied across the 18 participants. Table 4 provides a list of all the teachers in the study, including their years of experience, the number of years they have taught Grade 4, and the amount of time they have used *Investigations*. (All names have been changed for confidentiality). As shown in Table 4, five teachers have taught Investigations for two years or less and 13 teachers have taught Investigations for three or more years.

I have described the process for how I identified the districts, schools, and participants in this study. In the next section I describe four specific data sources used in my study, including the purpose of each data source, as well as their origins, as many of them are adaptations of existing instruments.

Table 4

Participants and their years of teaching experience, years teaching Grade 4, and years teaching the Investigations curriculum

Participant	School	Experience Teaching (years)	Experience Teaching Grade 4 (years)	Experience Teaching *Investigations* (years)
Becky	3	6	6	4
Betty	4	10	8	5
Cindy	2	5	5	4
Daryl	1	18	18	8
Gabby	3	2	2	2
Kara	2	<1	<1	<1
Kendra	3	20	4	2
Kim	1	13	3	3
Lacy	3	6	6	4
Laura	4	9	<1	<1
Leslie	1	<1	<1	<1
Lilly	3	<1	<1	<1
Lisa	2	7	7	8
Mandy	4	20	9	5
Mary	2	2	2	1
Nancy	3	4	4	5
Tamara	3	5	<1	<1
Valerie	4	5	5	3

Data Sources

Four data sources were used in order to examine planning processes and influences on teachers' planning: (1) Practices and Beliefs Interview, (2) Practices and Beliefs Survey, (3) artifacts: Teachers' Lesson Plans, and (4) observation of one Collaborative Planning Session. Each one is noted below, including a description of the instrument, when data was collected, and the purpose of the instrument. A summary table

of the data sources is included at the end of this section. Data collection began December 3, 2007 and concluded with the final interview on January 30, 2008.

Practices and Beliefs Survey

"Surveys can help identify (1) teacher beliefs about the quality of district-adopted textbooks, their preparedness, and their professional development expectations and needs; as well as (2) the frequency of specific instructional practices" (Chval, Grouws, Smith, Weiss, & Ziebarth, 2006, p. 47). A *Practices and Beliefs Survey* was administered to each participant immediately upon obtaining written consent of participation. The survey was designed to collect data about each teacher's practices and beliefs specific to the *Investigations* curriculum (e.g., how long they had taught *Investigations*, their perception of the role of the curriculum, etc.) and was modeled after: (1) the Center for the Study of Mathematics Curriculum (CSMC) Teacher Questionnaire (Grades K-5) (Chval et al., 2006); (2) the Trends in International Mathematics and Science Study (TIMSS) 2003 Teacher Questionnaire (Grade 4) (National Center for Education Statistics, 2003); and (3) Raymond's (1997) work regarding teachers' beliefs of teaching, learning, and planning mathematics. (See Appendix B for a copy of the *Practices and Beliefs Survey*).

The survey contains multiple sections, including questions to gather data about each teacher's background. The first section includes questions about *Investigations*, such as, "What role do the *Investigations* materials play in your planning?" The next section focuses on planning, with questions such as, "What percentage of instructional days do you primarily plan to use the *Investigations* lessons during class to teach mathematics?" The final section includes questions from three specific categories and elicited teachers

agreement with statements regarding: (1) mathematics and student learning, (2) mathematics teaching, and (3) planning for mathematics. An example of each statement, respectively, is: (a) "Each student learns mathematics in his or her own way," (b) "The textbook guides instruction and the teacher follows the lesson without deviating," and (c) "I provided students with as many problems and as much practice as possible in mathematics." Teachers were provided a copy of the survey with a self-addressed, stamped envelope to return the surveys to the researcher upon their completion, and all 18 surveys were returned.

Practices and Beliefs Interview

A primary data source for this study was the *Practices and Beliefs Interview* (See Appendix C for the *Practices and Beliefs Interview*). The interview protocol was used to collect data regarding the teachers' beliefs, planning processes, experiences, and other related areas. The *Practices and Beliefs Interview* included specific questions to determine the extent to which each of the following were influential on teacher planning: (a) *NCLB*, (b) assessment, (c) state standards or GLEs, (d) the *Investigations* curriculum, (e) supplemental resources, and (f) the colleagues in each participant's school. The *Practices and Beliefs Interview* was primarily based upon the characteristics of the Shavelson and Stern (1981) framework and the Inside the Classroom Teacher Interview Protocol (Weiss, Pasley, Smith, Banilower, & Heck, 2003). Questions specific to the use of *Investigations* were also included and were drawn from previous studies (Russell et al., 1997) on this inquiry-based curriculum.

All data were collected at the convenience of each participant. In particular, interviews were conducted at school, either before or after the school day or during

teacher preparation time. Some interviews were conducted during the lunch period, if preferred by the teacher. Each interview required approximately 60 minutes to complete. All interviews were conducted face-to-face, were audio-recorded, and subsequently transcribed between December 1, 2007 and January 30, 2008.

Teacher Lesson Plans

Following the conclusion of the *Practices and Beliefs Interview*, one set of lesson plans for three consecutive *Investigations* sessions was collected from each participant. Although teachers were aware that I was going to collect one set of lesson plans, prior to my visit they were not aware which specific sessions I would collect. By not disclosing which lessons would be collected prior to the interview, I attempted to reduce artificial influences on the creation of lesson plans. The purpose of collecting the set of Teacher Lesson Plans was to secure a written record of the product of the planning that occurred prior to the teaching of mathematics lessons over a specific period of time. Specifically, teachers were asked to provide their lesson plans for the Grade 4 *Investigations* introductory lessons from the *Arrays and Shares* unit, Investigation 1, Sessions 1-3. Two teachers were not able to provide a lesson plan from *Arrays and Shares* upon demand due to the fact that they do not write formal lesson plans, or because they did not save them from the beginning of the year. In these cases, teachers selected another set of plans.

A second set of Teacher Lesson Plans was also collected *after* I conducted the *Practices and Beliefs Interviews* (or in some cases, after the Collaborative Planning Sessions, described in more detail below). The purpose of the second set of lesson plans was to secure a second lesson artifact for analysis; that is, to compare how consistent teachers' planning was, as well as to determine how much influence, if any, collaborative

planning session may have had. The second set of lesson plans provided a means of detecting whether the interview process might have influenced teachers' planning processes. Teachers were allowed to choose a set of lesson plans to submit as a second artifact of lesson planning.

Together, the two sets of plans provide a written record of 97 total days worth of lessons. These artifacts were used to determine both planning processes and influences on the planning of mathematics lessons. For all 97 days, the plans were reviewed to identify the physical features of the lesson plan, as part of the planning process, as well as key characteristics of the plans that suggested influences from the *Investigations* curriculum or from supplemental resources. The *intertextuality* (Boles, 1994) of the plans was also examined to understand the depth of the plans that did not appear in the written text. Boles (1994) described intertextuality as, "text [that] makes reference to another text that, on the surface, appears to be unique and distinct" (p. 2). For this study, the lesson plan's intertextuality might include teachers' notes referencing page numbers of worksheets from other resources, either an ancillary document or a supplemental one, without further identifying the worksheet or including it with the plans.

Collaborative Planning Session

Researcher attendance at a Collaborative Planning Sessions occurred only at School 2, where participants are involved in team or collaborative planning. The purpose of attending this meeting was to identify influences on teachers' planning that might be unique to teacher collaboration. After learning that one school in my sample participated in collaborative planning consistently, I arranged to attend one Collaborative Planning Session. During my visit, and with prior permission, I audio-recorded the entire

Collaborative Planning Session and transcribed the file. Field notes were also taken during the session.

Summary of Data Sources

Table 5 provides a summary of the data sources described above. The data collection timeline and purpose for each source is identified.

Table 5

Data sources: Timeline and purposes

Data Sources	Data Collection Timeline	Purpose of the Data Source
Practices and Beliefs Survey 18 surveys completed	Completed and returned prior to interviews for all participants (Varied based on scheduled interviews)	To gather background and beliefs information from all participants related to planning procedures at their schools, beliefs about *Investigations*, and experience information.
Practices and Beliefs Interview 18 interviews completed	Completed between December 1, 2007 and January 30, 2008.	To amass specific data regarding teachers' beliefs, as well as the influence of *NCLB*, assessment, standards/GLEs, textbooks, the curriculum, and other possible influences on planning processes.
Teacher Lesson Plans (2 Sets) 32 sets of lesson plans submitted	First set collected at *Practices and Beliefs Interview*; completed by January 30, 2008. Second set collected after *Practices and Beliefs Interview* or Collaborative Planning Session; Completed by February 1, 2008.	To provide a record of the planning that took place for each lesson and to provide a document to analyze influences on planning.
Collaborative Planning Session 1 session with 4 subjects	Completed prior to collection of second Teacher Lesson Plan, when applicable	To gather data on the impact of collaboration on teachers' beliefs and planning processes.

Pilot Study

In order to assess the efficacy of the *Practices and Beliefs Interview*, a pilot study was conducted with three teachers who did not participate in the full study. The purpose was to gauge the length of the interview in order to determine if it could be completed in a reasonable amount of time and to clarify and refine the interview protocol. Participants in the pilot study were nominated by a local district mathematics coordinator and, according to the coordinator, represented a traditional teacher, a nontraditional teacher, and a teacher who was considered to be a mix of traditional and nontraditional according to the Raymond (1997) framework. Each teacher volunteered to participate in the interview, which was audio-recorded and transcribed.

Based on the clarity and quality of answers elicited by the original questions, the pilot study revealed the need to make a few notable changes to the protocol, including rephrasing a few questions, as well as dropping others from the protocol. For instance, the question, "In what ways, if at all, does the *Investigations* Teacher's Guide influence your planning?" was dropped because the pilot study results suggested the question was producing redundant information to a previous question about how teachers planned. Additionally, a few questions that originally appeared in separate locations in the protocol were later combined because teachers' responses to these questions were closely related to one another. One example was a question about using supplemental materials, which was more natural to ask when inquiring about resources teachers used for planning. The set of responses to the pilot interviews were also used for reliability testing, to be explained in greater detail below.

Data Analysis

This section describes how each data source was analyzed and how analyses served to answer the two research questions for this study. Triangulation of data was used to support the findings. My analyses of the qualitative data in this study are based in theory. In particular, I coded data after I collected it, using Shavelson and Stern's (1981) conceptual framework to identify the primary codes for processes and influences on teachers' planning. However, additional codes emerged as the result of data analysis. For this second layer of analysis, I relied on grounded theory, which Patton (2002) defines as, "What theory emerges from systematic comparative analysis and is grounded in fieldwork so as to explain what has been and is observed" (p. 133). Because this framework was not current, new influences and process considerations emerged during data analysis. Therefore, I had to consider recent changes in educational policy and, as a result, refine the framework as new codes emerged. The processes will be described in more detail below as appropriate.

Analyzing Interview Data

All interviews were audio-recorded and transcribed for analysis in relation to the two research questions. Subsequent qualitative analysis of transcripts and surveys occurred through the use of the computer program NVivo (QSR International, 2006). Because I employed a theory-based approach, I created the descriptions for coding based on the a priori categories of Shavelson and Stern (1981) and Raymond (1997). As new codes emerged during analysis, they were added to the Shavelson and Stern (1981) framework. The primary and secondary codes for defining characteristics of teachers' beliefs were taken directly from Raymond's (1997) work.

Raymond's (1997) four criteria for identifying characteristics and beliefs of teachers were employed to classify participating teachers as *traditional* or *nontraditional*. Appendix A contains criteria for characterization of each of the four categories: (1) teachers' beliefs about the nature of mathematics, (2) teachers beliefs about learning mathematics, (3) teachers' beliefs about teaching mathematics, and (4) teachers' mathematics teaching practice. In order to make a determination about each teacher's beliefs toward traditional or nontraditional teaching, survey responses were analyzed with respect to the Raymond (1997) frameworks.

From the Shavelson and Stern (1981) framework, characteristics that are defined under all of the sections were used as the *primary codes* for coding the data: (1) Antecedent Conditions, (2) Teacher Characteristics, (3) Teacher Cognitive Processes, (4) Consequences for Teachers, (5) Consequences for Students, and (6) Teacher Evaluation. The subheadings became the *secondary codes* under each primary code identified in each component. It should be noted that Consequences for Students was not described as it pertains to what is observed in the classroom. Because I did not conduct classroom observations, I did not use this section of the framework. NVivo enabled me to keep the data and coding separate for each teacher in the study, and also combine them for comparison across all participants and schools.

An example of the coding scheme that I employed appears in Table 6. I used the section on Antecedent Conditions to illustrate the coding scheme; the primary codes and secondary codes are taken directly from the framework. However, as noted above, the age of the research that produced this framework prompted the addition of new secondary codes to be under various primary codes, as the data warrant. Some of these new codes

were related to educational policy (e.g., *NCLB*), teacher beliefs (e.g., beliefs specific to *Investigations*), and curriculum (e.g., teachers' perceived effectiveness of *Investigations*). Examples of possible new secondary codes are included and underlined to denote that they are not part of the original framework.

Table 6

Example of NVivo coding scheme using Antecedent Conditions of Shavelson and Stern's (1981) framework

Original codes from the Shavelson and Stern framework	NVivo coding scheme, including primary codes and secondary codes created from original framework and some potential <u>new</u> secondary codes
<u>Information About Students</u> -Ability -Participation -Behavior problems <u>Nature of Instructional Task</u> -Goals -Subject matter -Students -Activities <u>Classroom/School Environment</u> -Groupness -Evaluative climate -Extra-class pressures	➢ Information about students ← **PRIMARY CODE** • Ability • Participation ← **SECONDARY CODES** • Behavior problems • <u>Special education, ELL, gifted</u> ← **NEW CODE** ➢ Nature of instructional tasks • Goals • Subject matter • Students • Activities • <u>Standards/GLEs</u> ➢ Classroom/School environment • Groupness • Evaluative climate • Extra-class pressures • <u>Assessment pressures</u>

Figure 2 includes a sample of the coding that was created with NVivo, and direct application of primary and secondary codes as described above. In the figure, a selection of coded text from one of the interviews is provided. To the right are the *coding bars* used in the NVivo program to denote coded text assigned to specific codes. Compatibility issues between the NVivo program and the program used for creating this dissertation text required the recreation of the example, instead of directly including a captured image of the original coding.

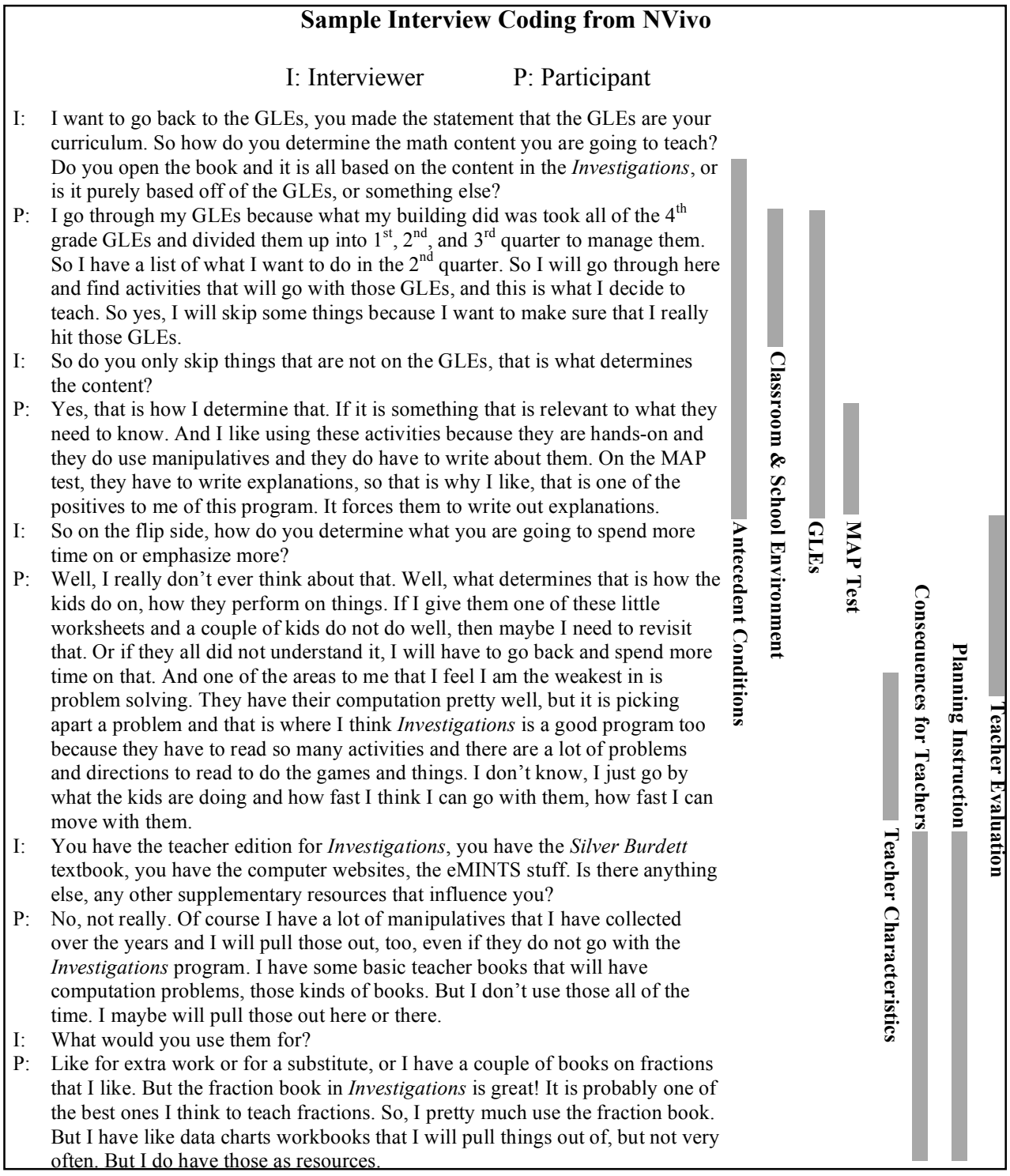


Figure 2. Sample NVivo coding with primary and secondary coding bars.

Analyzing Survey and Interview Data

The *Practices and Beliefs Surveys* were also coded using the Shavelson and Stern (1981) framework. Specific questions were created using the framework to elicit responses from teachers related to the planning process and influences on planning. These responses were coded with the same primary and secondary codes from the framework. Because new codes did not emerge from analysis of survey data, only the original codes were employed for this source.

The Raymond (1997) framework was also used to code specific responses on the surveys. The last three sections of the survey included statements based on Raymond's traditional and nontraditional characteristics that teachers noted their level of agreement or disagreement with. The surveys were analyzed by comparing teachers' agreement levels with the nontraditional responses, as well as their disagreement with the traditional responses. The data were coded to determine if teachers were: (1) traditional, (2) primarily traditional, (3) an even mix of traditional and nontraditional, (4) primarily nontraditional, or (5) nontraditional.

A weighted Likert item analysis was employed for analyzing the survey data. I assigned a value of +2 points to each response of "strongly agree" with a nontraditional statement. Teachers' responses of "agree" to nontraditional statements were assigned a value of +1. If a teacher "agreed" with a traditional statement, these instances were coded with a -1, while "strongly agreeing" with a traditional statement was assigned a value of -2. The opposites were also coded for each case; for example, responding "strongly disagree" with traditional statements were assigned a +2 value, and so on. Each teacher's values were then summed to determine which Raymond category they matched for four

specific areas: (a) their overall beliefs about the nature of mathematics as represented in the entire survey, (b) their beliefs about student learning, (c) their beliefs about teaching mathematics, and (d) their beliefs regarding planning for mathematics. This process provided an opportunity to support or refute my intuitions about teachers' beliefs from my initial analysis of their written responses.

The Teacher Lesson Plans were coded using specific portions of the Shavelson and Stern (1981) original primary and secondary codes to determine the process and influences on planning. In particular, plans were coded to address three parts of the framework: (1) Antecedent Conditions (i.e., information about students and nature of instructional tasks); (2) Teacher Characteristics (i.e., beliefs); and (3) Consequences for Teachers (i.e., planning instruction). For example, the lessons plans were examined to determine how teachers addressed information about students, which would include references to modifications for Gifted, ELL, or Special Education students, or including rationale from student test scores or classroom assessment that influenced the lesson plan.

The Teacher Lesson Plans were also coded with the final section of the Raymond (1997) framework, identifying teachers' beliefs towards planning. Specific aspects of the plans were compared to the characteristics of nontraditional planners to determine which of the five characteristics listed above each teacher was most closely aligned with. For example, one of the characteristics states, "The teacher has students work cooperatively" (p. 560). The lesson plans were examined to determine if teachers noted that group work would occur during the lesson, including working in pairs, small groups, and discussions together as a whole group, or if the teacher identified specific groups of students by name within the lesson plans.

Reliability of Data Coding

Reliability of the coding scheme was gauged prior to formal data analysis. In particular, two graduate students with backgrounds in qualitative research methods participated in reliability checks by coding data from the pilot study. Shavelson and Stern's (1981) framework was used for coding pilot study interviews to determine influences on planning, as well as planning processes of teachers. The graduate students were first trained in the application of the coding framework. Training included identifying sections of text in the interview transcript, and then assigning a primary or secondary code to each section of text. In some instances, sections of text were assigned more than one primary or secondary code when the content pertained to multiple parts of the framework. Double-coding the pilot data was necessary to determine whether it would be necessary to double-code data from the set of actual participants.

After practice-coding one interview together, and responding to questions the graduate students raised, the three of us coded an entire interview independently. The two graduate students' results were then compared with my coding assignments and an inter-rater reliability was calculated to report consistency in coding based on the Shavelson and Stern (1981) framework. This included noting how many instances all three people coded, and then identifying the amount of shared codes that each graduate student had in common with my coding. After multiple rounds of coding, comparing, and refining the schema, the reliability was calculated at 71.8% on a total of 63 codes, which allowed me to then code all subsequent research data.

Patterns across Teachers' Planning

Once all data were analyzed for individual characteristics and planning processes, I conducted an analysis across all of the data sources, using summaries from NVivo that included all text coded in each primary and secondary category. I analyzed the planning of teachers by looking for patterns across all data sources. Triangulation of all the data sources was used to demonstrate that across all of the sources, teachers consistently followed specific processes for planning. Triangulation is a process of validating the results by comparing data from multiple sources to determine the corroboration of the data (Oliver-Hoyo & Allen, 2006; Wiersman, 2000). "Triangulation [is] a technique common to qualitative research whereby multiple sources are used to verify themes identified from data" (Warnes, Sheridan, Geske, & Warnes, 2005, p. 173).

Triangulation was also employed to determine the consistency and level of authority of influences on teachers' planning. For example, questions regarding supplemental materials were included on the *Practices and Beliefs Survey*. Teachers' use of supplemental materials was also addressed through specific questions on the *Practices and Beliefs Interview* protocol. Finally, the collected Teacher Lesson Plans provided documentation of supplemental materials that were used, as teachers included such materials in their lesson plans. Therefore, the use of supplemental materials by teachers was validated through triangulation of these data sources.

I also analyzed each teacher's data to identify similarities and differences in planning processes of the Grade 4 teachers. To answer Research Question 2, the data was analyzed to determine all of the influences suggested by teachers and to what degree of influence each had on teacher's overall planning. Table 7 provides a summary of the

triangulation of data sources; specifically, how individual data sources were used in answering both of the research questions.

Table 7

Triangulation of data sources for answering each research question

Research Question	Primary Data Sources	Secondary Data Sources
What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?	• Practices and Beliefs Interviews • Teacher Lesson Plans	• Practices and Beliefs Surveys • Collaborative Planning Session
What factors (e.g., beliefs, experience, policy, curriculum) influence Grade 4 teachers' lesson preparation when using an inquiry-based curriculum?	• Practices and Beliefs Interviews • Practices and Beliefs Surveys	• Teacher Lesson Plans • Collaborative Planning Session

Summary

Data from four sources were analyzed with the goal of answering both research question related to the processes that Grade 4 teachers employed when planning for mathematics and the influences on teachers' lesson planning. I analyzed each source in an ongoing process of adding information, describing characteristics in further detail, and answering both of the research questions more deeply with each source considered. In chapter 4, I present the results of the study that were yielded from the qualitative analyses of the aforementioned data sources.

CHAPTER 4: ANALYSIS OF THE DATA AND RESULTS

This study sought to document the processes that Grade 4 teachers employed when planning inquiry-based mathematics lessons. The research focused on conditions of planning (e.g., where, when, and how long teachers plan), district and school level support for teachers of the *Investigations* curriculum, teachers' selection of the content of their mathematics lessons, as well as how teachers' lesson plans were created. In addition, this study examined the influences on the lesson planning processes and the decisions teachers made planning mathematics instruction. Such influences included, but were not limited to their own personal beliefs, conditions within the school district or community, and policy issues at the local, state and/or national level. Specifically, this study addressed the following research questions:

(3) What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?

(4) What factors (e.g., beliefs, experience, policy, curriculum) influence Grade 4 teachers' lesson preparation when using an inquiry-based curriculum?

The Shavelson and Stern (1981) framework (see Figure 1) regarding the domain for researching teachers' judgments, decisions, and behaviors, was used to inform qualitative analyses of interview transcripts, teacher lesson plans, and survey data. Although several components of the Shavelson and Stern framework were confirmed by the analyses, new components related to how teachers plan and what influences that planning also emerged. In the pages that follow, the components specific to the processes

and influences on planning are identified. This chapter also includes a final section reporting how teachers would make use of one extra hour of planning each day for mathematics, which was the final question on the interview. When appropriate, specific examples from the data sources are used to support the findings. When a teacher is identified, pseudonyms (see Table 4) are used to ensure confidentiality of all subjects.

Planning to Teach Inquiry-based Mathematics Lessons

This section identifies three major categories of support for addressing the first research question, "What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?" The first category is *Pre-Planning Procedures*, or the factors that exist as part of the planning process before teachers consider what they are going to teach. The second category, titled *Content Selection*, includes how teachers make selections of the mathematics content for their lesson plans. As noted, multiple factors are identified in the planning process that contributes to the selection of content. Once teachers have determined the mathematics content to be addressed, then they create their lesson plans, hence the final category, *Creating the Lesson Plan*. Regardless what happens prior to this step, teachers typically created a lesson plan individually, formatting their plans to meet their needs. The variations in lesson plan formats, as well as other planning dynamics, such as where and when teachers plan, are discussed in detail. A summary of the results related to the first research question is provided at the conclusion of this section.

Antecedent Conditions: Pre-Planning Procedures

Before teachers begin to plan for their mathematics lessons, there are Antecedent Conditions, "those categories of information that impinge, either with or without awareness, on teachers' classroom decisions" (Shavelson & Stern, 1981, p. 462) that exist within the local context and affect the planning process. Below I describe four such Antecedent Conditions, including: (1) information contained in the teacher materials of the *Investigations* textbook, (2) the expectations school personnel, specifically principals and School Boards, have for teachers within the district or school, (3) professional development opportunities at the district level, and (4) collaboration opportunities at the school level. Evidence of these Antecedent Conditions will be provided to illustrate their role in the mathematics planning process of teachers within this study.

The Investigations Textbook

Before teachers began to plan their lessons, they had access to published curricular materials. In this study, the *Investigations in Number, Data, and Space* was the inquiry-based curriculum adopted by all three school districts represented, and was the primary resource for planning mathematics lessons in Grade 4. The *Investigations* materials were written with specific mathematical goals for Kindergarten-Grade 5 students. These goals include: (1) offering meaningful math problems to students, (2) an emphasis on deep mathematical thinking, not superficial experiences with unrelated topics, (3) communication of math pedagogy and content to the teachers using the materials, and (4) to help students become mathematically literate (Economopoulos, Tierney, & Russell, 1998). The textbook materials include a suggested scope and sequence, written to address the content strands of: estimation, number sense, whole

number operations and computation, geometry and spatial sense, measurement, statistics and probability, fractions and decimals, and patterns and relationships. At Grade 4, the *Investigations* curriculum includes a total of 11 specific units, or modules, teachers can access when planning instruction. In Shavelson and Stern's (1981) framework, curriculum materials represent the "Nature of Instructional Tasks," including goals, subject matter, and activities for planning. It should be noted that the first edition *Investigations* materials do not provide individual student textbooks. Therefore, when textbooks are referenced throughout chapters 4 and 5, I am referring to the teachers' editions that include all of the activities for students in the form of teachers' notes on ideas they can present to students verbally or on the board in the classroom or in the form of blackline masters for reproduction and use with students.

The textbook materials also include discussions of relevant content and background information intended to support teachers during planning and implementation of *Investigations'* mathematics lessons. Specifically, there are sections devoted to the mathematical objectives of each lesson, sections that address linguistically-diverse classrooms and English Language Learners (ELL), tips for providing extensions for students and for modifying activities to meet the needs of learners, and dialogue designed to assist teachers in the facilitation of discussions of mathematics explorations (Economopoulos et al., 1998). The materials also include 10-Minute Math activities that teachers can use as warm-up problems for the mathematics lesson, student sheets with example problems, and assessment resources. As noted previously, the *Investigations* curriculum does not suggest "lecture" as the primary teaching method, typically associated with "traditional" or older methods of teaching (see

Table 1). Instead, the authors' intention is for students to engage in group activities, sometimes using manipulatives, as they grapple with mathematics problems each day, and then discuss their results with peers either in pairs or whole group settings. The textbook materials suggest that students present their thinking, including multiple solutions, behind ideas explored in the main portion of the lesson.

As a planning tool, the *Investigations* curriculum provides teachers with a place to begin, a place for choosing content, pedagogy, and assessment activities for their students. It also provides support structures that can be used by teachers to address the variety of needs in their classroom. Finally, it contains a "comprehensive" Grade 4 mathematics curriculum for teachers to follow throughout the school year (Mokros, 2003; Trafton et al., 2001).

Expectations for Planning

Before teachers walk into their classroom, before they pick up a mathematics book to plan from, there exist expectations regarding the use of curricular materials that are conveyed by the school district. As evident in two interviews in District C, such expectations emanate from both the School Board and principal.

> Becky: Our curriculum comes from above, from the School Board. We have to teach, we are supposed to teach [*Investigations*]. And if [the principal] says we have to use these programs, we have to use them.
>
> Gabby: [The principal] instructs us to plan out of *Investigations*. She does not collect our lesson plans, and she does not come help us plan. But she does direct us to, that we need to stay on *Investigations* and different things like that.

Statements similar to these were made by eight of the participants in the study, representing three of the four schools (Districts A and B). On the other hand, none of the teachers in the study was required to regularly submit lesson plans to their principal. This

phenomenon was apparent at all four schools, and from all 18 participants. Two teachers, each from a different school, indicated their principal collected lesson plans for professional evaluations, occurring twice per school year. When other teachers were asked about this, about half of the participants in the study confirmed similar procedures. Nancy refers to the collection of lesson plans related to her professional evaluation as the "dog and pony show" because she believes that teachers plan lessons and implement them differently for their evaluations:

Troy: Does [the principal] collect lesson plans?

Nancy: No. [Except for] our one dog and pony show [professional evaluation], and after you are tenured, your every other year "dog and pony show."

Troy: Does [the principal] collect lesson plans?

Laura: If I know [the principal] is coming in to watch something specific, I will give her what she is wanting there. But for the most part, she doesn't [collect lesson plans].

This section revealed that teachers are expected to plan from the *Investigations* curriculum, as stated by at least one teacher at every school. In reference to Shavelson and Stern's (1981) framework, the Classroom/school environment in Antecedent Conditions reports pressures that exist at the school level. However, principals at each school were not collecting teachers' lesson plans on a regular basis to know whether or not planning with *Investigations* was occurring, and as evidences, professional evaluations are not occurring regularly as to inform principals of the use of *Investigations*.

Supporting Investigations at the District Level

Professional development designed and provided by the district related to *Investigations* included content specific planning meetings for the entire school and

grade-level planning meetings within schools. Each of these collaborative opportunities provided teachers with a variety of experiences focused around the *Investigations* curriculum and teaching mathematics at Grade 4. This section describes the support provided to teachers for implementation by districts, while the next section will address the support structures at individual schools. Together, both sections are represented in Shavelson and Stern's (1981) Antecedent Conditions under multiple sections based on the level of work: (a) Information about students, (b) Nature of instructional tasks, and (c) Classroom/school environment.

The professional development that was provided by each school district varied greatly across the three districts represented in the study. All seven teachers across the two schools in District A identified professional development sessions that were available, both in the summer and during the school year, and acknowledged that they had participated. Below are two responses, one from Kim at School 1 and the second from Lisa at School 2, that demonstrate how *Investigations* professional development was provided within District A.

Kim: They give inservices each month to new teachers, which was really nice because I was not a new teacher, but I was new to this curriculum, and that was really nice because we got together right before we taught the unit and they showed us exactly what we needed to do.

Lisa: My first year, well they offer it to everybody, but my first year I went to a class that they had, one of the teachers that had been teaching *Investigations* since it was in the district, taught, went through the book with you. And that was helpful because they would say, here, this is what they are trying to get you to do. Sometimes you cannot tell. So that was something that was helpful.

Also in District A, under the guidance of the district mathematics coordinator, a pacing guide was created for all teachers to refer to when planning. This pacing guide provided teachers with the time frames throughout the entire school year that specific

units should be taught, as well as the number of days to spend on each unit. See Appendix D for a sample pacing guide for Grade 4 *Investigations*. During the interviews, all seven teachers in Schools 1 and 2 (District A) mentioned the pacing guide as being one focal point for the professional development meetings.

In District B, teachers were not given as many opportunities for professional development specific to the *Investigations* curriculum materials. However, two teachers in this district indicated that, in the past, some professional development for *Investigations* had been provided. They described the professional development was limited to the year that *Investigations* was first adopted by the district, and included being sent to another district (more than an hour away) for work with teachers from the other district who were more experienced users of the curriculum.

> Nancy: When I first came, my first year … they sent me to [District A] probably six times to watch teachers, which was great because you got to watch one lesson, and that was pretty much it, but it at least gave you ideas about how to organize your manipulatives and how to do your planning … But other than that, nothing, pretty much nothing.

> Lacy: I don't think I went more than once. There were some follow up visits, but I think I only went once. We have been offered to go to workshops in the summer, but it is the same thing, going back to [District A], so not a lot of training … That probably occurred the 2nd year I was teaching. And we have been using *Investigations* about 4 years since then.

Other teachers in District B received no training of any kind with *Investigations*. When asked the same question about support from the district, three new teachers responded as follows:

> Lilly: Nothing, basically just from my mentors. I have had to pick it up, and learn it on my own, and it has been a lot of years since I have had some of this stuff, so it is a lot of studying every night or going over it every night, and the way they teach it, it is a lot different than what I was taught

> Gabby: I have not had any training in it.

Tamara: None. I had no training. Some people have.

District C provided the least amount of professional development. I have included a response from each of the four teachers' interviews at School 4 that collectively demonstrate the consistent absence of support from the district with *Investigations*.

Betty: My professional development pretty much consists of what I did myself. My colleagues that had done the *Investigations* the year before me, just collaborating with them, and collaborating with other teachers who were teaching it at the same time I was. And it was basically at lunch, and "what are you doing now," and "how are you doing this?" We did not have any professional development on it at all other than that.

Laura: Not really any opportunities from the district. I am a brand new teacher there this year. This is my first year using *Investigations* … At this point, they have not offered anything, any training or anything like that. Just other teachers, if you ask them, they will tell you what they think.

Mandy: Outside of me just doing it on my own? Just collaborating with other teachers in the building … But I have to do this all on my own.

Valerie: Well I was not in the district when [*Investigations*] was bought, so I have never had any formal training.

The level of district support was further addressed by Betty in responding to the follow-up question, "Has the district supported *Investigations* at all?"

Betty: The manipulatives are provided, and our district did buy a lot of things to go with our series, so that was helpful.

As the above excerpts demonstrate, professional development for *Investigations* varied greatly across the three districts. The influence of the professional development opportunities will be addressed in more detail in a later section. The next section addresses the conditions of collaboration and support that each school in this study established for their teachers.

Supporting Investigations at the School Level

In District A, the two schools represented in the study are quite different demographically, and the level of support at each school is different. At School 1, teachers have the option of planning with each other, if they choose to, making time on their own. They also have the support of a Math Coach, with whom they can meet if they choose to do so. The teachers at School 2 in District A also have a Math Coach in their building. Mary and Cindy's interview responses describe the support for planning provided by the Math Coach.

> Mary: There are many times I have had to call our Math Coach, and say, "Hey, I do not get this lesson, I have been looking over it for an hour, and I am a little nervous to get up and teach this to my class," and she will come in.
>
> Cindy: The Math Coach is an important piece that I am glad we have this year because we have always had that with reading and writing, someone to say, "you are doing this well, but this isn't going so well for you. We need to work on this." So that is a good resource to have in your building, to go and ask a question of, "I don't understand this, can you help me figure this out?" or "When does this happen in 2nd grade? When does this happen at another grade level?"

The four teachers at School 2 chose to set aside a common planning time, after work, that they use every week to work together on planning mathematics. Although they have a common planning time during the school day, these teachers did not feel it was sufficient for common planning. With interruptions and other duties, such as calling parents or meeting with the principal, they decided to meet together after school. Cindy reflected on how this time was used by the teachers at her school.

> Cindy: When we started, there are three new people on our team, when we started, they were taking anywhere from an hour-and-a-half on. Now we have kind of minimized that to one hour. The more comfortable they have become with *Investigations*, they are now starting to look ahead and talk, we are now having more conversations, rather than just writing the daily objectives. They will ask questions about what would you do here, or what kind of

things are you going to try to pull from this lesson. So we have more of those kinds of conversations, as well as writing those objectives.

The teachers at School 2 also participated in what they referred to as "cohort," described in the next quote, which was another time to collaborate regarding mathematics. Although the district sponsored the cohort time, it was tailored to meet the needs of specific schools. School 1 was also involved in a cohort, but their focus was on communication arts. School 2, on the other hand, was involved with other district schools that had similar issues and demographics, and together, their cohort chose to focus on mathematics. In her interview, Cindy captured the purpose behind the cohort, and its influence on her planning.

Cindy: One of the things that the district is trying to do is to alleviate the gap between groups of students, the performance of groups of students. So each, schools that are kind of similar in some way, are grouped together. So we are in a *cohort* with four other district schools … We meet once a month and we talk about the book we are getting ready to teach. At our last meeting, we wrote "I can" statements for the three big ideas for this book, the book I am in currently. Which is awesome because now at our team meetings, we can go through and say this [session] right here is what they are doing. And if it is not one of the objectives, we are not going to hit that as hard, because it might be something they need exposure to, to get later, because it is spiraling, but it is not something we need to make sure they master.

Kara also discussed the cohort in her interview. From the work being completed at these meetings, Kara uses the discussion and takes it back to do planning individually.

Kara: Now that cohort has moved towards planning for the next unit and pulling out the math for each investigation, that makes it even easier because we already have the math kind of spelled out for us. It takes out some of the guesswork … That is how I plan, from that skeleton that we have.

Overall, the teachers in District A, Schools 1 and 2, have varying degrees of support at their individual schools when it comes to planning for *Investigations*. Teachers in School 1 were primarily supported at only the district levels, while teachers in School 2 were

being supported at both the district and school levels. However, their counterparts in Districts B and C had limited structures in place at their school level to support implementation of Investigations.

In District B, the teachers met weekly, but the planning time was not as structured or focused as the planning time at School 2. Teachers in School 3 sometimes plan on one day during the week if they have time after their district meeting obligations. However, when time does not permit, then they move their planning time to another day, planning together during their common prep time during the school day. This process was repeatedly mentioned throughout the interviews of the seven teachers at School 3. But the nature of the planning that occurred at this meeting was different than the planning at School 2. Below are selections from three interviews that capture the purpose of the common planning time at School 3.

Tamara: We usually meet as a grade level, and sort of touch base where everyone is. It is not detailed planning, but it gives us some idea of our pace.

Gabby: We collaborate together as a team to figure out what we are going to teach, and when we are going to teach it … Then we decide what area we are going to teach out of what book. We are not even planning *Investigations*, we are pulling in other stuff.

Nancy: I have file cabinets full of old teachers' stuff that I pull from, stuff I inherited. My other teachers, I constantly go to them, "hey what are you guys doing?" We work really well together, so I can always go to them and see what they are doing. Usually somebody has a good activity for whatever they are doing. We share these at our meetings.

Instead of identifying mathematical goals and objectives for students, teachers were typically involved in what I refer to as a *content swap*, where teachers exchanged worksheets, activities, and other resources related to one specific topic. This process and the resources used will be discussed in more detail in the next section.

As noted by the teachers in District C, School 4, their only opportunity to plan together was when they chose to do so on their own. Although they were encouraged to plan together by their principal during the school day, many had not taken this step. In her interview, Betty elaborated on the idea of collaborating together with her colleagues at the request of the principal. However, she emphasizes how difficult it is to make time to collaborate due to all of her other responsibilities.

> Betty: Our principal has asked all of us that have a shared planning time to meet every Tuesday, but that Tuesday during our hour time we have, I might have to process with a student in the Buddy Room, or she might have a student teacher she is working with. *It has been hard* because you have that one-hour. And our lunch time, forget that because it takes them 15 minutes to get through the lunch line and that leaves you 25 minutes to go to the bathroom, eat your lunch, make a phone call or two if you need to, and write a couple of notes to parents that you need to write and that is it. So, *it is hard* because that one hour, I try, but like today I had my one-hour and am planning for a substitute tomorrow and trying to get this project finished.

In Schools 1 and 2, there are more support structures in place that allow for teachers to understand the *Investigations* curriculum. In Schools 3 and 4, these structures exist in very limited capacity. The lack of support structures may result in teachers' discomfort with the *Investigations* program as evidenced by responses to a question from the *Practices and Beliefs Survey*, summarized in Table 8. Teachers in Schools 3 and 4 responded much differently to the level of preparedness to teach *Investigations* compared to teachers in Schools 1 and 2. The former typically expressed feeling unprepared, while the latter group largely felt prepared, and most felt Very Prepared.

Table 8

Participants' reported preparedness to teach Investigations, by district and school

		Very Prepared	Somewhat Prepared	Somewhat Unprepared	Very Unprepared
District A	School 1	2	1	0	0
	School 2	2	1	1	0
District B	School 3	0	4	2	1
District C	School 4	0	0	4	0

Overall, teachers at each of the four participating schools were exposed to varying levels of professional development, district inservices, collaborative planning, and support to plan for the *Investigations* curriculum materials they were expected to use. While the expectation of administrators in all four schools was to use *Investigations* for mathematics teaching, this did not appear to be happening in Schools 3 and 4, which will be described in more detail in the next section focused on how teachers select content once they have progressed through the pre-planning stage.

Content Selection

Analysis of the multiple data sources revealed there were four specific sources teachers used in selecting the mathematics content they planned to teach: (1) State GLEs, (2) assessment resources, (3) the *Investigations* textbook, and (4) supplemental resources. Each resource is described in more detail below, including how teachers related to using each for planning. Examples from multiple data sources are introduced to support these findings.

Grade Level Expectations (GLEs)

The primary resource regarding important mathematics content that teachers referenced when planning to teach was the *Missouri Mathematics Grade and Course Level Expectations* (Missouri Department of Elementary and Secondary Education, 2008). The current set of GLEs were first published by the Department of Elementary and Secondary Education, DESE, in 2004 after *NCLB* legislation was passed and recently updated to include course level expectations for the high school. While the 2008 version GLEs were considered a draft during the data collection period, it warrants noting a majority of the teachers in the study cited the 2004 document as a resource for choosing content they plan to teach.

In Schools 3 and 4, nine of the 11 teachers cited the GLEs as being the *primary resource* they used when determining what content to plan to teach in Grade 4. More specifically, these teachers remarked that the GLEs in Grade 4 had been organized by teachers in their school so that they could be addressed in quarters one, two, and three of the school year. Becky and Mandy's interviews provide a summary of what has been done in both of their schools in relation to the GLEs:

> Mandy: I go through my GLEs because what my building did was took all of the 4th grade GLEs and divided them up into 1st, 2nd, and 3rd quarters to manage them. So I have a list of what I want to do in the 2nd quarter … I will skip some things because I want to make sure that I really hit those GLEs.
>
> Becky: We have a ton to cover in 4th grade and we fit it all in during the first three quarters. The 4th quarter is more for enrichment or the fun stuff you don't really get to play around with during the year.

In other words, teachers at Schools 3 and 4 compressed the set of state Grade 4 GLEs into the first three quarters of the school year. Teachers then planned their mathematics curriculum using the GLEs, making sure they were teaching each GLE as a

topic, and as noted by Mandy, skipping content that did not address the GLEs. Before planning the lesson, teachers at School 3 engaged in a *content swap*, as mentioned previously. They identified activities from multiple resources to *address* the GLEs before the state MAP test occurred in the spring, and then shared activities among each other at their schools. The content swap will be described in more detail in the *Supplemental Resources* section, as the majority of activities that were exchanged were from supplemental resources.

Betty's interview captured how she and her colleagues rearranged the GLEs at School 4. She also suggested that fourth-quarter content was chosen based on what students had already been exposed to during quarters one through three, but needed more practice with so they could reach mastery before leaving Grade 4.

Troy: What do you do for 4th quarter if you have taught all the GLEs in the first three quarters?

Betty: We don't have 4th quarter concepts because all of those GLEs should be covered the first three quarters because our state testing comes before 4th quarter is over, so we have to cram all of that into the first three quarters. What we do 4th quarter is basically go back, and like I said, the division and multiplication, I go back and we work a lot on that. And we do some graphing and make sure that all of those skills are mastered before we release them to 5th grade.

The teachers at School 3 were so focused on teaching GLEs they had their student grade cards printed with the GLEs listed on them, and assigned grades each quarter to specific GLEs that students had learned during that quarter. Again, I refer to Becky's interview to clarify what all seven teachers in School 3 noted about the GLEs and grade cards, or student report cards.

Becky: The GLEs, we have all those set, and then we sat down when we did our grade card and decided what we would teach each semester, or each quarter, and then for the semester. We then put the GLEs onto the grade card.

Although I was provided access to one such student grade card on one of my visits to School 3, it is not included here because doing so would jeopardize confidentiality of the school district.

While the teachers at Schools 3 and 4 used the GLEs primarily to guide their content selection, teachers in Schools 1 and 2 used the GLEs for planning much differently. Their district administrators aligned the GLEs to each grade level, providing teachers with a document that identified what the lesson goals were, as well as the specific GLEs that were aligned to the activities in a particular textbook. An excerpt from this document is included in Appendix E. In her interview, Lisa described what had been done in her district with regards to the GLEs.

> Lisa: [The district math coordinator] went through and actually, for every objective in every single book, of every activity and investigation in every book, put the numbers of which GLEs correspond with which ones. There was a math group that met a couple of summers ago and they did that together, went through every investigation in every book and figured out which GLEs it met.

Like Lisa, Kim's interview response was also representative of the seven teachers in District A when she stated, "I plan with *Investigations*, I know that it is going with the GLEs, because I am trusting [the planning guide]."

According to the teachers in Schools 1 and 2, their content was selected mainly from the planning guide provided by the district that had the state GLEs aligned for each activity in *Investigations*. However, in Schools 3 and 4, the content was primarily being selected based on what GLE topic the teachers were planning to teach, then selecting activities to meet those GLEs. This will be addressed more in the following two sections where the teachers identified how they used the *Investigations* curriculum, as well as

supplemental materials, for their activities in mathematics. The teachers' lesson plans submitted at the request of the researcher did not confirm the explicit use of GLEs for planning because they did not include any obvious notations referencing particular GLEs.

Assessment Resources

The second method noted by teachers for selecting lesson content was through the review of end-of-unit assessments, or in some schools, end-of-quarter assessments. Teachers at all four schools referred to these as *common assessments* because every teacher in Grade 4 was required to give the same assessment to their students. In this discussion, the term *end-of-unit assessment* will be used to describe the variations of what are essentially common assessments that were given to all students in the grade level within a district at a predetermined point in time.

When questioned about the role of assessments in making content selection, 12 of the 18 teachers specifically identified end-of-unit assessments as a required component at their school, and this was the case in all four schools in the study. Some schools have assessments that are used at the end of each book in *Investigations*, while others use these tests at the end of the quarter for the purpose of assessing specific skills that appear on their grade cards. No matter how they might be used, it was clear from the interviews that end-of-unit assessments were used at all four schools. The following interview excerpts were taken from the responses to the question, "Does the content you plan to teach appear on state or District Assessment tasks?"

> Lacy: We have a common assessment over this skill … And so whenever we have this common assessment, we know we have to hit [specific skills] pretty hard.

Betty: We do our common assessments, our quarterly assessments, and we have to make sure we have everything covered 1st quarter so they can take the test 1st quarter, and do well.

Because end-of-unit assessments were administered at all four schools, I asked a follow-up question to determine how they might be used in the planning process. Several teachers noted that the content that appeared on the end-of-unit assessment sometimes determined what content they would plan to teach in their classroom. Three teachers from School 1 summarized the process as follows.

Kim: I have to look at the assessment, and I say what exactly are they being tested over on the assessment, and then I kind of have to skip around doing [those concepts] … I hate to do it [teach to the test], but that is the way it is.

Daryl: A lot of times, I will look at the assessment before I start, so I may run a copy off of that, and go through and look at the objectives of the whole unit and think about where to plug them into different days' lessons.

Leslie: At the 4th grade workshops that I attend, we always receive a copy of the math assessment … I will check to see what is on the assessment to see if [concepts] will show up again. I guess that kind of goes back to that other question now, as I think about it more, how do I decide on what to focus on more.

Cindy (School 2) suggested in her interview that teachers should be cautious in referring to these end-of-unit assessments for planning content. Teachers at School 4 discussed having to report their scores to their principal, who in turn reported the scores to the School Board. Therefore, planning with the assessment became routine for Betty and her colleagues. Betty's interview response follows Cindy's because it demonstrates the contrast in how teachers referred to using end-of-unit assessments to plan the content that students were exposed to in mathematics.

Cindy: I try to stay away from looking at the assessment because I think that can limit instruction and learning because you start getting assessment happy and thinking, "okay they can do these 5 things so we are moving on," when really it is not, that is not what it is about. You obviously want them to do

well on the assessment, but you don't just want them to know what is on the test. So I try to stay away from that.

Betty: We have to do our quarterly assessments, and those scores have to be reported to our principal, who then reports those to the School Board … We have to just make sure that our children are prepared for that quarterly assessment because those scores are reported and we are judged based on, well, your scores need to be improved so maybe you need to do a little better job teaching this or that.

Unfortunately, the selection of content based on end-of-unit assessments could not be confirmed through the lesson plans that were collected, or the surveys completed. There were no specific references made to topics that appeared on the end-of-unit assessments. Even at School 4 where scores were reported to the principal, no teacher included a reference to the lesson content appearing on any assessment. However, end-of-unit assessments were a common topic referred to in the interviews when discussing selection of content.

The Investigations Textbook

The *Investigations* textbook and materials, by design, are a planning resource. As noted above, the textbooks comprise an 11-unit, comprehensive mathematics curriculum for Grade 4. The textbook materials include a scope and sequence, activities for teachers to use, suggestions for modification and extensions, as well as information for meeting the needs of specific students, such as Special Education students, gifted students, and/or English Language Learners (ELL). The books also include a *Ten-Minute Math* section, designed for teachers to support students' mathematical learning throughout the day:

> At the beginning of some sessions, you will find Ten-Minute Math activities. These are designed to be used in tandem with the investigations, but not during the math hour. Rather, we hope you will do them whenever you have a spare 10 minutes – maybe before lunch or recess, or at the end of the day. Ten-Minute Math offers practice in key concepts, but not always those being covered in the unit. For example, in a unit on using

> data, Ten-Minute Math must revisit geometric activities done earlier in the year. Complete directions for the suggested activities are included at the end of each unit. (Economopoulos et al., 1998, p. 1.3)

Teachers in this study, while having access to *Investigations* as the primary district-adopted curriculum, did not plan solely from the textbook. In this section, I describe specifically how *Investigations* textbooks were used for planning by teachers across the three districts.

During their interview, seven of the 18 teachers specifically referred to reading the textbook as they planned lessons. The responses ranged from "scanning the book" to "reading everything, cover to cover." Below are several excerpts from teachers from School 1 and 2 demonstrating the range of descriptions offered on how the *Investigations* textbook was used for planning. All four comments are in response to the question, "In terms of the resources you use when planning, are you using the *Investigations* textbook?"

Daryl: Some, as a base. We will use some of the activities in it. I will see what they are going to teach that day, I will use some of it. I will use some of the cooperative activities in here.

Mary: So the night before a lesson I sit down and I use the book and I read the book and see what the book has. It has bolded print, ask these questions, this and that. So I usually plan by what the book says.

Lisa: Before each unit, I usually reread the book and I especially read the "About the Mathematics in this Unit", and then I will look through the first few lessons and think about which GLEs, there are written objectives in the book, and I will think about which GLEs do those fit with.

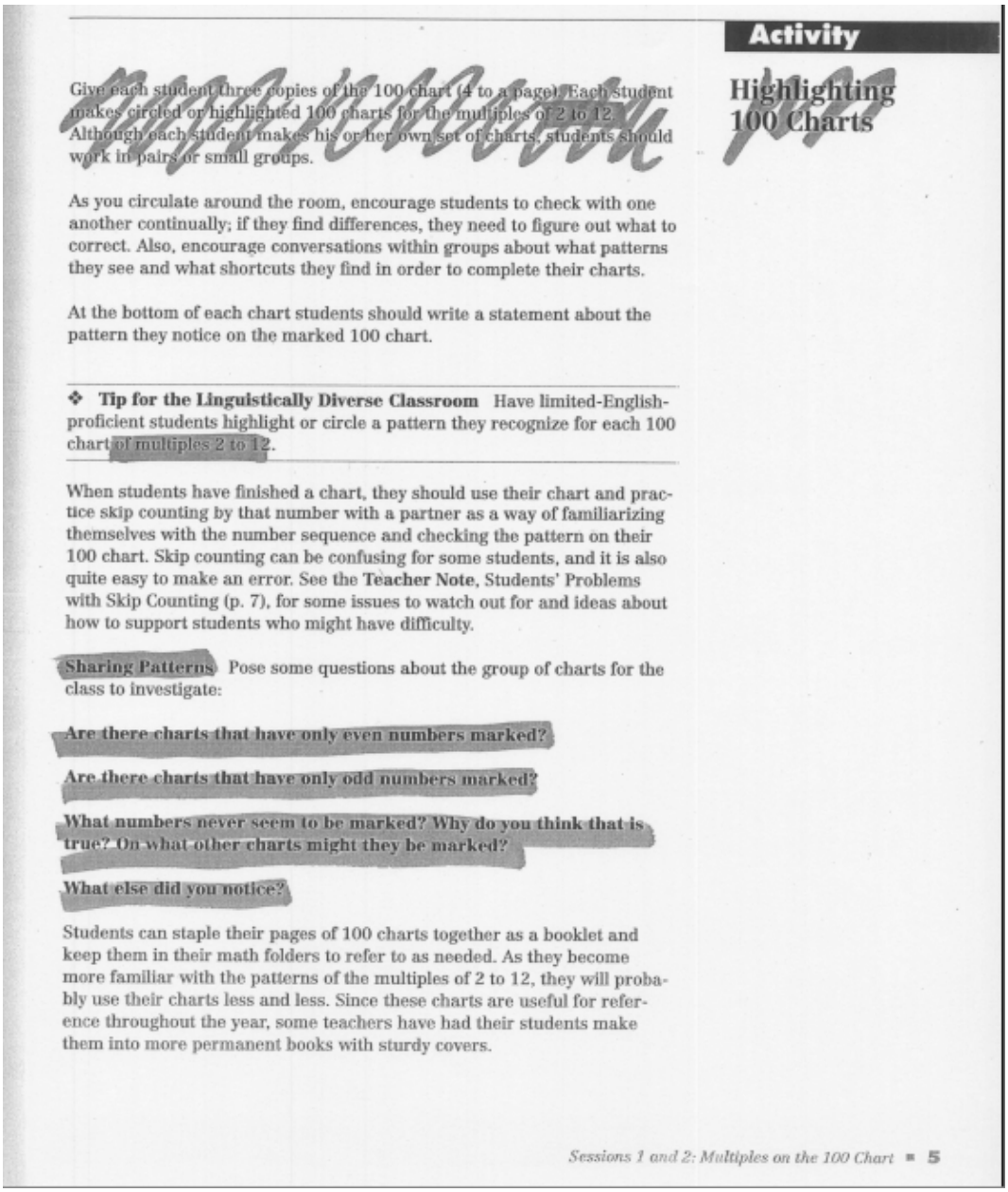
Cindy: Some people follow the book, my first year I did, just go by the book, but after teaching it a couple of times you kind of know what is going to come up and what is not going to come up, and how to guide that instruction … When I started, I would say that my plans said exactly what the book said, ask these questions, I wrote those questions down. I don't necessarily do that anymore. I do follow the lessons, and obviously with us writing objectives together, we go through the book. But my lesson does not always

necessarily look like the investigation in the book. I would say that it is still an investigation, but not necessarily exactly like what the book is doing.

Leslie notes that she reads the entire book:

Leslie: Yes. I do, all of the teacher's notes, because it is my first time through and I love math. Because it is my first time through, I feel I need to know what is happening, and it is cool. Yes, I read it all.

Some teachers indicated that they highlighted specific information or questions in the book that they wanted to make sure they addressed in the lesson, or wrote notes in the margin of their textbooks and this was evidenced in the collected lesson plans. Figure 3 contains four samples captured from teachers' *Investigations* textbooks, including the actual notes that they wrote in their textbook. These samples are taken from the lesson plans teachers submitted for analysis and demonstrate the kind of note-taking that teachers described they were doing with the textbook. As noted, some teachers merely highlighted the textbook (Figure 3a), or wrote very simple notes for future reference (Figure 3b), while others wrote specific questions they wanted to ask during the lesson implementation (Figure 3c). One teacher noted specific questions and conversation to have with students (Figure 3d).



Activity

Highlighting 100 Charts

Give each student three copies of the 100 chart (4 to a page). Each student makes circled or highlighted 100 charts for the multiples of 2 to 12. Although each student makes his or her own set of charts, students should work in pairs or small groups.

As you circulate around the room, encourage students to check with one another continually; if they find differences, they need to figure out what to correct. Also, encourage conversations within groups about what patterns they see and what shortcuts they find in order to complete their charts.

At the bottom of each chart students should write a statement about the pattern they notice on the marked 100 chart.

❖ **Tip for the Linguistically Diverse Classroom** Have limited-English-proficient students highlight or circle a pattern they recognize for each 100 chart of multiples 2 to 12.

When students have finished a chart, they should use their chart and practice skip counting by that number with a partner as a way of familiarizing themselves with the number sequence and checking the pattern on their 100 chart. Skip counting can be confusing for some students, and it is also quite easy to make an error. See the **Teacher Note**, Students' Problems with Skip Counting (p. 7), for some issues to watch out for and ideas about how to support students who might have difficulty.

Sharing Patterns Pose some questions about the group of charts for the class to investigate:

Are there charts that have only even numbers marked?

Are there charts that have only odd numbers marked?

What numbers never seem to be marked? Why do you think that is true? On what other charts might they be marked?

What else did you notice?

Students can staple their pages of 100 charts together as a booklet and keep them in their math folders to refer to as needed. As they become more familiar with the patterns of the multiples of 2 to 12, they will probably use their charts less and less. Since these charts are useful for reference throughout the year, some teachers have had their students make them into more permanent books with sturdy covers.

Sessions 1 and 2: Multiples on the 100 Chart ▪ 5

Figure 3a.

Activity

Highlighting 100 Charts

Give each student three copies of the 100 chart (4 to a page). Each student makes circled or highlighted 100 charts for the multiples of 2 to 12. Although each student makes his or her own set of charts, students should work in pairs or small groups.

As you circulate around the room, encourage students to check with one another continually; if they find differences, they need to figure out what to correct. Also, encourage conversations within groups about what patterns they see and what shortcuts they find in order to complete their charts.

At the bottom of each chart students should write a statement about the pattern they notice on the marked 100 chart.

❖ **Tip for the Linguistically Diverse Classroom** Have limited-English-proficient students highlight or circle a pattern they recognize for each 100 chart of multiples 2 to 12.

When students have finished a chart, they should use their chart and practice skip counting by that number with a partner as a way of familiarizing themselves with the number sequence and checking the pattern on their 100 chart. Skip counting can be confusing for some students, and it is also quite easy to make an error. See the **Teacher Note**, Students' Problems with Skip Counting (p. 7), for some issues to watch out for and ideas about how to support students who might have difficulty.

Practice w/ Partner

Sharing Patterns Pose some questions about the group of charts for the class to investigate:

Are there charts that have only even numbers marked?

Are there charts that have only odd numbers marked?

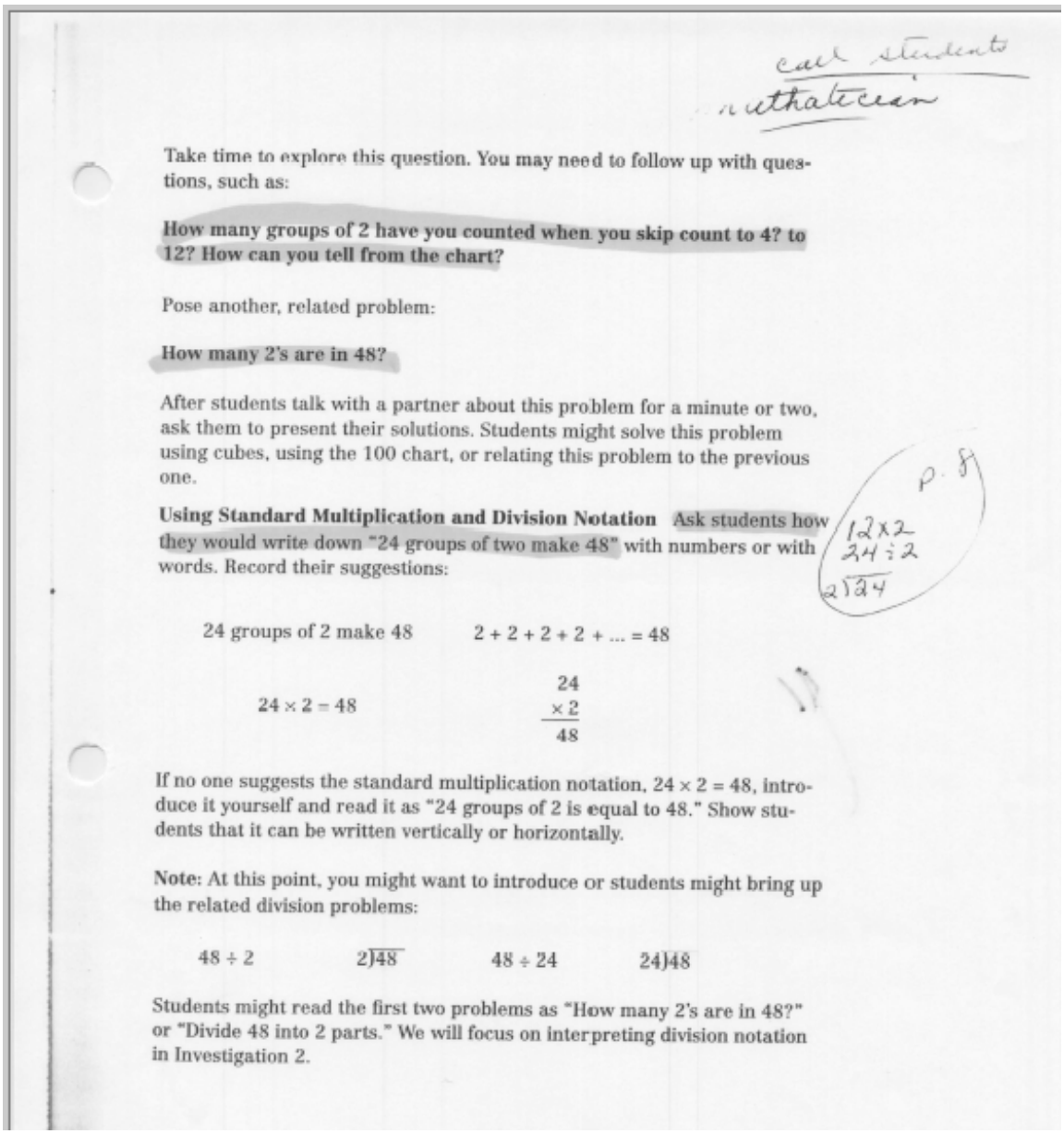
What numbers never seem to be marked? Why do you think that is true? On what other charts might they be marked?

What else did you notice?

ask groups

Students can staple their pages of 100 charts together as a booklet and keep them in their math folders to refer to as needed. As they become more familiar with the patterns of the multiples of 2 to 12, they will probably use their charts less and less. Since these charts are useful for reference throughout the year, some teachers have had their students make them into more permanent books with sturdy covers.

Figure 3b.



call students
mathatician

Take time to explore this question. You may need to follow up with questions, such as:

How many groups of 2 have you counted when you skip count to 4? to 12? How can you tell from the chart?

Pose another, related problem:

How many 2's are in 48?

After students talk with a partner about this problem for a minute or two, ask them to present their solutions. Students might solve this problem using cubes, using the 100 chart, or relating this problem to the previous one.

p. 8
12 x 2
24 ÷ 2
2)24

Using Standard Multiplication and Division Notation Ask students how they would write down "24 groups of two make 48" with numbers or with words. Record their suggestions:

24 groups of 2 make 48 $\qquad$ $2 + 2 + 2 + 2 + \ldots = 48$

$24 \times 2 = 48$ $\qquad$ $\begin{array}{r} 24 \\ \times\ 2 \\ \hline 48 \end{array}$

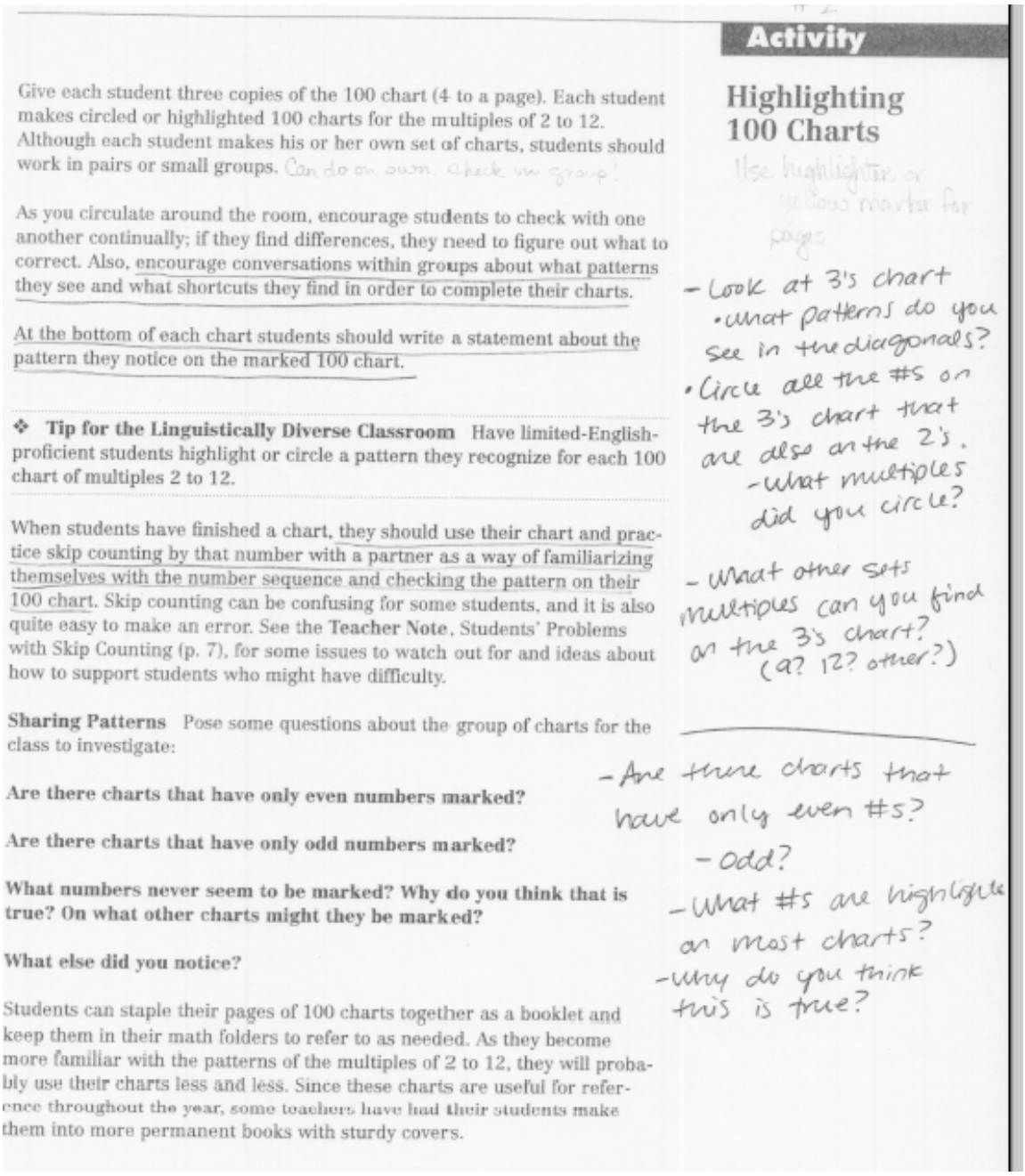
If no one suggests the standard multiplication notation, $24 \times 2 = 48$, introduce it yourself and read it as "24 groups of 2 is equal to 48." Show students that it can be written vertically or horizontally.

Note: At this point, you might want to introduce or students might bring up the related division problems:

$48 \div 2$ $\qquad$ $2\overline{)48}$ $\qquad$ $48 \div 24$ $\qquad$ $24\overline{)48}$

Students might read the first two problems as "How many 2's are in 48?" or "Divide 48 into 2 parts." We will focus on interpreting division notation in Investigation 2.

Figure 3c.



Activity

Highlighting 100 Charts

Use highlighter or yellow marker for pages

Give each student three copies of the 100 chart (4 to a page). Each student makes circled or highlighted 100 charts for the multiples of 2 to 12. Although each student makes his or her own set of charts, students should work in pairs or small groups. Can do on own, check in group!

As you circulate around the room, encourage students to check with one another continually; if they find differences, they need to figure out what to correct. Also, encourage conversations within groups about what patterns they see and what shortcuts they find in order to complete their charts.

At the bottom of each chart students should write a statement about the pattern they notice on the marked 100 chart.

- Look at 3's chart
  - what patterns do you see in the diagonals?
- Circle all the #s on the 3's chart that are also on the 2's.
  - What multiples did you circle?
- What other sets multiples can you find on the 3's chart? (9? 12? other?)

❖ **Tip for the Linguistically Diverse Classroom** Have limited-English-proficient students highlight or circle a pattern they recognize for each 100 chart of multiples 2 to 12.

When students have finished a chart, they should use their chart and practice skip counting by that number with a partner as a way of familiarizing themselves with the number sequence and checking the pattern on their 100 chart. Skip counting can be confusing for some students, and it is also quite easy to make an error. See the **Teacher Note**, Students' Problems with Skip Counting (p. 7), for some issues to watch out for and ideas about how to support students who might have difficulty.

Sharing Patterns Pose some questions about the group of charts for the class to investigate:

- Are there charts that have only even #s?
- odd?

Are there charts that have only even numbers marked?

Are there charts that have only odd numbers marked?

- What #s are highlighted on most charts?
- why do you think this is true?

What numbers never seem to be marked? Why do you think that is true? On what other charts might they be marked?

What else did you notice?

Students can staple their pages of 100 charts together as a booklet and keep them in their math folders to refer to as needed. As they become more familiar with the patterns of the multiples of 2 to 12, they will probably use their charts less and less. Since these charts are useful for reference throughout the year, some teachers have had their students make them into more permanent books with sturdy covers.

Figure 3d.

Figures 3a-d. Samples of four teachers' note taking in their *Investigations* textbook while planning.

Teachers' use of the *Investigations* textbook for planning is further supported from the data collected from the *Practices and Beliefs Survey* that all participants returned. One question from the survey asked teachers, "What role do the *Investigations* materials play in your planning?" The question was followed by a checklist with multiple responses, including: (a) help me plan daily instruction, (b) help determine scope and sequence, (c) provide activities to explore math topics, and (d) serve as a source of example problems. Table 9 provides a summary of responses by school.

Table 9

The role of Investigations materials in planning instruction by school

What role do the *Investigations* materials play in your planning?	School 1[a]	School 2[b]	School 3[c]	School 4[d]	Total[e]
• Help me plan daily instruction	3	4	7	2	16
• Help determine scope and sequence	2	3	4	1	10
• Provide activities to explore math topics	3	4	7	3	17
• Serve as a source of example problems	3	3	4	2	12

(Number of teachers: a=3, b=4, c=7, d=4, e=18)

As noted in Table 9, the *Investigations* textbook was used by 16 of the 18 teachers to plan daily instruction. In addition, the written lesson plans from six of the 18 teachers (representing 19 days out of 97 total days worth of plans) cited specific objectives found in the textbook.

Although the *Investigations* textbooks provided a complete curriculum to be used in the classroom, including information on how to modify for students of all ability levels, it was not apparent that this information was used for planning. For example, this information was not part of the recorded plans, as no modification for any student was

noted in any of the entire set of 97 days worth of submitted lesson plans. This result is significant given the fact that 10 of the teachers in the study made specific reference to having Special Education, ELL, and/or gifted students in their classroom. The interview with Lacy addressed this issue.

Lacy: I have the gifted class, but I also have some really low students.

Troy: How often do you plan for both ends of the spectrum? Are you doing anything differently?

Lacy: Not really. I expect the same out of both of them. When we are doing more of the *Investigations*, it gives them a chance to be at their own creativity level. Whenever we are doing something and the gifted kids get done, they know they have extra activities they can do.

On the other hand, in their interviews, six teachers made reference to making modifications in lessons, however, their comments focused primarily on reducing the load of work for the students, or re-teaching the same concepts over again. In the ancillary document that accompanies the textbooks materials there are three suggestions for meeting students' needs:

(1) changing the numbers in a problem to make the problem more accessible or more challenging for particular students

(2) repeating activities with which students need more experience

(3) rearranging pairs or small groups so students learn from a variety of their peers (p. 13)

These suggestions are integrated throughout the individual *Investigations* units as well. There are also sections related to supporting Spanish-speaking students, supporting a linguistically diverse classroom, and supporting the vocabulary development of ELL

students. However, as demonstrated in the following excerpts, teachers did not refer to using the textbook recommendations from when planning.

> Kim: I have seven different languages spoken in this class … So you know what, I am like, do what you can, do it the way that you need to because eventually we are all going to get to that way [an algorithm] anyway. And we don't stress about it.
>
> Lisa: I have a bunch of kids, they need things rephrased … I will shorten the amount of problems someone has to do.

Kim's response suggests that she allows students to work independently at their own level, but what she was conveying was students who use an algorithm, as many of her ELL students do, don't have to show multiple strategies as suggested in *Investigations*. Lisa, on the other hand, suggested a common modification made with special education students, reducing the number of tasks students work on. However, the *Investigations* materials do not provide a large number of tasks for students, and instead, have students work on a few focused tasks at a time. The suggestion is to change the numbers in the tasks, not to change the number of tasks.

It should be noted that 12 of the teachers in the study reported in their interviews that they modified the presentation of content for the varying levels of ability in their classrooms, but none mentioned changing the mathematical complexity of the content. A majority of the conversations focused on not sitting specific students together in groups, which is one of the suggestions in the textbook, or rereading directions to students. But as noted above, no written lesson plans included these modifications.

Despite the provisions for diversity written into the *Investigations* materials, none of the lesson plans demonstrated that these suggestions were considered. While most of the teachers mentioned having varying levels of students in their classes, no teacher

provided proof that any formal planning was used to make modifications for these students. However, teachers who reported making modifications discussed these as taking place *during* the lesson, not prior to implementation.

Supplemental Resources

The final source that teachers identified for content selection was supplemental resources. In their interviews, 12 of 18 teachers made reference to the use of materials supplementary to the *Investigations* curriculum. On the *Practices and Beliefs Survey*, 17 out of 18 teachers reported supplementing their textbook. When teachers were asked to indicate the type of supplementary materials used, nine of the 17 checked "other commercial textbooks," however, only six of the nine respondents provided the name of specific textbooks used as a supplement. In her interview, Gabby shared the names of some supplemental resources that she and her team used.

> Gabby: We supplement quite a bit, worksheets basically, from *Heath Mathematics*, and then we get some out of *Math Central*. We supplement quite a bit from there, other mathematics workbooks that I have from *Scholastic*.

Six of the nine teachers indicated they used "other curriculum materials." Lilly noted that she used practice worksheets from supplemental books, without identifying the books by name, and three teachers identified the Internet without providing the names of specific websites. Analyses of teachers' lesson plans confirmed the use of supplemental materials. In fact, several teachers provided lessons that were not from *Investigations* as their second lesson plan, while some also included copies of worksheets from other sources with their lesson plans. This issue will be discussed in more detail in the results to the second research question when I describe the influences of supplementary materials.

Other types of supplementary materials that teachers identified on the survey were: (a) materials presenting special topics not in *Investigations*, noted by 14 teachers; (b) worksheets for review, checked by 15 teachers; (c) worksheets for skill practice, recorded by 16 teachers; (d) materials to prepare for out-of-course assessments, noted by all 17 teachers who indicated they supplement; and (e) teacher-developed materials, checked by 13 teachers.

This relatively high rate of supplementation raises the question, why did so many teachers plan to supplement *Investigations*? Analysis of interview transcripts revealed that most teachers (12 of 18) alleged the *Investigations* curriculum was not fully aligned with the GLEs, or there were perceived "holes" in the curriculum. It is interesting to note only one of the 12 teachers holding this belief was from District A, while the other 11 teachers comprised the *entire sample* of participants in the other districts. Four excerpts from the interviews are provided to demonstrate why teachers said they planned to supplement the *Investigations* curriculum. As noted above, teachers perceived the curriculum to have "holes," which was the word of choice by the majority of respondents.

Lilly: I know they want us to use *Investigations* all of the time, that is their math curriculum, but sometimes there are those *holes* in there and you have to be able to use your resources and get at them, and I don't think they understand that.

Valerie: I have noticed with *Investigations* you have to fill in a lot of *holes*, so [for] one unit I may use [the textbook] only five times.

Kendra: *Investigations* is the program that has been chosen, and [the School Board] want[s] it taught, and they have said it is okay to supplement because they realize there are some *holes* in it.

Gabby: We are not using anything from *Investigations* as of right now, because there are *holes*. With *Arrays and Shares*, we basically teach everything out of that because it does hit on multiplication. It makes them think about things around the world and it helps them related to what they are learning

better. But now, no, it seems to dwindle off. We start at the beginning of the year with that, but we have all of this stuff we have got to teach you know, through our GLEs, and there are just *holes* that are not met.

Other teachers felt the curriculum, although published in 1998, was not current enough. All five eMINTS teachers mentioned that the resources on the Internet were more current and easily accessible. In response to asking how supplemental materials were used, Daryl and Laura's comments address the *old versus new curriculum* mentality that was discussed in teachers' interviews.

Daryl: I use the content and then just supplement, sure, but supplement substantially … Our text book, it is 8-10 years old, probably 15 years old now, by the time it was written. The website was yesterday. We just did one on geometric solids. Last year, there were very few websites for elementary kids on geometric solids. This year, there is a whole session of them on eMINTS, probably 200 of them. It changes that fast.

Laura: A lot of the supplemental resources, yes, a whole lot of supplemental resources, and we don't have a particular textbook that we have to go by. We don't even have real up-to-date textbooks. I don't know how old the *Investigations* textbooks are, but I know they have used them at least over the last 3 years, so they are not even 100% up to date.

At School 3, several teachers thought they were supplementing with what was referred to as a "bridge" program. This was a program that was purchased to help "bridge" the gap between the *Investigations* and the GLEs. However, after attending a school-wide inservice that took place during the data collection phase, the teachers found out that the so-called "bridge" was, in fact, the 2nd edition of the *Investigations* textbook. Tamara and Gabby's interview responses suggested that teachers thought they were using a supplemental set of materials.

Gabby: Now there are supplements to *Investigations*, there is a bridge to it that has a really good workbook that they use, and that has really come in handy. I use that some. We used that out of *Arrays and Shares* as well, which is helpful. It is the student handbook. It has definitely come in handy.

Tamara: The one thing we found out in our meeting last week that no one knew was that when we came in at the beginning of the year, we had all of these new materials in boxes. That was supposed to replace the old. We thought it was a supplement, but it was supposed to be out with the old, in with the new.

The use of supplemental materials for selecting content was well documented throughout the study. Teacher interviews, surveys, and collected lesson plans all confirmed that 17 of the 18 teachers supplemented the primary textbook. However, the teachers at Schools 1 and 2 tended to supplement for different reasons than the teachers at Schools 3 and 4.

Overall, teachers reported using four sources for content selection when planning mathematics at Grade 4. Teachers reviewed end-of-unit assessments, they focused on GLEs and identified materials that aligned, they read the *Investigations* textbook, and they found content in supplemental resources. Although there are distinct differences among the schools in which these resources were used, and how they were used for planning, these resources do make up the content pool from which teachers are planning activities. In the next section, I identify the process of writing the actual lesson plan, and how the teachers' plans were created.

Creating the Lesson Plan

The notion that teaching is an autonomous profession was supported through the ways teachers planned for mathematics at Grade 4. This section highlights the processes of creating a lesson plan, including where teachers did their lesson planning, how long they spent planning, the span of instructional time they planned for, and a description of lesson plans that were created. Where appropriate, data from multiple sources are noted.

Where do Teachers Plan?

Schools generally provide teachers with a preparatory period during each school day. Although not uniform in length, this time can be used for planning, meeting with other teachers, or any number of other duties that teachers are responsible for throughout the school day. Many teachers in this study suggested arriving early or leaving late from school, which also provided time for planning. Finally, teachers are typically provided with a lunch period that releases them from working with students, providing yet another period of time to prepare for lessons. Based on the interview data collected in this study, fewer than half (8 out of 17) of the teachers, indicated they spent at least one of these times before, during, or after the school day for planning at school. Table 10 presents a summary of where teachers planned by school. Some teachers stated that they planned over multiple time periods at school, such as during their prep time and after school. Six teachers said they planned before or after school, including three respondents who noted they also used their prep time for planning. Two teachers, from School 2 and School 3 respectively, specifically stated that they only planned after the school day had ended.

Lisa: Usually after school, usually I am still here, but it is not during the school day because there is not enough time.

Becky: I do all my planning after school because there is no time during school.

Two teachers said that they came into the school on the weekends to do their planning. Finally, Laura said that she did her planning at school because, "I live too far from school to haul all of my resources back and forth."

Table 10

Where teachers plan mathematics lessons, by school

	At School	At Home	In Both Places
School 1	0	2	1
School 2	1	2	1
School 3	5	1	0
School 4	2	0	2
TOTAL*	8	5	4

(*N=17 because one teacher at School 3 did not plan for mathematics, her special education teacher did the planning for mathematics)

Five teachers said they found it more convenient to plan at home. Two of the teachers planned only during the week, while two referenced the weekends as the time that they planned their lessons. In her interview, Leslie commented that she planned over both periods of time, setting up her week on Sunday, and then reviewing her plans each night for the next day.

> Leslie: I will sit down Sunday night, it is my planning night, when I will kind of look at the week as a whole, and on that particular day, I will write down Investigation 2, Session 3 on Thursday, and that will be it, just so I have a basic framework. And then the night before each day, like tonight I will go home and specifically look at tomorrow, and really get to know that a little better.

The remaining four teachers noted that they planned in both places, usually doing the majority of planning at home, but then reviewing these plans and making final additions to them at school. Their review was completed either before or after school, and sometimes on the teacher's prep time. Kim's and Cindy's interview responses captured this method, while Cindy also highlighted how she uses her prep time not for planning, but other tasks to get ready for her lesson.

> Kim: On Sunday nights, I do my weekly plans, or Sunday morning if I get up before the kids or after the kids go to bed, in my sunroom at home. I sit there and plan out, see what I am going to do. I do a rough sketch of what I am

going to do, I say basically "pages what through what" that I would like to hit each day. Then, each day, I have from 9:00-10:00 off because they have Specials every day at that time, so right before they come back I look it over again, even know I have taught this before. This is my fourth year of teaching it and I still have to review it to know exactly what I am doing.

Cindy: Sometimes I plan in the morning, when I get here. Sometimes I plan at home, at night. It just kind of depends. Sometimes I plan part of my day at home, or part of my day in the morning. And I usually have a break before math, but I am usually planned before the day starts. [During] my breaks I usually make copies, or do those kinds of things because I don't like to be down to the wire like that, it makes me a little nervous.

No clear patterns in where teachers planned emerged from the analysis, with the exception of noting that five of the six teachers in School 3 planned at school; teachers in the other schools were spread relatively evenly in terms of where their planning took place. This variation is continued in the next section when teachers responded to how long they spent planning for mathematics.

Amount of Planning Time

During the interview process, all teachers in the study were asked to, "Describe the process you follow to plan a mathematics lesson using the *Investigations* curriculum. How much time to you typically take to plan one lesson?" Responses varied from a minimum of 10-15 minutes to about 2 hours. Table 11 includes the teachers' responses, organized by blocks of time. Similar to where teachers plan, the amount of time required to plan was generally spread evenly by school.

Table 11

How long teachers report spending in the planning of mathematics lessons, by school

Planning Time	School 1	School 2	School 3	School 4
Less than 20 minutes			3 teachers	1 teacher
21-40 minutes	1 teacher	2 teachers	1 teacher	1 teacher
41 minutes – 1 hour	1 teacher		1 teacher	1 teacher
More than 1 hour	1 teacher	2 teachers		1 teacher
Could not identify a specific amount of time			1 teacher	

A few teachers noted spending less than an hour.

> Mandy: Any where from 30 minutes to 1 hour. It depends on what I have down in my plan book for that next day, especially as I have used it more, I am more familiar with it. When I first started planning with *Investigations* I easily could have spent two hours a night looking through things. But it has gotten easier and faster, anywhere from 30 minutes to an hour.

On the other end of the spectrum were teachers who spent over an hour planning for mathematics.

> Mary: The amount of time depends on the lesson. I can tell you that the longest it has probably taken me to plan a math lesson has been between an hour and a half and two hours … *Because this way of doing math is new to me* [italics added], so I am kind of having to teach myself well enough to be able to make sense to my kids.

Finally, there was one teacher that could not put a time limit on the planning time.

> Kendra: I don't know because I plan everything on one day for the week, so I don't keep track of just my math planning. I could not even guess, but a long time.

However, this variation in time teachers spend planning mathematics lessons is only part of the story. In the next section, some of these teachers' responses are revisited when teachers' planning time spans are discussed.

Planning Time Spans

Shavelson and Stern (1981) suggested the possibility of five levels of planning that built upon each other: (1) daily, (2) weekly, (3) monthly, (4) term, and (5) yearly. However, Brown (1988) noted only the existence of four levels of planning, citing a hierarchal order from top to bottom and excluding *term* planning: (1) yearly plans, (2) unit plans, (3) weekly plans, and (4) daily plans (see Table 2). However, both suggest that teachers may plan daily and/or weekly, which was supported by the data in this study.

When asked how often they planned, the majority of teachers, 11 out of 18, said they planned weekly, while only four teachers planned daily. There were also two teachers who planned at different intervals, one for three days at a time and the other for 10-12 days at a time. As noted above, the teachers did not spend the same amount of time planning for mathematics, but teachers were also not planning for the same spans of time in the study. Teachers who said they planned for less than 20 minutes each day typically tended to plan for individual instructional days, versus some who planned for a week at a time. Below are sample responses regarding how long it takes teachers to plan. Four teachers make reference to planning for less than 20 minutes, but most of these teachers are planning daily.

> Gabby: Depending on what it is, I mean roughly, 10-15 minutes … I have to plan day-by-day.
>
> Nancy: Just for math, maybe 15 minutes a day for the next day. I mean, Monday night I will take home my *Investigations* book and read my next day's lesson, or read the next couple of days' lessons to plan out, but maybe 15 minutes a day to plan for the next day.

Lilly's response, on the other hand, clarifies that she planned weekly, but for less than 20 minutes per week.

Lilly: It usually takes, for a good lesson, probably 15-20 minutes to get it all together and prepared … I will do the lesson plans for all week.

Lilly's response is striking because this indicates on a daily basis she was averaging about 3-4 minutes of planning time for mathematics. Also, Mary's response was worth revisiting as she said she planned for more than one hour, but she was one of the teachers who said she did this daily.

Mary: The amount of time depends on the lesson. I can tell you that the longest it has probably taken me to plan a math lesson has been between an hour and a half and two hours … Because this way of doing math is new to me, so I am kind of having to teach myself well enough to be able to make sense to my kids the next day. I am literally taking it one day at a time.

Taken together, these two sections are difficult to generalize because the only data available to support this information was from the interviews. Analysis of the submitted lesson plans did not yield evidence regarding the scope of planning because there was not a specific planning time span (e.g., 1 day, 3 days, 1 week, etc.) requested from each teacher. Teachers were not asked to record how long they spent planning each submitted lesson plan. Furthermore, the survey did not address these planning-related issues. There were questions related to how much curriculum was planned, but not the time span. Although there were not clear patterns regarding how long teachers planned, and for what span of time planning covered, there was substantially more consistency in the format of submitted lesson plans, and this is addressed in the following section.

The Lesson Plan Format

When teachers plan, they have several options for recording their ideas into what is ultimately considered to be their "lesson plan." The lesson plan can include multiple pages of detailed notes or mere reminders of what the teacher might use in the classroom

when teaching mathematics. No matter how detailed the plans are, all teachers plan in some way (Leinhardt, 1989).

Analysis of the 97 total days worth of lesson plans revealed a wide range in specificity. On one end of the spectrum, teachers take notes in their Lesson Planning Book, what I will refer to as the "2-by-2 box." On the other end of the spectrum, teachers write more detailed versions of the textbook lesson on the computer or by hand in a notebook. Although the precise dimensions of a lesson-planning book are not standardized, the box provided for planning each subject is typically not larger than about 2-inches by 2-inches square, and they are designed for teachers to write their lesson plan inside, one box for each subject on each day of the week. Figure 4 provides two samples of these 2-by-2 boxes.

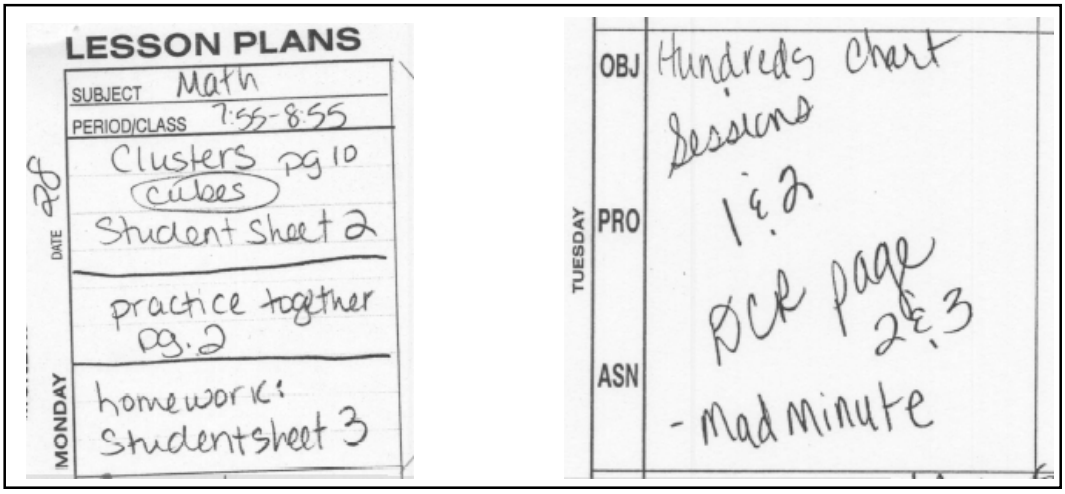


Figure 4. Two samples of 2-by-2 boxes found in teachers' lesson-planning books.

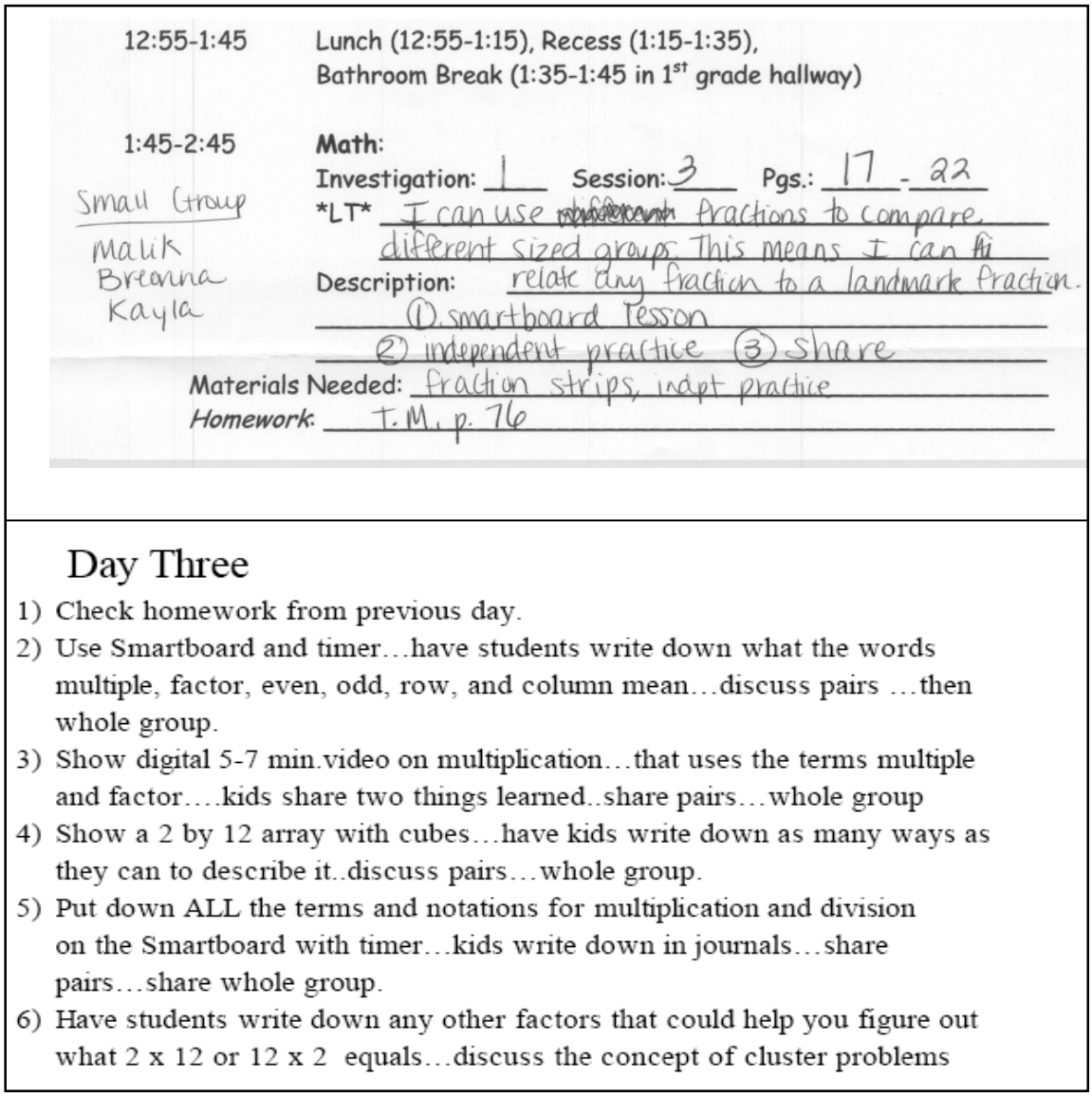
Several teachers submitted copies of their lesson-planning books as part of their collected lesson plan, providing these 2-by-2 boxes with their lesson plans inside of them.

The submitted lesson plans provided the data to suggest that the 2-by-2 boxes were the most common form of lesson plan for teachers in this study. Of the 97 total days worth of lesson plans submitted by the teachers, 66 of the days were planned in a 2-by-2 box. Laura submitted 10 days worth of lesson plans that she types in a template on her computer, using the 2-by-2 boxes as the template. Figure 5 is an example of 2 days worth of Laura's lesson planning template created on her computer.

	Math	READING	Writing/Spelling	Science/S.S.	Specials
MONDAY	Button arrays Grid paper array in different colors cut and glue	The Raft What is the girl in the photo thinking? What is the frog thinking? Vocab:disgusted,raft,scattered,cluttered, downstream, nuzzle Context clue P111	Run on Sentences143L reading Literary word cards P. 43 spelling book Cursive writing Click Clack Moo - letters	Read intro to Missouri P.3-9 Rivers 10-15 Posters - Rules	Art 
TUESDAY	One Hundred Angry Ants Rewrite with different animals and arrays	read story comprehension P111A inferences/analyze partner read P.108l	Base words Cursive writing P. 44 spelling book Punctuation takes a vacation – punctuating letters.	Elevation map 16 Read P. 18-22 - resources	PE/MUSIC 

Figure 5. Sample of Laura's lesson planning template on her computer, using 2-by-2 boxes.

The second most-common form of lesson plan submitted by teachers was a teacher-generated sheet, either typed on or hand-written. In particular, seven different teachers submitted 17 days out of 97 days worth of lesson plans in this format. Figure 6 includes two samples from teachers who used their computers to create a planning template. Both teachers submitted both sets of their lesson plans in these formats, providing consistent examples of how they both planned.



12:55-1:45 Lunch (12:55-1:15), Recess (1:15-1:35), Bathroom Break (1:35-1:45 in 1st grade hallway)

1:45-2:45 Math:

Investigation: 1 Session: 3 Pgs.: 17 - 22

Small Group
Malik
Breanna
Kayla

LT I can use ~~different~~ fractions to compare different sized groups. This means I can fi

Description: relate any fraction to a landmark fraction.
① smartboard lesson
② independent practice ③ share

Materials Needed: fraction strips, indpt practice

Homework: T.M. p. 76

Day Three

1) Check homework from previous day.
2) Use Smartboard and timer…have students write down what the words multiple, factor, even, odd, row, and column mean…discuss pairs …then whole group.
3) Show digital 5-7 min.video on multiplication…that uses the terms multiple and factor….kids share two things learned..share pairs…whole group
4) Show a 2 by 12 array with cubes…have kids write down as many ways as they can to describe it..discuss pairs…whole group.
5) Put down ALL the terms and notations for multiplication and division on the Smartboard with timer…kids write down in journals…share pairs…share whole group.
6) Have students write down any other factors that could help you figure out what 2 x 12 or 12 x 2 equals…discuss the concept of cluster problems

Figure 6. Two samples of teachers' self-created lesson plan templates.

Two other teachers submitted only hand-written notes from a notebook for their lesson plans, representing 10 out of 97 days worth of lesson plans. Figure 7 provides a sample of the detail that was common to the written plans submitted. In this case, the teacher began with the objective, noted as "O;" and written as an "I can" statement. The teacher also identified strategies to look for during the lesson, on the left side of the plan.

The teacher included a notation about the *commutative property* being addressed in the mathematics lesson. Finally, the plan includes questions that the teacher will ask, as well as the location for providing instruction, at tables or on the carpet in the room.

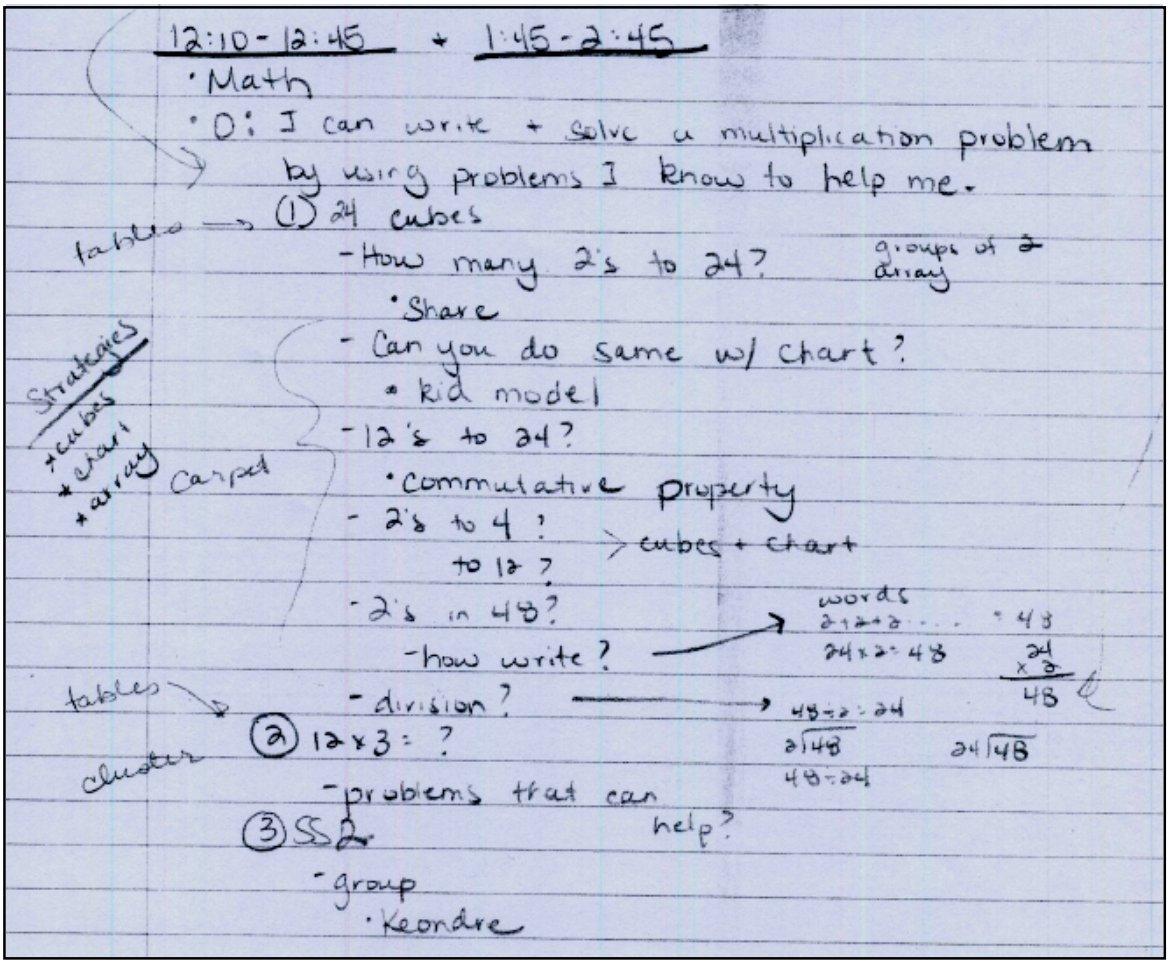


Figure 7. Sample of a hand-written lesson plan that was submitted.

Four teachers did not submit anything for their lesson plan beyond photocopied pages from the *Investigations* textbooks, making it difficult to determine what format of lesson plan they follow. Also, four sets of lesson plans were not submitted by three of the participating teachers for various reasons.

As these examples illustrate, the planning that was recorded on paper was quite minimal compared to what might actually take place in the classroom, especially considering the majority of teachers indicated they spent 45 minutes to one hour teaching mathematics each day. What did not emerge as salient characteristics in teachers' lesson plans were: objectives, questions to ask, transitions between activities, identifying specific groupings of students for cooperative learning, materials, and/or assessment tasks, either formative or summative. The plans that were submitted by teachers were mere sketches of what they planned to happen, as noted by Lacy in her interview.

> Lacy: You can look at my lesson plan now and think, "How does she even get through the day?" *But you just store so much in your head* [emphasis added]. You know what you are going to do.

The submitted lesson plans were contradictory to the typical lesson-planning format that teachers in the study cited being exposed to during their preparation to be a teacher. In interviews, teachers were asked to reflect on their teacher-training program, "How much was lesson planning emphasized in your teacher development program? Were you introduced to templates or models for planning?" Eight of the teachers, and at least one teacher from each school, specifically responded the Madeline Hunter model for planning was used in their teacher development program. Appendix F includes two samples of the Madeline Hunter model for planning; the first contains descriptions for each portion of the model, while the second is a template teachers could fill in for a lesson plan. Below are three responses from School 3 teachers' interviews demonstrating their experiences with the Madeline Hunter model for planning in their teacher development programs.

> Lilly: [My professors] did the big Madeline Hunter lesson plan, and we had to use that for everything, and really, I think it was pointless. It does not prepare

you for what we are doing in here, I am sorry to say. They fully prepared us on how to present a lesson, and know what areas, how to do the input, and how to do the guided practice, and the independent practice, and they pounded that in our head, and we know how to present a good lesson. But when it comes to planning, they did not go into detail about this is how they plan this or this is how they plan that. Realistically, are you going to do an 8-page lesson plan for every single lesson you do a day? We would be grey headed by the end of the year. It was a little bit ridiculous!

Lacy: In my teacher training program, well of course we had to do the Madeline Hunter 15-page lesson plan, which is so unrealistic and does not happen … I write stuff down, but it is not the Madeline Hunter plan. Thinking about the college, yeah, they prepared you for your lesson plans, but I mean it was just so much extra to have to put in there, which is not what a teacher normally does day-to-day. You just don't do that, you would never get to leave [school].

Becky: We had to do Madeline Hunter lesson plans for everything! We were told this is not how you are going to plan when you are a teacher, certain teachers said that, not all of them. But they said that, as a teacher, you will not get this detailed unless you are in a school district that has to turn in lesson plans, which we don't. I don't write those anymore like that, I would spend all of my time doing that. But we did, in college we had to, and in student teaching.

Although eight teachers were exposed to the Hunter model or template for planning, my analyses revealed this model did not influence their own lesson planning. In fact, when asked the follow up question, "Do you plan the way you were taught to plan?" all eight of these teachers responded, "No." This result was confirmed through analysis of the teachers' submitted lesson plans; none of the 97 days worth of lesson plans bore any resemblance to the Madeline Hunter model. Instead, 10 teachers turned in at least one plan including their 2-by-2 boxes from their lesson plan book. Nine teachers made mere references to page numbers of worksheets, either from *Investigations* or from supplemental materials, not to specific tasks or activities. Although 11 teachers did reference materials in at least one of their plans, only six of these teachers noted an objective of the mathematics lesson in their lesson plan.

On the other hand, eight teachers indicated they were not introduced to any model or template for planning in their undergraduate teacher development programs. Instead, they were expected to just create a plan from an activity, or from a state standard.

> Cindy: Like in undergrad, I felt it was like, "take the state standard and write a lesson plan." And now it is like, "take the state standard, look at the curriculum, look at your kids, look at your objective, now write a lesson plan."

Twelve teachers referenced learning how to plan from their mentor teachers in various placements during their program, or specifically from student teaching, as evident in the following excerpt:

> Valerie: I guess just modeling through other teachers in practicums, in clinicals, and in student teaching. Especially from student teaching because I pretty much do my plan book the way that she does. I guess, really in even clinicals, you did not have to do planning for the day, you might have a lesson on Tuesday, and a lesson for 2 weeks from then, but you did not have to have a full day.

It has been demonstrated through multiple data sources that teachers create lesson plans in multiple formats, with limited consistency. The one format that was consistently used was the 2-by-2 boxes that a majority of the teachers used to take notes in for their lesson plan.

Summary of How Teachers Plan

There was little consistency in how teachers in this study reported planning for instruction. The antecedent conditions and the selection of content were consistent by districts and schools typically. However, the teachers did not plan for the same amount of time, in the same settings, or adopt the same lesson plan formats. Teachers' autonomy in their decision-making was evidenced in their written lesson plans. In addition, while most teachers had been exposed to the same planning formats in their teacher preparation,

these templates and models were not considered useful for planning according to the interview data and did not appear in the lesson plans at all. Finally, teachers' lesson plans typically represented a document that they used for recording notes to themselves. These notes may refer to specific pages in the *Investigations* curriculum or supplemental materials, or worksheets to use, or even some objectives that they want students to learn. But the notes that are recorded in their lesson plans do not provide a script to follow when they are teaching mathematics.

This section has been devoted to answering the first research question, "What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?" The next section focuses not on how lesson planning occurs, but what influences teachers' lesson plans. Many of the processes described in this section will be revisited in an attempt to connect the *how* teachers plan with the *why* teachers plan in that manner.

Factors Influencing Lesson Preparation

Overall, teachers are influenced by many factors when planning mathematics lessons. This section is devoted to addressing the specific influences on lesson planning that emerged from data analysis. The five influences that are described in more detail below include: (1) teacher collaboration, (2) teachers' beliefs, (3) accountability issues, (4) curriculum resources, and (5) teacher reflections. Within each category, subcategories are used to further clarify results.

It should be noted that some of the same examples from sources in the first section are presented again in this section, but in more detail. There are several instances

where *how* teachers planned and the *influences* on that planning overlapped. Therefore, more detailed examples of text are presented in this section, including more contexts to support how influential the specific instance was on teachers' planning. All three major data sources (interviews, surveys, and the collected lesson plans) provide evidence related to the second research question. In addition, a fourth data source, the collaborative planning session, is reviewed in this section.

Collaboration

Throughout the school year, teachers are provided many opportunities to collaborate with other teachers when planning mathematics lessons. Some of this time is predetermined at the district level, while other opportunities are specific to the school. This section discusses how teacher collaboration influences lesson planning. I begin with a discussion of teacher interactions during common planning and workshops, and end with the influence of the Math Coach, available to teachers in Schools 1 and 2 only.

Teachers Influencing Each Other

Teachers in this study identified multiple opportunities to collaborate with each other across three of the four schools. In Schools 1 and 2, there were district inservices with *Investigations*, such as cohort meetings or district professional development, for each unit of the curriculum. In School 2, the teachers met weekly to plan together, and discussed how they worked together when they needed help with anything related to *Investigations*. The teachers at School 1 did not meet to formally collaborate, however. This was reflected in how dissimilar teachers' lesson plans looked, their reactions in the interviews, and the fact that one of the teachers at School 1 admitted there was no collaboration on the returned survey.

When teachers did collaborate, the amount of influence evidenced in the data was high. I attended one collaborative planning meeting of the teachers at School 2 and recorded the session. While in attendance at this meeting, I witnessed teachers discussing an upcoming set of lessons on students using area models to understand the fractions one-fourth and one-eighth. This conversation represents an example of teachers influencing each other's plans for mathematics. Also, Lisa and Cindy have taught longer than Mary and Kara, so their experience was relied upon in this situation to help guide the two less-experienced teachers.

Below is part of the discussion from the planning meeting. Through this interaction, the teachers identified some specific activities that they would all use during the week. Each teacher is identified by name. They also modified the *Investigations* activities in particular ways. Cindy, for example, suggested referring to the *Teacher Checkpoint*, an assessment component in the *Investigations* curriculum, and checked to see if specific tasks were included. Lisa confirmed they were not, and the team decided to omit some of the curriculum for the current lessons being discussed.

Kara: So, on Monday we would be splitting one-fourth and one-eighth.

Cindy: And you might want to separate those, because there are a couple different lessons on fourths.

Lisa: And we are starting on one-fourth tomorrow, so then the lesson is one-fourths and one-eighths, and then they go back to just fourths, and stick with that for a while before they go back.

Kara: So Tuesday would be the *Favorite Fourths*?

Mary: I am totally confused.

Kara: I am too, I don't know –

Lisa: Look at page 12.

Kara: Okay, fourths and eighths, that is what I am going to be working on tomorrow, or starting with fourths.

Lisa: And then turn to page 14, and the rest of the things in this lesson are all on fourths. The *Favorite Fourths*, *Equal Fourths*, *Proofs for Fractional Parts* is on fourths, and then they make the *Fourths Quilt*.

Cindy: Don't you think it makes more sense to stick with fourths and do all of the investigation with fourths, and then move onto eighths, rather than going back and doing fourths?

Lisa: I am not sure why they made that happen at this part, I don't know why they did that.

Kara: And really they don't talk about eighths except in that one part.

Mary: Well and then they have to divide halves, fourths, and eighths, so they go into those.

Lisa: What if you did all of the fourths activities, and then after those, you did the *Fourths Quilt*?

Cindy: Well, lets look at the *Teacher Checkpoint* and make sure that there are not things on eighths on it.

Lisa: Nope, there are not. So we can just leave off eighths until later, until the end of your session after they have done the *Fourths Quilt*. What I usually do is I have them, they have made so many shapes with fourths by that point, that before we make pages with just eights, I have them look at the pages that just have fourths already, and they have to make their fourths into eighths.

Cindy: Which it does say in here, you can use any of your patterns with fourths to make eighths.

Although it is not included in this transcript, the teachers informed me that prior to this portion of the discussion, the lesson objectives that were presented at their previous cohort meeting were discussed and all four teachers agreed that those learning objectives were the goals for the entire week.

In her interview, Mary suggested there was a great deal of influence from these interactions, both the cohort meetings and the team planning sessions. Since she was new

to the *Investigations* curriculum, Mary appreciated the insights provided by her colleagues.

Troy: How much do these meetings influence your planning?

Mary: Team meetings, a lot because that is where I get the objectives, and then a lot of times while we are going through, if I have a question, "What does this mean? What does this mean?" Oh, things like that. So that helps a lot. In our Cohort, we don't really have a lot of time to plan, but like I said, last month, we ended up coming up with all of these Learning Targets, so, I think that was really beneficial for everybody. I think that is what we are going to start doing. I think that is going to be a lot more beneficial because then we are not going to have to be thinking about it in our team meetings anymore, we will just be going through and saying this lesson, do this session, this session, etc.

Teachers in School 3 also stated that they collaborated with each other. Five of the seven teachers identified their collaboration time as team meetings that were held during the district's early release one time per week. This time was not fully devoted to collaborating about teaching mathematics; however, and on many occasions this time was used for other school-related issues. If the opportunity arose to plan for mathematics, sometimes teachers used any extra time after these meetings to meet. When this time was not available, they tried to meet at least for a few minutes the next day, again to plan for *all subjects*, not just mathematics. Teachers in School 3 also identified the option of asking each other questions, as they needed. Their collaboration time was not as structured as the teachers in School 2, since they did not meet consistently or for the same length of time, but their work together was influential on what each teacher did in their classroom. Below are two examples from the interviews that demonstrate how teachers used their collaboration time in School 3. Each teacher was asked to, "Describe the level of influence that those planning meetings have on you planning for math."

Lilly: We collaborate as a team, and then I usually follow out of the *Investigations* what we are doing because it is pretty helpful, it kind of helps you word for word. And then if I have to supplement anything, I will usually ask my mentors … Maybe, out of a 40-minute meeting on our common planning, usually on Thursdays, maybe 15-20 minutes on math. We decide what we are going to teach next, what areas we are going to cover, what is a good idea for this, how much time we are going to spend on it, all in the next week.

Lacy: Oh a lot, a whole lot. Like our next planning for math, we are going to do, we are starting measurement, so we did not actually say if we are going to pull that from *Investigations* because I do not know if there is a book, I don't think there is, I think we are going mainly from our old cow book, and pulling resources for measurement … Area and perimeter, we can pull from the *Investigations*. So, there are bits and pieces that we know we can pull out and use from *Investigations*, but we are not going to be able to get everything we need from measurement from *Investigations*.

In contrast, School 4 had no formal, scheduled collaboration time, neither at the district nor school level. The principal encouraged teachers to work together during common prep times, but this was not happening. As a likely result, the teachers at School 4 did not exhibit the same degree of influence on each other, in contrast to the three other schools, as evident in the following interview of Mandy, who notes that teachers at her school are not comfortable talking together with each other.

Troy: I want to know about your opportunity to collaborate and plan with other teachers. Do you have that opportunity?

Mandy: Valerie and I have the same planning periods in the morning, and we are going to try once a week to get together. This will probably be one of the things we will talk about. That is our goal, and we each have an hour break, but not like the whole hour. Probably about half of it, try to get together, just the two of us because we have the common planning time, to talk about what are you doing, what am I doing, what can we do.

Troy: Up to this point you have not been doing that?

Mandy: Not at this point [in January].

Troy: What level of influence do your colleagues have on your planning?

Mandy: I depend on them for a lot, actually. I am always asking them where they are at, if they are in this book, "where are you?" or "what book are you using" or if they are in the textbook right now … I do ask a lot of questions to my colleagues as I am not the type to go it alone. And some are more comfortable with that than others.

I have also chosen a section of Valerie's interview to demonstrate the contrast that appeared from the interview data between Mandy and Valerie's views of working together. While Mandy expects that meetings with Valerie will occur after the break, Valerie does not echo this sentiment of working together.

Troy: How about the planning time that you have in common with the other teacher during the week?

Valerie: We are supposed to meet up with them, once a week, but it is once of those things that we are on opposite ends of the hallway and it just does not seem to happen. Occasionally we send an email of where we are at, but we have really not gotten into the groove of that yet.

Overall, the opportunity for teachers to influence each other through collaboration was evident in Schools 1, 2, and 3, representing 14 of the 18 teachers in the study. The only school where collaboration did not seem to influence the teachers was School 4. This was evidenced further in the survey results as only two of the four teachers indicated they had the opportunity to plan with colleagues. In the next section, I discuss another opportunity that provided collaborative support for teachers, working with a Math Coach.

Influence of Math Coaches

The support of a Math Coach was only available at Schools 1 and 2 during the school year that data was collected, while School 3 had a Math Coach during the previous year. Although the level of influence was limited at School 3, that was not the case in Schools 1 and 2. Kim and Leslie were from School 1, and Cindy at School 2. In their interviews, they described the level of support from the Math Coach as much higher.

Kim: [The Math Coach] comes to our meetings once per month now, that just started because we just got a Math Coach this year. She does help us plan at those meetings.

Leslie: The [Math Coach] does a 4th grade workshop for each book before we are to teach the book. She goes through, not every single session, but she hits on the main idea of every investigation, the math the kids should learn from it. And then she points out important parts of some sessions that we are looking at for the first time. We also try out some of the games and activities.

Troy: Is that pretty sufficient, are you getting what you need from the meetings?

Leslie: Yes, especially since [the Math Coach] makes these charts that have, she breaks it down into where it looks like a lesson plan, but basically it outlines the whole book, where she has like the key concepts kids should learn, questions they may have about it, resources needed, and then she also has a component of what kids should learn, but it is in kid friendly language.

Cindy: [The Math Coach] is a big influence, talking about this is the problem I am having, what would you do? My kids are not understanding fractions, how would you present this to them? This is what I am trying to get them to do, this is what I tried, that did not work, what would you do? She helps answer questions like this and supports us because she has taught 4th grade for many years.

Math Coaches, although not available in all schools, influenced teachers lesson planning. Thirteen of the 18 teachers made at least some reference to the Math Coach in their interview. Many of them noted how much support the Math Coach had provided to their planning of mathematics. Overall, teachers in Schools 1, 2, and 3 stated in their interviews that collaboration time with other teachers had an influence on their planning.

As noted in the section devoted to Research Question 1, some of the collaboration work that had been done had produced documents that teachers planned from, including pacing charts and organizing the GLEs for use by teachers when planning. These documents were also influential on how teachers planned and resulted from collaboration at either the school or district levels. Finally, the teachers in School 4 did not collaborate to the same degree as teachers in the other schools. Consequently, none of the teachers'

lesson plans from School 4 looked similar, which was not the case in the other three schools. In the next section, I address another major influence on teachers' planning, their beliefs about teaching and learning.

Teachers' Beliefs

Teachers' beliefs about how students learn, about teaching mathematics, and about the curriculum influenced their planning of mathematics lesson. In this section, teachers' beliefs are described from two perspectives that emerged during analysis. The first is that teachers' personal beliefs, from either the traditional or nontraditional perspectives, influenced how they planned from the curriculum. The second point is that teacher's individual beliefs about *Investigations* were associated with their level of use of the curriculum.

Beliefs about Mathematics Teaching and Learning

According to Raymond (1997), teachers may have a variety of beliefs regarding the nature of mathematics, about how students learn mathematics, how to teach mathematics, and about mathematical practices. (For Raymond's complete framework, see Appendix A). In each category, she described five categories of beliefs: (1) traditional, (2) primarily traditional, (3) an even mix of traditional and nontraditional, (4) primarily nontraditional, and (5) nontraditional. Because the *Investigations* curriculum is considered a nontraditional program, I used Raymond's framework to create several survey questions in order to assess where participating teachers' beliefs were situated on the spectrum from traditional to non traditional.

In order to gather this data, several statements were written for teachers to respond to as either strongly agreeing, agreeing, disagreeing, or strongly disagreeing with

(see Appendix C). Approximately half of the statements represented the beliefs of a traditional or primarily traditional teacher. The remaining statements represented nontraditional or primarily nontraditional beliefs. Based on survey responses, the majority of teachers were classified as nontraditional, while a few teachers would be considered a mix of traditional and nontraditional. In order to illustrate this, I have included two figures. Figure 8 represents the entire survey, all 33 questions related to the Raymond (1997) framework. Figure 9 represents all 33 questions, but is broken into subgroups of teachers' beliefs related to student learning, teaching mathematics, and their planning practices.

In both figures, a teachers' response of "strongly agree" with nontraditional statements was coded as a nontraditional response, noted with a white box. (The opposites were also coded; responding, "strongly disagree" with traditional statements were considered nontraditional responses, or white boxes, and so on for each case). Teachers' responding "agree" to nontraditional statements were coded as primarily nontraditional, or light gray. If a teacher "agreed" with a traditional statement, they were coded as primarily traditional, or dark gray. Finally, "strongly agreeing" with traditional statements was coded with black marks to represent traditional beliefs.

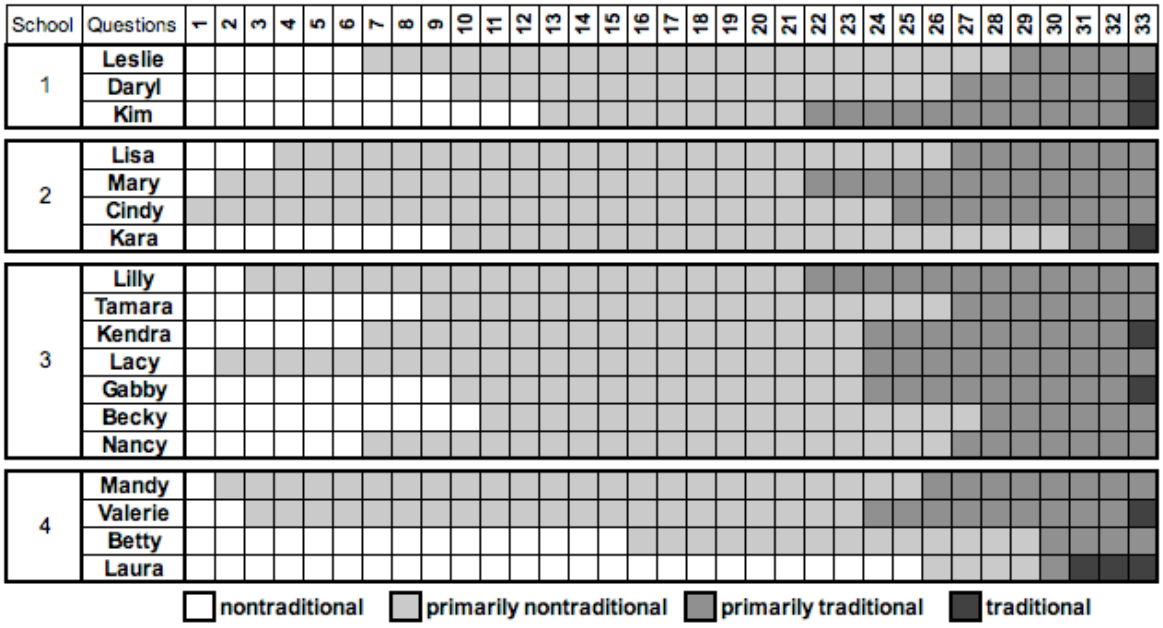


Figure 8. Teachers beliefs, classified along the spectrum from nontraditional (white) to traditional (black), based on the Raymond (1997) framework.

Based on responses summarized in Figure 8, most of the teachers in the study could be considered "primarily nontraditional." Based on the Likert item analysis of survey responses, 14 of the 18 teachers were considered primarily nontraditional, while Betty and Laura were both considered nontraditional and Mary and Lilly both scored in the even mix of traditional and nontraditional category. No teachers would be considered primarily traditional or traditional according to the analysis.

However, when you look at the three subgroups represented in Figure 9, there is a strong argument that teachers across the study vary between their beliefs for students' learning, teaching, and planning mathematics. This was also confirmed through the Likert item analysis, where 15 of the 18 teachers were considered primarily nontraditional in their beliefs about student learning. Two teachers were nontraditional in their thinking, and Valerie was the only teacher who was considered an even mix. Teachers' beliefs

about the teaching of mathematics were also primarily nontraditional, with 10 of the 18 teachers were classified in this group. Five teachers were in the nontraditional category, and three were considered an even mix. The largest variation resulted within the topic of beliefs about planning with eight of the 18 teachers were primarily nontraditional, but the remaining 10 of the 18 teachers were considered an even mix of traditional and nontraditional.

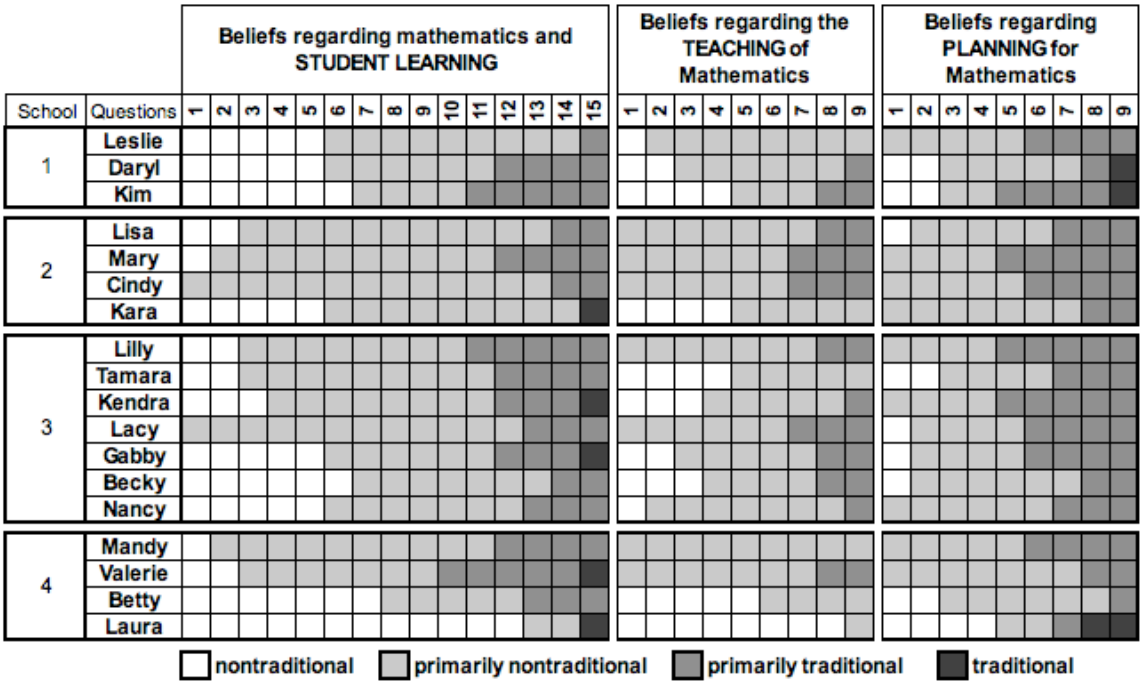


Figure 9. Teachers specific beliefs, classified along the spectrum from nontraditional (white) to traditional (black), based on the Raymond (1997) framework.

Analysis of the lesson plans does not corroborate results from the surveys. The lesson plans were analyzed to determine if they contained specific references to the *Investigations* textbook pages and activities, or contained other evidence that the teachers were planning nontraditional lessons (Raymond, 1997), such as using groups, working on

only one or two questions in a lesson, asking students to provide rationales for solutions, and examining multiple solutions for problems. Other notable components related to traditional lessons were also examined to determine if teachers' plans would be considered traditional (Raymond, 1997), including worksheets of practice problems, or pages copied from other curricula besides *Investigations*.

Teachers in Schools 1 and 2 submitted *Investigations* lesson plans for *all* of their requested lessons, but were split among the categories of primarily nontraditional and an even mix at both schools on the surveys. Teachers in School 3 were almost exclusively an even mix of traditional and nontraditional beliefs regarding planning according to survey analysis; only two teachers were considered primarily nontraditional. All of the School 3 teachers' requested *Arrays and Shares* lesson plans were from *Investigations*, but the majority of the second lesson plans were from traditional curricula materials and included worksheets and supplemental materials. Finally, teachers in School 4 who were classified as primarily nontraditional based on the survey analysis, with the exception of Mandy, turned in *Investigations* lesson plans when they were requested. Three of the teachers turned in all supplemental-based lessons for the second lesson plan. One teacher, Betty, refused to turn in a second lesson plan because she did not plan from *Investigations* and was concerned about her principal finding out. In the next section, I discuss teachers' beliefs about the *Investigations* curriculum. While their general beliefs about the nature of mathematics influenced the use of the curriculum, teachers' beliefs about curriculum had an even greater influence.

Beliefs About the Investigations Curriculum

Based on analyses of interview data, survey data, and lesson plans, teachers' beliefs about the *Investigations* curriculum appeared to be related to their use of the curriculum. In this section, I describe the beliefs that were common among teachers who supported the use of the *Investigations* curriculum, as well as those that were critical of the program.

First, the use of cooperative learning groups was identified by 14 of the 18 teachers as an important concept for learning, and one that the *Investigations* curriculum provided structures for supporting in the textbooks. However, only four of the 97 total days of collected lesson plans included any notes about using groups in class. Typically, teachers identified in their interviews that groups were used in class, but not always predetermined. Below is an example from the interviews that characterizes how teachers noted using cooperative groups in mathematics.

Troy: Do you use groups?

Gabby: Oh yeah, I use groups a lot. My kids do well in groups, they like groups, they do very well and they collaborate together. I can put them in groups and kind of walk around and facilitate, but they do really well in groups. And I do a lot of group work! And *Investigations* does hit on group work, which I like, I like that a lot.

Troy: How do you plan for your groups?

Gabby: It depends on the content and what I am teaching. It depends on how many kids I put in a group and what we are teaching or going to learn. I don't do groups of 3. I either do a group of 2 or a group of 4, I don't like 3, unless we have an odd number … I usually decide the groups during my lesson, based on who is here and who is absent.

Teachers who believed the *Investigations* curriculum supported student learning were supportive of several instructional strategies that are part of the *Investigations*

philosophy (see Table 1). For example, teachers identified with students talking more in class, sharing their ideas and explaining their reasoning. Seven teachers noted this was a positive aspect of the curriculum.

> Lisa: One of my girls the other day said something, the whole thing that we have been using a square with 16 to divide into halves, fourths, and eighths … She said, "I don't understand." This was without me saying anything. And they all kind of sat there and I said, "does anyone have her same question?" and about 6-7 kids did, so I said, "does anyone know why? Can they explain it?" I had 2-3 different kids come up and explain … Students explaining their answers is good for other students to hear, and they have to justify their responses on the MAP test, so they are getting ready for that as well.

The third positive instructional component of Investigations noted by teachers in the interviews was the "hands-on" *Investigations* activities. Teachers at all four schools remarked about the hands-on activities in their interviews. Becky suggested the use of manipulatives supported her students' understanding in mathematics.

> Becky: Some of the lessons I think are really good, and the kids that struggle with just basic concepts, seem to understand when they are using the hands-on group work. They see different ways to do it. So I like that.

Finally, seven teachers mentioned that *Investigations* was an inquiry-based program, sometimes referring to constructivism, or problem solving.

> Cindy: I would say that my planning has become more student-centered than textbook-centered because I use what my kids do in class to help me plan for the following *Investigations* lesson.

Teachers tended to support the *Investigations* curriculum and the ideas behind the *Investigations*' philosophy. However, there were several teachers who stated what they perceived as deficiencies with the *Investigations* curriculum. In most cases, this influenced them to supplement the curriculum. Although the responses below are from multiple teachers, only one teacher in District A, Daryl, described the *Investigations* curriculum in a negative way. However, *all 11 teachers in Districts B and C* made at least

one reference to the curriculum lacking specific components, or needing to be supplemented.

The first common belief that emerged from the interview analyses was that *Investigations* did not provide enough practice for students to work on computation skills or basic facts. This belief was shared among most of the teachers, although three specific quotes from interviews are included here:

Mandy: [*Investigations*] doesn't do computation near like they need to know, especially when I talk to 5th grade teachers. They will say that is an area that they seem to be weak in and I don't know if that is due to practice, because computation is a practice skill. They just have to memorize them and do them repetitively.

Valerie: I think there are a lot of gaps. [*Investigations*] misses all of the drill and practice.

Gabby: *Investigations* does not touch on prior knowledge that much. I mean, it is more critical thinking, think outside of the box, but if the kids don't have the skills before they get here, it does not touch on any basics so it does not reinforce that.

Teachers also suggested the *Investigations* curriculum was outdated, which influenced their need to supplement or look for new activities on the Internet.

Valerie: Now *Investigations* I think was written before eMINTS was so big and the computers, classrooms had only so many computers, so it needs to be updated more for an eMINTS classroom. Or even for 2007, you can tell it has a couple of computer games, but it does not keep up with the times.

Daryl: Our text book, it is 8-10 years old, probably 15 years old now, by the time it was written. The website was yesterday. We just did one on geometric solids. Last year, there were very few websites for elementary kids on geometric solids. This year, there is a whole session of them on eMINTS, probably 200 of them. It changes that fast.

Laura: We don't have a particular textbook that we have to go by. We don't even have real up-to-date textbooks. I don't know how old the *Investigations* textbooks are, but I know they have used them at least over the last 3 years, so they are not even 100% up to date.

Six other teachers expressed the belief that *Investigations* was not as effective as other activities they found for planning mathematics. Five of these six teachers were from School 3. These teachers consistently referred to one specific supplemental resource (*Heath Mathematics*) they used when planning mathematics lessons.

> Gabby: When I was in school, we used the *Heath Mathematics*, the book we supplement quite a bit with.
>
> Nancy: We have an old book that my husband had here when he was in the 4th grade and he is now 32. We call it the cow book, I am sure you have heard the other teachers talk about it. I pull a lot from there.

While some teachers perceived the *Investigations* curriculum to be outdated, other teachers used a supplemental resource that was, in fact, significantly older because they felt that *Investigations* was somehow lacking. Seven teachers, all from Schools 3 and 4, commented that the *Investigations* curriculum was not as easy to plan for as a traditional textbook was. Mandy and Kendra's responses are included here:

> Mandy: If I had to say what is easier to plan from, the [*Silver Burdett*] textbook is by far easier to plan from because it is all laid out for you. The *Investigations* is laid out for you, but in a different way … It is much more time consuming and difficult to find activities to plan.
>
> Kendra: [*Investigations*] is overwhelming! When I came in at the beginning of the year, I asked where is the teacher's book? Well, there is no one specific teacher's book.

Based on the surveys and interview data, teachers who used *Investigations* regularly, generally believed it to be an effective curriculum. This was supported by the number of days worth of *Investigations*-related lesson plans submitted by those teachers who expressed their beliefs in the curriculum. Many of these teachers also believed that the instructional strategies upon which the curriculum was built – cooperative groups, students solving problems and sharing solutions, and other components of *Investigations*

– were more effective than more traditional approaches such as teacher presentation and student practice worksheets. However, there was one group of teachers who believed *Investigations* to have deficiencies, and therefore chose to regularly supplement the curriculum, often utilizing much older, more traditional curricular materials.

Accountability

This section describes how issues related to teacher and school accountability influenced teachers mathematics planning. Teachers are held to high standards of accountability under current education policies, such as *No Child Left Behind*. These policies include state testing, state-mandated curriculum standards in the form of GLEs, and documentation of Adequate Yearly Progress (AYP) towards educational goals. All three of these components emerged as influences on teacher planning of mathematics. However, there are some issues regarding *NCLB* that I begin the section with, as they affect how teachers related the other components, and how these components influenced their planning.

Awareness of NCLB

Several components of *NCLB* that are related to lesson planning including: (1) articulated standards in the form of GLEs, (2) state testing with the Missouri Assessment Program (MAP) test, and (3) AYP status, based on MAP test scores. Under the requirements of *NCLB*, schools should address each of these components and each is likely to influence teacher decisions. However, data from this study indicate that teachers did not directly connect the GLEs, MAP test, and AYP components to *NCLB*. The impact of each component will be reported below, as each was influential on teachers' planning.

Each teacher in the study was asked explicitly what specific components of *NCLB* influenced their planning. The data suggest that teachers not only do not associate *NCLB* with mathematics or testing, but instead link the *NCLB* policy to reading only. In some cases, teachers referenced Senate Bill 319 (SB-319), a Missouri Law requiring teachers to test students' reading levels at Grades 3-6 and possibly retain students not reading at specific levels.

School 1

Kim: *No Child Left Behind*, you mean the reading one?

Troy: The entire policy, do you think it is influencing your planning?

Kim: No, because I would have tried to do the best with each kid anyway, so that is just an extra piece of paperwork to me … But I would not have changed my plans either way, because I am working for the kids the best I can anyway, so for me that is just extra stuff. In fact I was just talking to a parent today who got, her kid was in the Senate Bill 319 deal, and she got a letter.

School 2

Cindy: I feel like that is more of a reading focus because when I think of *No Child Left Behind* I think of Senate Bill 319 and the retention list … I guess that is where my brain automatically goes, is reading.

Lisa: I don't think it really does. In fact there is nothing about math, about them being on level in math. They are retained in 4th grade if they are not reading at a certain level. But there is nothing about math.

School 3

Nancy: Not so much, when you think of *No Child Left Behind*, you think of reading. But reading impacts math, especially with *Investigations*, it is pretty reading intensive and the kids have to be able to read those problems … But I have never really thought about *No Child Left Behind* in math, except for I know those low readers often perform poorly on the MAP test because they can't read it. And I have poor readers that are strong math students, but their reading is what keeps them from being successful in math.

Lilly: Math, well I think it is a small percent because, really, I believe *No Child Left Behind* has a lot to do more with reading. I mean you do read in math,

> but you are not reading huge books in math to learn how to do multiplication problems. So, maybe reading directions, that sort of thing, but I think [*NCLB*] has to do more with reading rather than math … So it is effecting, definitely, my reading, my communication arts, but not necessarily my math as much.

School 4 teachers were the only group that made explicit reference to *NCLB* being connected to state mathematics MAP test scores and AYP status. However, the disconnection was still apparent in their responses. Teachers in School 4 are under pressure because their entire school did not meet AYP goals for mathematics in the previous school year. While Laura addressed this in her response, her focus on changing this status was not based on what the school could do, but was instead aimed at the *NCLB* policy and how she felt the policy needed to change instead. Mandy notes other components of *NCLB*, such as the GLEs, but she disregards their connection to the policy.

> Mandy: Well, first of all I do not like that law … We work really hard, and I do not think about that law as far as influencing my classroom. I have my state requirements, and that is what guides me, not that law. If we get a new President, we may have a new law. So, that law to be honest does not influence [me]. What the state tells me to do with the GLEs and DESE that influences me. But that law does not influence me.

> Laura: We are in school improvement this year. [The school district] is, but it is because our building did not meet Adequate Yearly Progress. I have an aunt that works at DESE … So this *No Child Left Behind* thing, after we found out that our school was in school improvement, I was of course upset about it and spoke with her. She made me feel a lot better because … when I spoke with her, she said, "Don't worry about it because the schools who are in school improvement now, the jump from 2004 to 2007 is not gradual, it is very steep," and she said, "any school who is not in school improvement now, in the next 2 years will be in school improvement if they don't change something."

According to these two responses, teachers' concerns are not based on current requirements of *NCLB*, but instead on the considerations of how the law could be

changing in the future under a new Presidential administration. Laura's response suggests that teachers in schools not meeting AYP status need not be concerned as the majority of schools in the state will not meet these requirements in the future. The implications of the disconnect between *NCLB* and the components of GLEs, MAP testing, and AYP status will be discussed further in chapter 5.

However, one other aspect that came up during the interviews, and is included in the supporting text above, is the relationship between *NCLB* and SB-319. Under SB-319, teachers and schools are obliged to promote only those students who have met grade-appropriate reading levels. As a result, schools are required to test students in Grades 3-6 and provide additional instruction in reading for any students who are put on an improvement plan in reading. Specifically, schools under SB-319 are required to retain Grade 4 students whose reading level is below Grade 3. While SB-319 is not directly related to *NCLB*, this law does affect Missouri teachers.

GLEs Influence What Gets Taught and When

Grade-Level Expectations (GLEs) in Missouri have gone through many adaptations from the original Show-Me Standards that appeared over a decade ago to help guide education for students in the state. Currently, the GLEs exist for every grade level, Kindergarten through Grade 12, and were last updated in March 2007.

According to the interview responses, the current GLEs have a major influence on teachers' planning. Specifically, I asked teachers if the content they planned to teach appear in the GLEs for Grade 4 mathematics. I also inquired how each teacher determined the mathematics content they planned, which generated many responses focusing on the GLEs. Mandy noted in her interview that, "the GLEs *are* our

curriculum." From the responses to these two questions, it became evident that the GLEs are having a major influence on teachers' planning. This level of influence did vary some based on the schools. Teachers in Schools 3 and 4 tended to rely on the GLEs to guide them in identifying content to teach, as evident in the following excerpt from Valerie's interview.

Troy: Do you actually use the GLEs, do you have them in front of you to plan?

Valerie: That is what I teach off of. It directs, I look at the GLE and then I go from there.

Troy: When you say you use the GLEs, do you physically look at the GLE and then go and find one lesson that matches it, or a bunch of lessons?

Valerie: A bunch of lessons, a bunch of worksheets, websites that pertain to that objective … I go off of the GLEs, they are my math bible … Even our math quarterly assessment, it is aligned to the GLEs. The questions are written word-for-word, like using the word describe. We even throw words in there that are italicized in the GLEs, so they are aligned.

Other teachers in Schools 3 and 4 had similar reactions about the GLEs being a force guiding their content selection, their assessments, and a majority of their planning decisions. As reported previously, teachers in Schools 3 and 4 planned from documents they created at their schools, redistributing the GLEs into the first three quarters of the school year. Mandy's interview supports this finding.

Troy: How do you determine the math content you are going to teach? Do you open the book and it is all based on the content in the *Investigations*, or is it purely based off of the GLEs, or something else?

Mandy: I go through my GLEs because what my building did was took all of the 4th grade GLEs and divided them up into 1st, 2nd, and 3rd quarter to manage them. So I have a list of what I want to do in the 2nd quarter. So I will go through here and find activities that will go with those GLEs, and this is what I decide to teach. So yes, I will skip some things because I want to make sure that I really hit those GLEs.

Troy: So do you only skip things that are not on the GLEs, that is what determines the content?

Mandy: Yes, *that is how I determine that* [italics added]. If it is something that is relevant to what they need to know.

Becky commented on how her school had not only reorganized the GLEs to fit in the first three quarters, but they had then put the GLEs on their grade cards, or student report cards, for Grade 4. The grade card is comprised of Grade 4 GLEs that the teachers believe are core concepts also found on the state MAP test.

Troy: How do you determine the math content you are going to teach, where does that come from?

Becky: The GLEs. We have all those set, and then we sat down when we did our grade card and decided what we would teach each semester, or each quarter, and then for the semester, and we pretty much have stuck to that. Because of the MAP test, in 4th grade you have to have everything done by 3rd quarter, so we pretty much don't mess with when and what we teach, we get it done before.

Troy: Who put the standards on the grade card?

Becky: We sat down as a whole grade level, and our first grade card, we used to have just grades. Now we have a checklist and grades. We started off with all of the GLEs on the grade card, and we found out that was silly and ridiculous and we had to redo that after our first semester. Now we picked the main, core MAP test concepts to put on there, and then we teach everything else, but those are the ones that are on there. We sat down as a grade and then had to get it cleared through the principal. That has been changed 3 times in the past 3 years. This is the same from last year, though.

Troy: How do you determine what you are going to skip?

Becky: Pretty much if it is not hitting our GLEs, or we have something that seems to be a better concept than the *Investigations* lesson, just because we know it is on the MAP test, then that is what is skipped. Like with the *Seeing Silhouettes and Solids* book, we are not tested on that, so we don't even really use that book. We are 3-D, 2-D, so we don't pull from there. They don't get blocks [on the MAP test], so they can't build those, so we knew to skip all of that stuff. We kind of just hit and miss, look through the books, see what is good, what is not beneficial.

Teachers in Schools 1 and 2, both in District A, did not rely on the GLEs to influence them in the same ways as teachers in the other two schools. The collaborative work that was described earlier noted that District A had provided teachers with a document outlining all of the Grade 4 GLEs that had been aligned to each *Investigations* unit (For a sample, see Appendix F). Therefore, they did not focus on identifying objectives to build content around. Instead, District A teachers, according to their interview responses, *trust* the work that had been done in the district, and they trusted the *Investigations* curriculum, so they focused more on planning to teach *Investigations* than on finding activities to meet the GLEs. Teachers at Schools 1 and 2 did not participate in content swapping, but the GLEs were still indirectly guiding their planning based on the work that had been completed at the district level. Below are three selections from the interviews demonstrating District A teachers trusting the GLE alignment that was completed with *Investigations*. Lisa even notes that her team looks ahead to the Grade 5 GLEs to make some decisions because they are confident about knowing what they have to plan to teach in Grade 4. Leslie and Cindy both provide support of the *Investigations* curriculum in their excerpts.

Leslie: I am just trusting that *Investigations* takes me in the right direction. Honestly, I have not looked much at the GLEs for 4th grade, and maybe that is something I should do, I don't know … I don't see that the [school district] would give us this math program, and they would give us Math Coaches who tell us to use this, if it was not matching what they expect us to be teaching. I think it would be really silly.

Cindy: I know [the GLEs] pretty well now, because I have gone through them … Now I know what I need to teach, we have gone through them, kind of talked about them, what books hit what … *Investigations* does align pretty well with the GLEs. There are a few holes, but I think there would be with any curriculum … I would say we are very GLE focused, but we know where the GLEs are in our books now.

Troy: If you are going to skip something [from *Investigations*], how do you decide what to skip?

Lisa: It would have to be something that is not in the GLEs, or something that goes beyond what we are supposed to cover. Like in this unit, we are going to cut out ordering fractions from smallest to greatest. That is a 5th grade GLE, and I, at our last meeting, said it is very hard for them to order fractions from smallest to greatest, and the GLE says we need to be putting them close to landmarks like zero, half, and one … The GLE for ordering from smallest to greatest is 5th grade, so we should not even do that investigation.

Troy: How much of the content you are teaching appears in the GLEs?

Lisa: I would say almost all of it in some way. Sometimes you have to be creative in how you associate them, or how you say this fits with this GLE, but almost all of it does. [The district math coordinator] went through and actually, for every objective in every single book, of every activity and investigation in every book, put the numbers of which GLEs is corresponds with. There was a math group that met a couple of summers ago and they did that together, went through every investigation in every book and figured out which GLEs it met, and that was kind of, it helped some people that were fighting *Investigations*, they did not want to do it. It helped them see, hey, this stuff is relevant.

As these examples illustrate, the GLEs are influential in District A, but they are not impacting planning in the same manner as indicated in Districts B and C. Teachers in District A tended to supplement much less in Grade 4. This was evident in the collected lesson plans from teachers at School 1 and 2, where all 35 days worth of submitted lesson plans were from the *Investigations* curriculum. In contrast, only 45 out of 62 total days of submitted plans from the other two districts came from *Investigations*, and six of these came from what teachers at School 3 referred to as their supplemental "bridge" to *Investigations*, which turned out to be the second edition materials.

While all 11 teachers in Districts B and C cited the GLEs as the source for their decisions about what to teach, not one of the 62 days worth of lesson plans explicitly referenced a GLE as the objective or source. This was also true of the seven teachers in

District A. Although they did not identify the GLEs by name, 17 of the 35 days worth of lesson plans did include an objective or learning target that was taken either from *Investigations* or from team planning meetings. The survey did not collect data about GLEs because they were not initially expected to be this influential, but instead emerged as a major influence after data analysis was undertaken. On the other hand, the MAP test was expected to be an influence on teachers' planning, and this hypothesis was confirmed.

Teaching to the MAP Test

The Missouri Assessment Program (MAP) is the state-mandated test, which under *NCLB* has become the required assessment tool administered in Grades 3-8 and used for identifying AYP status of Missouri schools. Based on the data collected in this study, teachers in Schools 3 and 4 were more concerned about their AYP status affected by their MAP results. However, as noted above, the majority of teachers in this study did not recognize the MAP test as part of the *NCLB* legislation, and many of these teachers did not connect the MAP test to the GLEs. However, some teachers in Schools 3 and 4 explicitly stated they "teach to the test."

Tamara: Everything is MAP test-driven here.

Becky: We teach to the MAP test, we say that all the time, we teach to the MAP test. We know what we are low in, and if we don't get [our scores] up, we know we will be sitting in a [staff] meeting about it. This year our scores went up, but we are still low in a lot of stuff. So we know that is what we need to focus on. That is what we hit the hardest during the year.

Teaching to the MAP test is noticeably apparent in Gabby's interview as well, also from School 3. She addresses multiple aspects related to the MAP, noting that the GLEs do prepare the students for the MAP test, but that the test is what drives her

instruction, her choice of content, and as she states, "everything" she does in her classroom, including not using Investigations.

Troy: How much of the content you are teaching for math appears on state or District Assessments?

Gabby: As in the MAP test? *Everything. Everything* we teach in math appears on the MAP test. You know, we make sure it is covered because we teach towards the MAP test. And that is why we have problems with *Investigations*, because not everything taught in *Investigations* is, to me, is geared towards the MAP, and that has got to be taught, or we have to supplement in order for them to know that. As far as district, we are also given the curriculum we have to teach, but it is from the GLEs that we work. *Everything* we teach is geared towards the MAP. There is nothing in here that we teach that isn't geared towards the MAP.

Similarly, in Lacy's interview, she addressed how the teachers at School 3 used MAP released items to help prepare their students for the MAP test. She also addressed the use of "interventions" time. This was identified by the majority of teachers at Schools 2 and 3, as time during the school day that had been set aside for MAP preparation, typically about 30 minutes per day.

Lacy: I have so many different things. I have MAP released items that we do every once in a while, and that might be for a morning worksheet. During the afternoons on Mondays, we try to have MAP prep time, during interventions, the last hour of the day, and that is when we pull it together, those MAP prep things that we might pull off of DESE's website, the released items … Truthfully, I like *Investigations*, I just don't think it prepares them all the way for the MAP.

In her interview, Leslie remarked that MAP testing was considered more influential after January, since she was using test preparation materials in her class for instruction. Leslie teaches at School 1 where the MAP test was not suggested to be driving instruction like the other two schools, but still had an influence.

Troy: Would you say that the MAP test influences your planning?

Leslie: Starting today, yes. Just today, I got out that stack of books, the Terra-Nova books. In them is a section of multiple-choice math questions that I need to teach them how to do that for the MAP test … I will do like a week of math MAP prep, and then a week of reading, and alternating weeks. But it is one of those things where, if I don't teach it, even know I may think I am the most kick-ass 1st year teacher, that my kids will still not do well on that MAP test. So that is one thing I will start supplementing with on Monday.

At School 2, teachers described feeling more pressure to do well on the MAP test because they face funding issues being a Title I school. Cindy elaborated on this in her interview. But the test does not appear to determine the content of lessons. Instead, the teachers are aware of what they have to do to prepare kids sufficiently, by using the *Investigations* curriculum, supplementing as needed.

Cindy: Unfortunately the MAP is a big influence because our school is a Title I school, and so money is a big issue. If we don't do well, we lose our funding. When I started teaching here, it was not an influence. But I have been here 5 years total, so when I student taught here, it was not, we were kind of talking about it, but it is amazing what 5 years can do. Now, our principal is big on performance. "Where are your kids?" We have a data wall in the office that we report our scores on, and it is kind of breathing down your neck. It is something that I wish I did not have to deal with, but I do because it is a part of my job. Not the part I like, but a part of it I deal with.

Mary suggested that her planning was based on the previously mentioned objectives that her team identifies, and that some of those are specific to district assessments, others only to the MAP test, and other objectives are found on both assessments.

Troy: You have talked about the district and state test, but the content you are teaching, does it appear on both of those assessments?

Mary: Like every single thing I teach? Yes. Because, like for example, they will have to compare fractions on their district assessment on Thursday, and they will have to do it on the MAP test, too. I guess sometimes there are objectives that they only do on the district assessment, and they will not have to do on the MAP test. And then there are things that they don't have

to do on the district assessment, but they will need to do on the MAP test, like the geometry stuff I brought up.

School 4 teachers responded in their interviews that they were influenced by the MAP test. Mandy said she focuses on teaching only the GLEs that are tested on the MAP. How this was determined was unclear, however, as the test changes ever year. Betty also suggested she teaches the GLEs so students will pass the MAP test.

Mandy: I have found that the 4th grade MAP test does not use all of the GLEs. So, now I am trying to even focus on the GLEs that are tested. And, I know, I always did not want to be a teacher that teaches to the test, that is not a good thing to me.

Betty: We are influenced by [the MAP test] because we teach the GLEs to pass the MAP test, to get our kids ready to move on for what the state says we should have them learn.

The influence of the MAP test was also conveyed in survey responses collected from all of the teachers. When asked if they supplemented the *Investigations* curriculum, 17 out of 18 teachers answered in the affirmative. All 17 of these teachers identified assessment preparation (e.g., end-of-unit assessments) for MAP, as one of the reasons for supplementing. Leslie, the only teacher who reported not supplementing the *Investigations* curriculum, nevertheless indicated she used test prep materials. As previously referenced, Leslie maintained that she was influenced by MAP only when she used the extra materials to prepare her students for standardized testing, but argued this was not part of her everyday *Investigations* lesson planning.

MAP Test Data

In accordance with the classifications reported by Brown (1988) and Shavelson and Stern (1981), another level of planning that occurs studying schools is yearly planning. This level of planning can be described as being completed at the end of one

year, over the summer, or just before the school year begins. Major school goals are considered, as well as general themes that might be used for term or monthly planning. Some yearly planning is done at the administrative level and then relayed to teachers to use in their classrooms (Shavelson & Stern, 1981). Also, Brown (1988) identifies one of the influences on yearly planning as, "Successes and/or failures during the previous school year" (p. 75).

A key finding that emerged from the data is that, while the MAP test has significant influences on planning, MAP scores were not influential on teachers' lesson planning. Eleven teachers in the study reported writing yearlong school goals or action plans from the test data analysis they did at their schools. However, this practice occurred only at Schools 3 and 4. Betty and Lacy addressed this issue during their interviews.

> Betty: We get a breakdown of everything. Our principals have color-coded all of the different concepts and which ones your kids scored Below [Proficient], I think we did 70%, before we did 50%, but I think it was 70% this last time … We all went through at one of our Professional Learning Communities, and we found the ones that were repetitive on the list, and then we went through and we said we need to do a better job of teaching this, and this, and this. And so, I do try to make sure that I am hitting those extra hard, but then, you still have to have a balance and teach everything else.
>
> Troy: Do you see the MAP scores of the kids who came to you this year as well, or are you only making decisions from last years scores, or do you do a mix?
>
> Betty: Well, we do see our scores from our kids this year, when they come from 3rd grade to 4th grade, and teacher's breakdowns. From this, we spend time writing Smart Goals for the school, breaking apart MAP test data.

Lacy also described the process that School 3 used to exam test scores and create school goals. She identifies the content they chose to focus on for the year and notes how "interventions" time was influenced by the MAP exam results.

Lacy: I get to see my scores from last year and I get to see my students' scores from last year. And then, as a whole, we look at this class that we have this year, too. Actually, we look at the class from last year, and their data, that way we can see what we taught, and how we taught it wrong, what we teach, and what we are missing, what the missing pieces are to make this year's scores better. That is what we do.

Troy: Have you done anything as a grade level or whole school with the scores?

Lacy: Yes, we wrote an action plan.

Troy: Once you look at the [student MAP] scores and write your action plan, do you look at the scores again?

Lacy: Not a whole lot, as much as you would love to have the time to sit down and look at them, it just does not happen … We are focusing on multiplication. We plan our interventions activities based on these goals. We also do rote memorization with the timed tests.

According to the interviews with teachers at Schools 3 and 4, the staff at these schools chose to write very generic action plans or school goals that would be used throughout the year. School 3 chose to focus on multiplication facts, and teachers at School 3 suggested their *interventions* activities be focused around multiplication. School 4 chose to work on computation skills, however teachers at School 4 provided no evidence the school goal was being addressed through intervention activities. In her interview, Laura remarked that she does not use the scores because, "Scores can be totally wrong. Kids don't take time, they could be cold, they could be sick, they could be hot or hungry or whatever. So, no, they really don't influence the way I plan." Valerie suggested in her interview that MAP scores for their incoming students were inaccurate.

Troy: How about the MAP scores from the students you have this year, have you seen their scores, and do they influence what you are doing?

Valerie: Yes, I have seen them. But it is kind of a loaded question. No, because the scores coming to us we believe to be inaccurate. So, no, because they are not accurate, we have students in the building with IQs below 70 but scoring proficient and advanced on the MAP test.

Analysis of the collected evidence indicates that teachers are not considering MAP test data when planning mathematics instruction. Instead, MAP data are used to write school goals or action plans. Sometimes this information is used for *interventions*, however the goals are not being addressed beyond the school level. Both Schools 3 and 4 did not meet AYP goals from the previous year, leading both to create school goals focused on computation or multiplication, but neither school identified *specific methods* for addressing deficiencies in mathematics classroom.

Overall, teachers felt the effects of accountability in various ways. This included a general misunderstanding among teachers at each of the schools about how the *NCLB* policy affects their classroom. The GLEs had a major influence across all four schools, but in very different ways. Some teachers chose to use the GLEs to guide content decisions, instead of the *Investigations* materials, while other teachers relied on district alignments of the GLEs to *Investigations* for planning lessons. Finally, teachers in the study described using MAP assessment data for school-level decisions, but not classroom-level decisions. Therefore, the MAP scores were not a source of influence on teachers' daily planning decisions.

Curriculum Resources

In this section, the two most prominent curriculum resources that influenced teachers' planning will be discussed. Specifically, the *Investigations* curriculum and supplemental materials had varying levels of influence, dependent upon which school that teachers taught in.

The Investigations Curriculum

Multiple data sources have provided descriptions of how teachers used the *Investigations* curriculum to guide lesson planning. Some teachers reported relying on components of the textbook when planning mathematics instruction. However, the degree of influence these materials had is described in more detail here. While the interviews provided a great deal of support, surveys and lesson plans were crucial in understanding the level of influence that *Investigations* had on teachers planning.

To demonstrate the influence of the *Investigations* curriculum, I begin with the survey results. On the survey, there were specific questions asking the teachers how long they had taught *Investigations*, to rate the quality of the materials, to estimate the percent of the *Investigations* curriculum they would "cover" in the upcoming year, and finally, to note what percent of days they primarily used *Investigations*.

Teachers with fewer than two years of experience using *Investigations* tended to rate the program either Poor or Fair, as was the case with six of the eight teachers of less than two years. On the other hand, teachers with three years of experience or more teaching *Investigations* tended to rate the program quality higher, as five of these 10 teachers rated the program as Good or Very Good. No teacher using *Investigations* for three years or more considered the program to be Poor (See Table 12).

Teachers in Schools 1 and 2 tended to rate *Investigations* much higher than teachers in Schools 3 and 4. As the table demonstrates, three of the seven teachers in Schools 1 and 2 rated *Investigations* Very Good or Good, with the four remaining teachers rating it Fair. In School 3, five of the seven teachers rated *Investigations* as Fair or Poor, while two of four teachers at School 4 rated the curriculum as Fair or Poor.

Table 12

Teacher rating of the Investigations curriculum, by years of experience teaching Investigations and school

Years teaching *Investigations*	How would you rate the overall quality of the *Investigations* materials?	
1	Good	School 1
3	Very Good	
8	Fair	
1	Fair	School 2
1	Fair	
4	Fair	
8	Very Good	
1	Fair	School 3
1	Good	
2	Poor	
2	Fair	
4	Fair	
4	Good	
5	Fair	
1	Poor	School 4
3	Fair	
5	Good	
5	Good	

In their interviews, teachers reported how often they planned from the *Investigations* curriculum. Teachers' responses by school are reported in Table 13. As noted previously, two questions specifically asked teachers to estimate what percent of *Investigations* they "cover" in a given school year, and the number of days they primarily used *Investigations*. For both questions, five possible responses were provided: (a) <25%, (b) 25-49%, (c) 50-74%, (d) 75-90%, and (e) >90%. Table 14 presents the results to both questions, sorted by teacher and school.

Table 13

Teachers reported percent usage of Investigations, averaged by school

	Average Percent Usage of *Investigations*	Range
School 1	73.3 %	30 % – 100 %
School 2	87.5 %	80 % – 90 %
School 3	45.0 %	40 % – 75 %
School 4	31.3 %	5 % – 50 %

Table 14

Percent coverage of Investigations and reported percent of days teachers primarily plan for Investigations, by teacher and school

		Estimate the % *Investigations* you will "cover" this year.	What % of days do you primarily plan to use *Investigations*?
School 1	Leslie	75 – 90 %	> 90 %
	Daryl	> 90 %	75 - 90 %
	Kim	> 90 %	No Answer
School 2	Lisa	> 90 %	> 90 %
	Mary	> 90 %	> 90 %
	Cindy	75 – 90 %	75 - 90 %
	Kara	50 – 74 %	> 90 %
School 3	Lilly	50 – 74 %	> 90 %
	Tamara	50 – 74 %	50 – 74 %
	Kendra	50 – 74 %	50 – 74 %
	Lacy	25 – 49 %	25 – 49 %
	Gabby	25 – 49 %	< 25 %
	Becky	75 – 90 %	75 - 90 %
	Nancy	50 – 74 %	50 – 74 %
School 4	Mandy	25 – 49 %	50 – 74 %
	Valerie	< 25 %	< 25 %
	Betty	50 – 74 %	50 – 74 %
	Laura	25 – 49 %	< 25 %

Survey results reveal teachers in Schools 1 and 2 "cover" a great deal of the *Investigations* curriculum, close to 90% for both schools, while teachers in Schools 3 and

4 cover only about half of the curriculum. Analysis of teachers' usage of *Investigations* revealed all teachers in Schools 1 and 2 reported using the curriculum over 75% of the school days. By way of contrast, only two of 11 teachers in Schools 3 and 4 reported using *Investigations* this frequently, including three who reported teaching from *Investigations* less than one-fourth of instructional days.

The reported percent usage of *Investigations* was considered in light of the submitted lesson plans. All 35 days worth of lesson plans collected from teachers at Schools 1 and 2 were *Investigations* lessons. In School 3, teachers submitted 30 days out of 40 days worth of lesson plans from first edition *Investigations*, while teachers at School 4 submitted 15 days out of 22 days worth of *Investigations* lesson plans; for teachers at School 4, all of their second lesson plans came from sources other than the *Investigations* curriculum.

To further emphasize the influence of *Investigations*, I have included four excerpts from interviews, *all* from teachers in District A where there was more reported use of the *Investigations* textbook. In the first sample, Leslie declares that she loves the curriculum and explains why. In the second example, Lisa notes how experience with the curriculum has helped her to understand how to use it more effectively. Cindy references her own mathematical learning from using *Investigations*, and Kara comments on the program supporting the development of number sense.

Leslie: I love it! I love it a lot. I like *Investigations* because I think it makes kids, and adults, anyone involved with the program, think about numbers, what they mean, and how they interact with each other … I am very trusting of this curriculum.

Lisa: When I first started I did not know what I was doing and I did not understand the math very well, so it was very helpful to have something in bold and you knew, you say this, and then it tells you exactly what to look

for … As I got more confident with math, and I understood it better, I could get out of the book a little bit. I could read over it, set it down, and then teach without it.

Cindy: Would I ever think that going back to the old way is the right way to teach, no, because I have learned to be a better mathematician by teaching this way … It is kind of ridiculous that you just learned a formula or procedure to follow, and you never truly understood it … I think these kids get much more of a base understanding than I ever had. And when I got to harder math where you had to think through a problem, I could not do it because there was not somebody telling me to follow this step, so things did not make sense. This is definitely the way to go I think.

Kara: I see a lot of positive things about it. I see that the kids are coming at math from a completely different angle than I did as a student … These kids have better number sense and they see patterns so much more than I did. I just learned how to memorize things.

Based on the data previously presented, it is not surprising that the Investigations materials have a greater influence on teachers in District A. The teachers in Schools 1 and 2 tended to be influenced by the *Investigations* curriculum and, therefore, used it more often. In contrast, teachers in Schools 3 and 4 were using *Investigations* much less, and used other materials more frequently.

Supplemental Resources

When teachers report they will use *Investigations* only 50% of the time, it follows they use must draw on other resources for the remainder of instructional time. This section describes how supplemental resources influence teachers' planning, including the role of parents' beliefs and demands in teachers' decisions to make use of supplemental materials.

The primary influence identified by teachers for using supplemental materials was the need to address the GLEs at Grade 4. Teachers in Districts B and C used GLE-based pacing guides that were divided into the first, second, and third quarters of the school

year. These pacing guides influenced decisions about what content to focus on, which in turn influenced the materials that teachers relied. Lilly addressed the influence of trying to teach to all of the GLEs, and why it was necessary to supplement *Investigations*.

> Lilly: There are those holes in [*Investigations*] and you have to be able to use your resources and get at them, and I don't think [district administration] understand that … I am doing all of the GLEs we are supposed to cover, but not with *Investigations*.

Lacy also described why her colleagues at School 3 supplemented *Investigations*, based on their beliefs about the *Investigations* materials. In particular, these teachers did not see the benefits of using specific books, and chose to find other materials from a variety of different sources.

> Lacy: We might start with the [*Investigations*] lesson, and then if there is stuff we can pull in that pertains to that, supplement, we do that. Like with this book, the geometry book, *Seeing Solids and Silhouettes*, we don't find much in that book to teach that relates to the MAP test … The *Heath Mathematics*, we pull a lot from that … I took over a retired teacher's classroom and I have a lot, a lot that does not get used, but there are good things to pull in here to prepare for MAP test. I have all these folders from *Silver Burdett*, and there are tons of little workbooks from like *Scholastic*.

Becky addressed the issue of supplementing the *Investigations* curriculum through content swapping. In the following response, she describes how all of the teachers at School 3 shared activities, and generally all chose to use the same materials.

> Becky: I mean we all do the same thing, we all get stuff from each other, too, for supplementing. I would say a lot, and we share ideas. This is a good hallway that actually shares materials. There are not teachers that hide their good ideas in their rooms … They influence the way I teach in math, we all kind of do the same things. We all influence each other since we are teaching the same way.

Similar responses were noted among teachers at School 4. Laura addressed the issue of sharing materials and noted that teachers at her school have access to materials on the web, which is where most of her materials come from.

Laura: Now if there is a really neat lesson that somebody has done, everybody shares as far as that kind of stuff. And we do have a shared website as well, or a shared folder, so I can go into any of the other folders and see if there is, and that is something else I do quite often, I can go into the other teachers' folders and see what they are doing math-wise, and pull that activity in … We try to post that stuff [on the web] for everyone.

Although 14 of the 18 teachers said parents did not influence their planning in mathematics, multiple data sources contradict this position. During Gabby's interview, she revealed a conversation she had with a School 3 parent, describing the parent's reaction to the math curriculum and their influence on homework. Several teachers in the study indicated they do not send *Investigations* activities home since parents are not able to help their children.

Troy: Sometimes other people are influential in planning of mathematics lessons. How do the following people influence your lesson planning, parents or the community?

Gabby: No influence whatsoever because *Investigations* is not parent-friendly. [Students] cannot take the things home because the parents do not know how to teach it. I just actually talked to a 3rd grade parent, and she was complaining that she hated the math series because it was not parent-friendly. Her teacher had given her son one of the homework assignments out of the *Investigations*, and took it home and the parents and the child could not collaborate because the parents did not understand what was going on … It is definitely not parent-friendly or community-friendly because they are not for sure what is going on.

While the majority of teachers said parents did not influence their mathematics planning, many of them also noted that they did not send homework from *Investigations* for the same reason as Gabby. Instead, teachers at Schools 3 and 4 assemble packets of worksheets, skills review, multiplication tables, and so on, for students to work on at home. Although *Investigations* does provide student homework, teachers in Schools 3 and 4 regularly supplemented it with their own assignments.

In summary, most of the teachers that were supplementing *Investigations* were not biased to which parts of the program they supplemented, and in many instances suggested supplementing different components depending on the lesson. In particular, teachers modified lesson content, scope and sequence, and even chose not to send home the homework from the curriculum. While teachers in Schools 1 and 2 reported supplementing periodically when specific deficiencies in the program were noticed, teachers in Schools 3 and 4 supplemented more regularly and, in some cases, chose to skip entire books in the *Investigations* series and instead taught activities they felt better addressed specific GLEs.

Many of the reasons that teachers chose to teach or deviate from *Investigations* were related to the GLEs, MAP tests, their beliefs about the curriculum, and attention to parental perceptions. Overall, teachers who had more experience in teaching the curriculum tended to believe *Investigations* was effective and therefore chose to use it as intended by the authors. Additionally, teachers were more likely to teach *Investigations* in schools where district and school level supports existed.

Teachers' Evaluations

Teacher Evaluation is the final component of the Shavelson and Stern (1981) framework (see Figure 1). In this stage of the planning process, teachers reflect on what happened in the classroom (e.g., specific interactions with students) and use that information to plan for the next day. Thirteen teachers reported that they reflected on the learning and interactions that took place in the classroom and reported these interactions influenced their subsequent lesson plans. This data was only available through the interviews, as observations of implementation were not part of the study.

At least one teacher from each of the four schools described the reflection process they went through to determine whether they needed to revisit an activity, or if they could move on to the next concept, based on the student interactions during lesson implementation. In the three interview responses provided, teachers describe their monitoring of student progress, deciding whether to make changes in their plans and proceed to the next lesson. Interestingly, all three teachers cited here were from different districts, but commonly used the phrase "getting it" in describing whether students understood the concepts and whether to proceed with instruction.

Mary: Those kids that aren't *getting it*, I will be working closer with them tomorrow when we are getting ready to do unlike numerators and denominators … I am not just teaching it and moving on. I am teaching my students and reflecting to see if they are *getting it*, so I want to help them more, help them better to *get it*.

Gabby: I have to plan day-by-day, according to my students because it just depends. The lessons in *Investigations* can take a little longer than planned, so I do it day-by-day just to see what they need. I don't plan week-by-week because it does not work for me. I know that some teachers do, but I don't, especially in math, because if they *get it*, then we will move on, but if not, I will take a little bit longer time.

Laura: If my kids are not *getting it*. If we are working on a concept, and they are really not *getting it*, I am kind of old school still in the fact that I don't like it when my kids don't get something. And if I have like half the class that does not have it, it is very hard for me to move on … My lesson plans, I need to have them done for a week at a time for my sanity, to kind of know where I am going. However, if my kids are *not getting something*, or if I need to, I don't stick to those plan necessarily. In a week's time, there may be half the stuff I don't get to. I don't usually put a time limit on things, so lets say we did not get through a lesson, then I will go back and redo it. Or you know, hit the rest of it the next day. If it is something that they are *really getting*, why not do it some more because they are finding success. If it is something that they are *not getting*, then I hit on it again. I am not a person, like I said, I do like to have lesson plans written down, especially in case there is a substitute or whatever, but I never really stick to those lesson plans

Other teachers indicated they would simply re-teach the concepts students did not learn in previous lessons, a trend evident in eight different teacher interviews.

> Betty: Well, obviously if a lot of people do not grasp what I have taught, then obviously I go back and re-teach it. I usually, with my gifted kids gone one day a week [Wednesday], if I introduce something on Monday, we have Monday and Tuesday, and then I can re-teach [Wednesday]. If I don't need to re-teach it, we do some kind of reinforcement, or we do review, too, that day, because my kids that go to the gifted program are expected to keep up.

Several teachers reported taking notes during their math lesson in order to determine how they might address student misconceptions the following day. Included here is an excerpt from Cindy's and Kara's interview to demonstrate this process, as the two of them used slightly different methods for taking notes. Kara references "checkout sheets" the students fill out as a self-assessment regarding how well they understood the lesson and can explain it to others, while Cindy uses a clipboard for taking notes.

> Cindy: Sometimes I take anecdotal notes like that, which are really pretty unorganized. Sometimes I take notes more like this, where I write an objective at the top, and then I give them a score. So tomorrow, if I was looking at this, I would know that I was going to pull the 3 or 5 students with 2s, and I would make sure to reteach that concept because they were *not getting it*. Sometimes I take notes like this, it is more like a strategy. I have names and kids' specific strategies. Sometimes I would use that. I might look over this tonight and say, or I might look over kids work and know that 5 kids tried one student's strategy, but had a computation error. So I might pull those 5 kids with the number line strategy and talk about "what went wrong here?" or "what do you notice where you did well?" "what made sense to you?" and "where do you think your error is?" … I take all kinds of crazy notes. I try to take them everyday, carrying the clipboard around.

> Kara: I will definitely go through each of those checkout sheets … My biggest thing with this and most days with my next day's planning, is "can they do the problem?" but also "can they explain why they are doing it in good words?" … That was the deal, if you gave yourself a 3, that was, I can explain this clearly to someone else.

The majority of teachers indicated that they reflected on what had happened within their most recent lesson, and many suggested re-teaching as the method for addressing any misconceptions that occurred. Most teachers indicated time as a constraint for why they could not re-teach some concepts.

Valerie: We don't have time with MAP testing sometime in March … Unless they are completely lost, we keep trucking.

Nancy: Time just doesn't allow for re-teaching anymore … There is not enough time in the day to re-teach.

The data supports that teachers' reflection process does influence what they do in future lessons. The results of reflection could be revisiting concepts, re-teaching a concept, or making changes to the lesson plan based on the needs of the students. It could also include pulling groups of students together that had similar misconceptions. Contrary to the interviews, this was not evidenced in the lesson plans collected from teachers. Instead, the most common representation found in lesson plans was teachers drawing an arrow from one day's plans to the next day to demonstrate the need for continuing the lesson. In these cases, it was not apparent that any new planning resulted from the reflection, and instead, teachers were simply continuing plans.

Summary of the Influences on Teachers' Planning

Four major influences on teachers' planning in mathematics emerged from the analysis of the data: (1) collaboration, (2) teachers' beliefs, (3) accountability, and (4) curriculum materials. Teachers in the three districts had access to varying levels of professional development and opportunities for collaboration at district and school levels for teaching *Investigations*. Teachers who experienced collaboration specific to *Investigations* were planning with the materials regularly, while teachers who were

simply afforded collaboration time used such time to discuss GLEs and swap content. Teachers' beliefs were also a major factor in planning. When asked to submit *Investigations* lesson plans, teachers provided these materials. However, the majority of teachers submitted supplemental materials for their second set of requested lesson plans. Many teachers were not planning with *Investigations* regularly because they did not believe it was effective, although they *liked* the manipulatives, the cooperative learning, and some other components of the program.

Another influence on lesson planning was accountability, including GLEs, the MAP test, and AYP status. Teachers at Schools 1 and 2 were not using the GLEs to guide their instruction, and they did not feel pressured to teach to the MAP test. However, teachers in Schools 3 and 4 were planning content to "cover" the GLEs, which they stated would prepare kids for the MAP test. Some teachers in Schools 3 and 4 admitted to *teaching to the test* as a result of not meeting AYP status goals the year prior. Finally, some teachers suggested deficiencies in *Investigations*, leading them to use supplementary materials. Teachers indicated "holes" in the *Investigations* curriculum were the reason for using other materials for planning.

If More Planning Time was Available

This section reports a summary of responses to the final interview question, "If your principal gave you one extra hour each day for planning of mathematics, what would you do differently?" The purpose of the question was to determine whether teachers would plan differently if provided additional time to do so. It provided an opportunity for teachers who were not satisfied with their current circumstances to

articulate what they might do differently in planning mathematics instruction. It also provided teachers who were planning with *Investigations* a chance to discuss what they might do to plan more effectively. Therefore, the results may represent a vision of what might happen under ideal planning conditions. Specifically, three common responses emerged from qualitative analyses. If granted more planning time, teachers would: (1) use *Investigations* more often, (2) use/make use of student work to plan more effective lessons, and (3) collaborate with their colleagues in planning *Investigations* lessons.

Using Investigations More

Teachers indicated they would spend additional time planning with *Investigations* if provided more planning time. This was true of most teachers, despite the fact that teachers at Schools 1 and 2 demonstrated higher levels of planning with the curriculum than teachers at Schools 3 and 4. Lisa suggested, since District A teachers all have SMART Boards™ in their classrooms, that converting many of the current *Investigations* materials to be used on the SMART Board™ would be her first goal. This was a typical response of teachers in District A, to enhance the *Investigations* curriculum.

> Lisa: I think I would create more stuff for the SMART Board™ that goes with *Investigations*, or more manipulatives to use on the SMART Board™. I could make copies or scan the blacklines in *Investigations* so we can have it up there, instead of an overhead.

At Schools 3 and 4, teachers felt more planning time would provide them an opportunity to explore the *Investigations* curriculum in depth in order to better understand the program. Some teachers referred to aligning the GLEs with *Investigations*, while others suggested taking time to read the *Investigations* materials more.

> Lacy: For planning mathematics differently, I would say that we would probably sit down together and we would say, these GLEs that we have, what book is it going to come out of and what other things are we going to pull in so we

can use this book more effectively. I don't feel that we are probably using it the way we are supposed to, I know we are not. There are books probably sitting over there in that box that hardly ever get opened.

Nancy: I would love to see us have time to really go through *Investigations* and see what, I know that is what other districts have done, they have sat down and said, okay, what GLE deserves this approach? And I think that has never been done with our *Investigations* … I would like to be able to see us do that [alignment].

Lilly: I would have more time to study *Investigations*, have more time to dig for other things. I think I would be a lot more detailed and we would be much more prepared as teachers and feel better about teaching *Investigations* … I would be able to dig through this room and figure out all of what I have … I would be able to figure out how to use [the manipulatives], that is what is frustrating for me.

Using Student Work

Although teachers expressed a desire to plan *Investigations* lessons and use the curriculum more, they also alluded to working with student work more often. A District A teacher indicated she would use her students' work more to influence future lessons. Three teachers mentioned they would like to look at student work more, specifically formative assessments, and provide more feedback to students if afforded more planning time.

Lisa: I think I would maybe give them more formative assessments, that I could quickly grade and get more information about specific things.

Leslie: I would probably look more in depth at what my kids do because I feel at certain times you are just looking at is it right or is it wrong. I think there is still value in, you look at the right and wrong, and then you focus on the kids that got it wrong. I think there is tons of value in the kids that got it right, and there is tons of conversation that can happen from that. So I think I would also start to look at kids who did get the right answer.

Cindy: One thing I would make sure is that I looked at my kids work every night … That is something I would make sure I did, and I would write very specific feedback on the kids work every night, which is impossible. But if I had an extra hour, just that specific feedback daily for kids would be huge!

Greater use of formative assessments was suggested only at Schools 1 or 2. However, teachers in all four schools echoed the final suggested use of the extra hour of planning time, namely the opportunity to collaborate more.

Working with Colleagues

Teachers in all four schools referenced the benefits of working with colleagues. Thus, not surprisingly, they suggested more collaborative planning time would be beneficial. Below are responses from Betty and Laura who desired collaboration at School 4.

> Betty: My ideal thing would be for all of our 4th grade teachers here to get together for one hour, our whole PLC [Professional Learning Community] drive is collaboration amongst each other … we can all get together and just plan for an hour a day. If we had an hour a day, we could get a lot done. We could plan for the whole week, you know, and then the next day we could take all of the GLEs we wanted to take and put all of our plans inside of those. There is so much work, we could use that time to grade our assessments and then switch because so much of that is subjective, and we could grade each other's. That is what I would do with [an extra hour], I would collaborate with all of us to plan math and nothing else.

> Laura: If [the principal] gave me an extra hour and there were other teachers that had the same hour, I would probably go in and talk to them, and see what it was that they were doing and you could actually be more specific and you would have a little bit more time to sit and talk. But that is probably really the only thing, just to get a feel for where their kids are at as well. And a lot of them have taught a lot longer than I have, so their expertise and experience goes a long way, too.

Collaboration was the most common response to the question, even for teachers like Cindy and Kara who were already afforded collaborative time at School 2.

> Gabby: I would sit down and collaborate more with our teachers, sit down and try to get another feel for how they teach. Every teacher teaches differently. Every teacher has a strong point and every teacher has a weak point. It is like that with every teacher and I would definitely collaborate with my peer teachers and try to figure out how they teach it and try to see if I could get any new ideas as to how to teach.

Cindy: I think I would also want to spend time planning intervention with my team … I feel like we have no time, there are constantly things to do. So those are the things I think I would do, [provide] specific feedback, look at my kids work every single night, and planning with my team.

Kara: I think I would probably want to spend that with my team, too, just because it is really nice to be able to bounce ideas off of each other and find out what is working for someone else, or what has worked. As a team, we just don't get to sit down and talk about math everyday because we have reading, and writing, and all of the other stuff that goes along

Overall, if provided an extra hour of planning time for *Investigations*, teachers would make changes in their existing planning. Teachers not currently collaborating would seek to work with their colleagues more, while teachers who are already meeting regularly would continue to meet and plan together, focusing on other aspects of the curriculum such as student work. Teachers at Schools 3 and 4 suggested using the time to do the work that the teachers at District A had already completed, namely aligning GLEs with *Investigations*.

In summary, the results of the data analysis for this study have provided many insights into both how teachers plan and what influences that planning. Although some response patterns were expected, others were novel ideas about teachers' planning processes.

CHAPTER 5: DISCUSSION, SUMMARY, AND RECOMMENDATIONS

This study sought to identify how teachers plan inquiry-based mathematics lessons at Grade 4, and to generate an inventory of influences on lesson planning. The study was informed by previous research on teachers' decision-making over the past three decades that suggested teachers followed some specific processes for lesson planning. Moreover, this study was based on a conceptual framework of the lesson planning process, including stages teachers progress through when planning (Shavelson & Stern, 1981), and specific influences on their processes. Finally, this study addressed the need to study teacher behaviors of planning in order to better understand the process of teaching (Castro, 2006; Jackson, 1966).

In this chapter, I summarize the dissertation research, discuss its major findings, and offer implications. More specifically, the chapter is divided into six sections: (1) Summary of the Study and the Findings, (2) Discussion of the Findings, (3) Implications of the Study, (4) Limitations of the Study, (5) Recommendations for Future Research, and (6) Reflections.

Summary of the Study and the Findings

Teachers are afforded great autonomy in deciding what happens in their classroom. In some school districts teachers implement mathematics curriculum materials as directed by the corresponding teacher materials, while in other districts, teachers may create lesson plans using a variety of resources. Teachers' decisions may also be guided by policies at the school and district levels. For example, policies related to curriculum

pacing guides, Grade-Level Learning Expectations (GLEs), or standardized testing may influence teachers' decisions.

Previous research suggested that effective teachers enter their classroom with a plan for what they expect will take place each day. "Teachers and classrooms rarely function effectively without some kind of planning" (Yinger, 1980, p. 107). Sometimes this plan is a highly detailed document, while other times it is merely a set of bulleted notes. In some cases, the planning is not formally recorded. Previous research into teachers' lesson planning offered limited insight on how these plans come to be, what influences their creation, and what teachers' lesson plans actually look like. This study has documented these characteristics and reports the findings to inform the field about the processes of planning, specifically with inquiry-based mathematics curricula, in today's era of accountability.

Purpose of the Study

The primary purpose of this study was to document how Grade 4 teachers using inquiry-based mathematics materials prepared their lessons. Specifically, this study explored planning with the *Investigations in Number, Data, and Space* curriculum. This included understanding the planning process and the specific influences on Grade 4 teachers' mathematics planning. This study addressed two research questions:

(1) What processes do Grade 4 teachers use to prepare to teach mathematics lessons from an inquiry-based curriculum?

(2) What factors (e.g., beliefs, experience, policy, curriculum) influence Grade 4 teachers' lesson preparation when using an inquiry-based curriculum?

Methodology

The participants for this study were selected as a purposeful sample (Patton, 2002) from three school districts in Missouri. A total of 18 teachers were identified from four schools: Schools 1 and 2 in District A, School 3 in District B, and School 4 in District C. The districts represented both urban and rural settings, as both schools in District A were in a large city, while both District B and District C schools were located in small rural communities in the same state. The schools were selected based on the criterion that their districts had been implementing the *Investigations* curriculum materials, specifically the first edition materials, for at least two academic years. All Grade 4 teachers in each school were invited and those who agreed to participate (18 out of 25 teachers) included first-year teachers, teachers in the first few years of their career, as well as veteran teachers of 15 years or more. Teachers in the sample were also required to teach the *Arrays and Shares* unit from the *Investigations* curriculum.

Each teacher who agreed to participate in the study completed a *Practices and Beliefs Survey* prior to the collection of any other data. Teachers also participated in an interview in which they answered questions related to how they planned for mathematics and what influenced their planning. Each interview was approximately one-hour in length and was audio-recorded and transcribed. A third data source included two sets of lesson plans submitted by each teacher. The first set of plans was from the *Arrays and Shares* unit of *Investigations*, including all of the teachers' plans and notes for the first three sessions from Investigation One. The purpose was to have a set of lessons common to all teachers in the sample. The second set of plans was the teachers' choice, meaning teachers could submit one day or multiple days of plans after their interview was

completed. A total of 32 lesson plans, representing 97 instructional days, were submitted. The final data source was a transcription of a collaborative planning meeting in one school in order to identify additional influences on teacher planning.

Once the data were collected, qualitative analysis on the interview transcripts, surveys, and lesson plans was conducted. For analysis, I relied on Shavelson and Stern's (1981) conceptual framework to identify the primary codes for processes and influences on teachers' planning. However, additional codes emerged as the result of data analysis. For this second layer of analysis, I relied on grounded theory, which Patton (2002) defines as, "What theory emerges from systematic comparative analysis and is grounded in fieldwork so as to explain what has been and is observed" (p. 133). These new codes will be discussed in a subsequent section and used as the basis for a refined framework for researching lesson planning.

Results of the Study

The results of the study were presented in three sections of chapter 4: (1) Planning to Teach Inquiry-based Mathematics Lessons, (2) Factors Influencing Lesson Preparation, and (3) If More Planning Time was Available. Prior to writing lesson plans, most participants described the opportunity to work with other teachers to determine what mathematics content they would focus on. Although some of this collaborative planning occurred at the district level, it primarily occurred at the school level. Teachers in District A were provided with planning resources from their district collaboration, including a pacing guide and a planning chart with all Grade 4 GLEs aligned to the *Investigations* curriculum lessons. All three teachers in School 1 noted attending collaboration meetings at the district level primarily, while all four teachers in School 2 reported opportunities at

both the district and school levels. All seven teachers at School 3 participated in a flexible collaboration time at their school, meeting once a week for approximately 20 minutes to discuss mathematics. In some cases, the collaboration among teachers at School 3 occurred after school-wide meetings, on early release days, or during planning periods the next day when there was not time available after these meetings. In contrast, the four teachers at School 4 had no structured opportunities provided at the district or school levels to work with other teachers in their school beyond seeking each other out on their own initiative, something that did not occur regularly.

When collaboration occurred, the majority of teachers in the study reported that they discussed objectives for students, the GLEs they would teach, content or pedagogy issues with the *Investigations* curriculum, or they spent the time searching for supplemental content to share with each other. Sometimes, end-of-unit assessments were reviewed in order to determine what content to teach or skip. Although principals, school boards, and district administration expected teachers to plan with the *Investigations* curriculum, this expectation was not an enforced policy in any school district. Teachers in Schools 1 and 2 tended to plan using *Investigations* lessons regularly, while teachers in Schools 3 and 4 supplemented the curriculum often.

Once teachers participated in pre-planning activities (e.g., collaboration, content swapping), they consistently created their written lesson plans in isolation. The majority of the participants in this study used a Lesson Plan Book to record their plans in a relatively small space, approximately 2-inch by 2-inch square. The remaining teachers planned more detailed, hand-written or typed lesson plans. A majority of teachers in the study did not create lesson plans using the format they learned in their teacher

development programs. Instead, teachers suggested they learned to plan from their experiences as student teachers and as classroom teachers. The time teachers spent planning, where and when they planned, and for how many days they planned were characteristics unique to each teacher in the study.

The influences on teachers' mathematics planning were numerous; however, some influences had more effect on teachers' planning of *Investigations* lessons than others. For example, District A teachers' collaboration provided specific structures for planning, including the aforementioned pacing guides, as well as conversations with other teachers and Math Coaches about *Investigations*. District A teachers' participation in collaboration directly influenced their planning of lessons using the *Investigations* materials and activities. Teachers at School 3 used collaboration differently, but the influences on lesson planning were still noticeable. These teachers were focused on discussing which Grade 4 GLEs would be the basis for instruction. Collaboration time afforded them the opportunity to swap content, share activities, and decide what specific tasks they might use to plan their lessons. School 4 teachers experienced almost no collaboration, evidenced by the variety of lesson plans submitted, as well as their interview responses.

Teachers' beliefs also influenced how teachers planned, especially their beliefs about the *Investigations* curriculum materials. In particular, teachers at Schools 1 and 2 considered *Investigations* to be an effective curriculum that addressed the GLEs and referenced specific components they felt were important for students and their mathematics lessons. These components included students working in groups, sharing strategies, and using manipulatives to explore mathematics concepts. In contrast, teachers

at Schools 3 and 4 repeatedly expressed concerns that the *Investigations* curriculum had "holes" in it, meaning it did not address the GLEs sufficiently, and therefore they supplemented the curriculum extensively, and in some cases, almost completely using other curricular materials.

Accountability emerged as another significant influence on planning. The majority of teachers across all four schools identified both the Missouri Grade 4 GLEs and the state's MAP test as highly influential on what they planned in mathematics. In fact, some teachers argued the GLEs *were* their curriculum, while teachers at School 3 reported the GLEs were rearranged into Quarters One, Two, and Three in order to ensure they got all of them "covered" by the MAP testing window early in the Fourth Quarter. Other teachers explicitly admitted to "teaching to the test." Accountability issues were particularly influential on teachers in Schools 3 and 4 who frequently supplemented the *Investigations* curriculum in order to address perceived deficiencies. However, even in Schools 1 and 2, where *Investigations* was the primary curriculum, teachers experienced the influences of accountability. The majority of these teachers suggested the influence of high-stakes testing came after January when their district provided test preparation materials for them to use with their students. Because School 2 was a Title I building, teachers reported experiencing additional pressure for their students to do well because test preparation was an expectation.

A key finding of this study was that a majority of teachers stated *No Child Left Behind* did not influence their lesson planning for mathematics. However, this assertion was primarily because these teachers were simply not aware of what *NCLB* mandated. Specifically, several teachers responded that *NCLB* did not influence their mathematics

planning because they believed the law was related only to communication arts or reading, but did *not* apply to mathematics. Additionally, teachers also cited Missouri Senate Bill 319 as an influence related to *NCLB*. Upon further research, SB-319, a state mandate focused on testing students' reading levels and retaining students not reading at designated levels, was actually signed six months prior to *NCLB* becoming a Federal law. Therefore, a majority of the teachers in this study were misinformed about *NCLB* and its requirements.

The final component of this study dealt with the hypothetical situation of how these teachers would utilize one extra hour each day for planning mathematics. The general consensus of the participating teachers from all four schools was their desire for greater opportunities to collaborate with their colleagues. Teachers who were planning for *Investigations* wanted to explore ways of using the curriculum more effectively, such as analyzing student work and providing more feedback to students. Those teachers who were not using the *Investigations* materials for planning were interested in spending more time with the program, in order to better understand components of the curriculum and, in turn, plan to use it more regularly; this included aligning the *Investigations* curriculum with the Grade 4 GLEs, as was previously accomplished in District A.

Discussion of the Findings

In order to address the research questions, or more specifically how teachers planned and what influenced that planning, four topics are included in this Discussion of Findings: (1) Planning with Inquiry-based Curriculum Materials, (2) Time Afforded for Planning, (3) Teachers' Beliefs, and (4) A Refined Framework for Teacher Planning,

which includes a revision of the Shavelson and Stern (1981) framework regarding teachers' decisions when planning for mathematics.

Planning with Inquiry-based Curriculum Materials

The *Investigations* curriculum represents one of several inquiry-based mathematics curricula designed based on recommendations for content and instruction outlined in the National Council of Teachers of Mathematics' (1989) *Curriculum and Evaluation Standards for School Mathematics*. Table 1 includes a description of how the *Investigations* curriculum differs from traditional curriculum materials. These characteristics are supported by Stein, Remillard, and Smith (2007), who state that *Investigations* and other inquiry-based curriculum materials, "embody an approach to mathematics teaching and learning that is qualitatively different from textbooks or instructional resources previously available" (p. 320). However, due to the scarcity of what participating teachers recorded in their lesson plans, it is difficult to determine *if* and *how* the specific components related to inquiry-based curricula (identified in Table 1) are being attended to in the participants' mathematics classrooms. For example, teachers suggested in their interviews that they made manipulatives available to students and had students work in groups; however, without observations to confirm these practices, it is difficult to know if characteristics associated with inquiry-based materials are, in fact, being implemented.

Previous research suggests that the textbook is an authority in the classroom and provides teachers with a majority of the ideas they plan to teach (Brownell, 1954; Castro, 2006; Herbel-Eisenman, in press; Olson, 1980; Sewell, 2005; Tarr et al., 2005; Travers, 1987). Moreover, Venezky (1992) suggested that elementary teachers are specifically

trained to rely on the textbook and *not* create their own curriculum, a position that Stein et al. (2007) reiterated, "Textbooks are the main source for mathematical tasks used by teachers for classroom instruction" (p. 346).

This study corroborated previous research that teachers rely on their textbook for content selection. However, participating teachers relied on the *Investigations* textbook in varying degrees. On one hand, teachers from District A used the *Investigations* curriculum as the primary source for the content they planned, but teachers in Schools 3 and 4, on the other hand, did not regularly plan lessons based on the *Investigations* textbook; in fact, teachers in School 4 reported planning with *Investigations* only about 25% of the year. These results contradict Venezky's (1992) suggestion, as well as earlier research involving middle grades mathematics teachers: "The district-adopted textbook strongly influences both *what* and *how* mathematics is taught" (Tarr, Chavez, Reys, & Reys, 2006, p. 200). The results of this study suggest that the textbook's influence varies by teacher, with some teachers making extensive use of the district-adopted, inquiry-based textbook and others largely relying on supplemental materials instead.

Previous research has reported several reasons teachers plan lessons beyond their curriculum materials. One was distrust in materials that did not align to their personal beliefs; another was that some materials were overwhelming to plan with (Ball and Cohen, 1996). Results of this study support both of these findings. In particular, teachers' beliefs about *Investigations* influenced their level of planning with the materials. Twelve of the 18 teachers believed the *Investigations* curriculum had "holes" in it and did not align with the state Grade 4 GLEs. Interestingly, 11 of these 12 teachers came from Districts B and C, where limited or no professional development had been provided to

support teachers' understanding of how to implement the *Investigations* curriculum. The remaining teacher was the lone eMINTS teacher in District A who suggested that *Investigations* was "old" and he could find more recent activities on the Internet. Consequently, these teachers chose to utilize supplemental materials to "fill" the perceived gaps. Additionally, teachers reported the *Investigations* materials as being more difficult to plan with than traditional materials, which might account for their use of supplemental materials in planning. It is worth noting that Travers (1987) suggested about 50% of the materials used by teachers are supplemental materials, which is consistent with the level of use of teachers at two schools in this study.

Mathematics textbooks generally provide teachers with logical sequencing of activities, content for teachers to plan with (B. J. Reys & Reys, 2006), as well as suggestions for addressing diversity in the classroom. The *Investigations* curriculum is a comprehensive mathematics program designed through research about best practices (Mokros, 2003; Trafton et al., 2001). Moreover, the curriculum contains suggestions for specific content that should be addressed at particular grade levels. However, if some teachers supplement *Investigations* so heavily that they are, to a large extent, "writing their own curriculum," does the curriculum remain comprehensive and logically sequenced? It is also worth noting that teachers in this study provided no evidence they were, in fact, addressing the diversity issues in their lesson plans or making use of the numerous ideas suggested by the *Investigations* materials for addressing diversity issues.

Although this study did not examine the relationship between textbooks and student achievement, the *Investigations* curriculum has been the subject of intense criticisms in recent years (e.g., Kliman, 1999). The National Research Council (2004)

suggests, “Responsibility for curricular evaluation is shared among three primary bodies: the federal agencies that develop curricula, publishers, and state and local districts and schools” (p. 9). Given the low frequency of use of *Investigations* in two of the four schools, I question whether student achievement at these schools can be attributed to the curriculum when teachers were essentially creating their own curriculum at the classroom level, disregarding suggestions for planning and implementation from the textbook authors.

The final finding associated with planning of inquiry-based curricula is related specifically to *how* teachers planned. McCutcheon (1980) noted that teachers’ planning process could be called “planbook planning” (p. 6), referring to teachers’ notes for themselves, or bulleted points, in their Lesson Plan Books. In this study, the majority of teachers were indeed planning in 2-inch by 2-inch boxes, confirming that “planbook planning” is still common 27 years after McCutcheon’s assertion. Although 12 of the 18 teachers were planning for longer periods of time, at least a week at a time, a few teachers were *incremental planners* who focused on daily planning. Teachers at all four schools were involved in writing school goals and action plans at the *yearly* level, and yet there was no evidence this level of planning influenced their everyday mathematics planning. Such results raise the question, is the time that schools spend analyzing their previous year’s assessment data a wise investment when this information appears *not* to directly affect teachers’ planning on a daily basis?

Time Afforded for Planning

An emergent theme throughout this study was time, or lack thereof, for teachers to create effective lesson plans. Time constraints were the reason typically cited by

teachers for not referring to assessment data for planning beyond the yearly level. According to the Center on Educational Policy's (2006b) report on *NCLB*, "Principals and teachers are making better use of test results to improve teaching." However, this was not evident in this study because school goals and action plans were not directly influencing everyday planning for mathematics. Instead, teachers used the assessment results to plan extra test preparatory activities for the entire grade level or to plan specific activities focused on one or two mathematics topics, such as measurement, to address deficiencies noted in the previous years' assessment scores.

The high degree of accountability that exists today, coupled with the complexity of inquiry-based curriculum materials, suggests that teachers should be spending more time planning than they had in the past (Fernandez, 2005; Fernandez & Cannon, 2005). Moreover, Stein et al. (2007) suggest that teaching inquiry-based materials requires expertise and understanding of the authors' pedagogical philosophies. Most of the teachers in this study reported spending no more than 40 minutes planning for mathematics. In most cases teachers were planning one week's worth of lessons, and this suggests an average of only about eight minutes per day planning; one teacher spent only 15-20 minutes per week, or 3-4 minutes per day in planning mathematics lessons. Given these results, how can we expect teachers to cope with the challenges associated with teaching inquiry-based lessons when they are spending so little time for planning?

The majority of teachers who regularly supplemented the curriculum cited time constraints as one reason why they *were planning* with materials outside of *Investigations*. For these teachers, it was easier to photocopy pages from other curricula than to use the *Investigations* materials. In fact, a few teachers said there simply was "not

enough time in the day" to completely understand how to plan for inquiry-based materials. With limited opportunities for collaboration, many teachers were on their own to plan. Although elementary teachers are afforded a preparation period daily, in most cases teachers' duties beyond their own classroom left them limited time to focus on planning during school, and this meant they resorted to planning during personal time, beyond the school day or at home and on the weekends. When teachers were asked about planning differently if afforded extra time, they typically responded that using such time for essentially planning together would free up time to address other duties they are required to fulfill. One teacher even referenced the old adage, "two heads are better than one," suggesting the collective group could address more planning issues than any one individual teacher. However, I wonder if further collaboration would require sacrificing personal time, as was the case with School 2 teachers.

Time constraints were also cited as the reason why teachers typically did not address the final component of the Shavelson and Stern (1981) framework, Teacher Evaluation. Teachers expressed concerns that there was not enough time to effectively evaluate all of their students' work and consider all of the misconceptions each day in order to affect future lessons. The issue of time was also the reason that teachers felt they could not re-teach concepts throughout the year as they were pressured to present the complete Grade 4 mathematics curriculum to students before the MAP test in early April. Taken together, these issues suggest the need to consider how to address the issue of time related to teachers' planning and implementing of inquiry-based lessons.

Teachers' Beliefs

According to the Center on Education Policy (2006a), "*NCLB* is having a greater impact on the everyday activities of schools and districts" (p. 1). However, how influential can *NCLB* be if teachers are so misinformed about this watershed policy? Recall that eight of the 18 teachers in the study did not realize this law pertained to mathematics in the first place, and this was surprising for several reasons: (a) we are currently in the *sixth full year* of the policy implementation, (b) because the responses about *NCLB* spanned across all four schools, as well as varying levels of teacher experience, and (c) *NCLB* is arguably the predominant issue in education in recent years. While it may be expected that new teachers might not be as informed about the policy and its requirements, even veteran teachers who were teaching when *NCLB* was mandated were misinformed. Jennings and Rentner (2006) suggest the federal government, as well as state and local district governing boards, are all more involved in education because of *NCLB*. However, beyond the state's responsibility of "creating and expanding testing programs for grades 3-8 … [and] setting minimum testing goals that all schools must achieve" (p. 112), this study did not reveal an increased level of involvement by the state based on the teachers' responses and misinformed notions of *NCLB* requirements.

Several teachers suggested they did not believe that the previous years' MAP scores were accurate for a variety of reasons. Because some teachers questioned their fundamental validity, MAP scores were not directly influential on their lesson planning or instructional decisions. Teachers were not only misinformed about *NCLB*, but were also distrustful of one of the most visible influences of the policy, namely scores on the

high-stakes MAP assessments. Teachers' beliefs about GLEs were also slightly disconcerting as some teachers suggested they should teach only GLEs their students were to be tested on. "Not only does such a practice diminish curriculum and instruction, but most psychometricians will tell you that the assessment has yet to be created with a high enough level of validity and reliability to justify its use as the sole basis for making consequential decisions" (S. Thompson, 2001, p 359). Teachers are narrowing the curriculum that students experience to selected topics when they supplement based solely on teaching GLEs, a phenomenon associated with high-stakes testing (Jennings & Rentner, 2006; Loveless, 2005). Finally, the majority of teachers in the study were not aware that Missouri is currently revising their GLEs, although GLEs were cited as a major influence over the content teachers planned for.

Teachers' beliefs went beyond general educational policies to include specific district policies as well. For instance, District A had undertaken the task of aligning Grade 4 GLEs with the *Investigations* curriculum. As a result, a majority of teachers in this district held the belief that planning with and implementing *Investigations* was expected. However, at least one teacher in the district did not share the same sentiment about the alignment; he believed other resources could provide better mathematics experiences for the students. If teachers do not believe the district-adopted textbook is the vehicle for delivering instruction, but instead rely on supplemental materials, then we should also be asking, what are the effects on student learning when supplementing inquiry-based curricula?

The belief about *Investigations* not sufficiently aligning with the GLEs was apparent at an even deeper level when teachers expressed their concerns about the age of

the *Investigations* curriculum. Many teachers referred to *Investigations* as "old" materials, even though the version of the materials all teachers in the study were using was published no earlier than 1997. Contrary to this, teachers at School 3 found comfort planning with materials that were approximately twice as old, as some of the teachers and their relatives had used them as students in the same district. Some teachers suggested that materials found on the Internet were "up-to-date" and therefore better aligned with the Grade 4 GLEs than the *Investigations* curriculum. Several teachers also believed the *Investigations* curriculum was not "parent-friendly," so they decided not to send homework from the curriculum with students. Stein et al. (2007) report, "Research illustrates the ways that teachers' beliefs about mathematics and how it is learned influence how they interpret and use curriculum materials" (p. 353), and suggest teachers' beliefs can lead to lower levels of implementation of the curriculum.

A Refined Framework for Teacher Planning

Much of the research identified in chapter 2 comes from a span of studies over the past three decades designed to study teachers' decision making in the classroom. Richard Shavelson and Paula Stern were involved with several researchers exploring teachers' pedagogical decisions related to grouping students in literacy classrooms from the 1970s into the 1990s. Their work produced the most significant publication for this study, Shavelson and Stern (1981). Their research addressed teachers' thoughts, decisions, judgments, and behaviors as they related to planning group instruction and suggested the, "conceptual domain for research on teacher judgments, decisions, and behavior" (p. 461), which provided the basis for research and analysis of data in this study, and was utilized to design the data collection tools and create primary codes that were employed in the

qualitative analysis of the data (see Figure 1). Although useful for designing this study, as well as analysis of data, the Shavelson and Stern (1981) framework had some shortcomings.

Figure 10 provides a refined conceptual framework for researching teacher lesson planning. This suggested framework includes many elements of the original Shavelson and Stern (1981) framework, but has been modified in substantial ways. The original framework is identified with solid-lined boxes and arrows. Using only the Shavelson and Stern (1981) framework, it is possible to trace the original two loops of the planning cycle, from Antecedent Conditions to Consequences for Teachers, and from Antecedent Conditions to Teacher Evaluation. However, based on the results of this study, I describe the new components that were added to the planning framework in Figure 10.

In order to distinguish my refinements from the previous work, dotted-lined boxes and arrows identify all additions to the original framework. All descriptors in these new categories resulted from this study. Any new additions in the original framework are noted in bold, italicized, and underlined text to separate them from the novel codes. All arrows in the framework convey one-way influences on the sequential boxes.

The new category at the top of the framework, Accountability, does not necessarily represent a starting point for analyzing teachers' planning. For some teachers, schools, and districts in this study, planning began with characteristics from this new Accountability category. However, other teachers, schools, and districts began the planning process with Antecedent Conditions, similar to Shavelson and Stern (1981), or with components identified in the new Teacher/Peer Collaboration category.

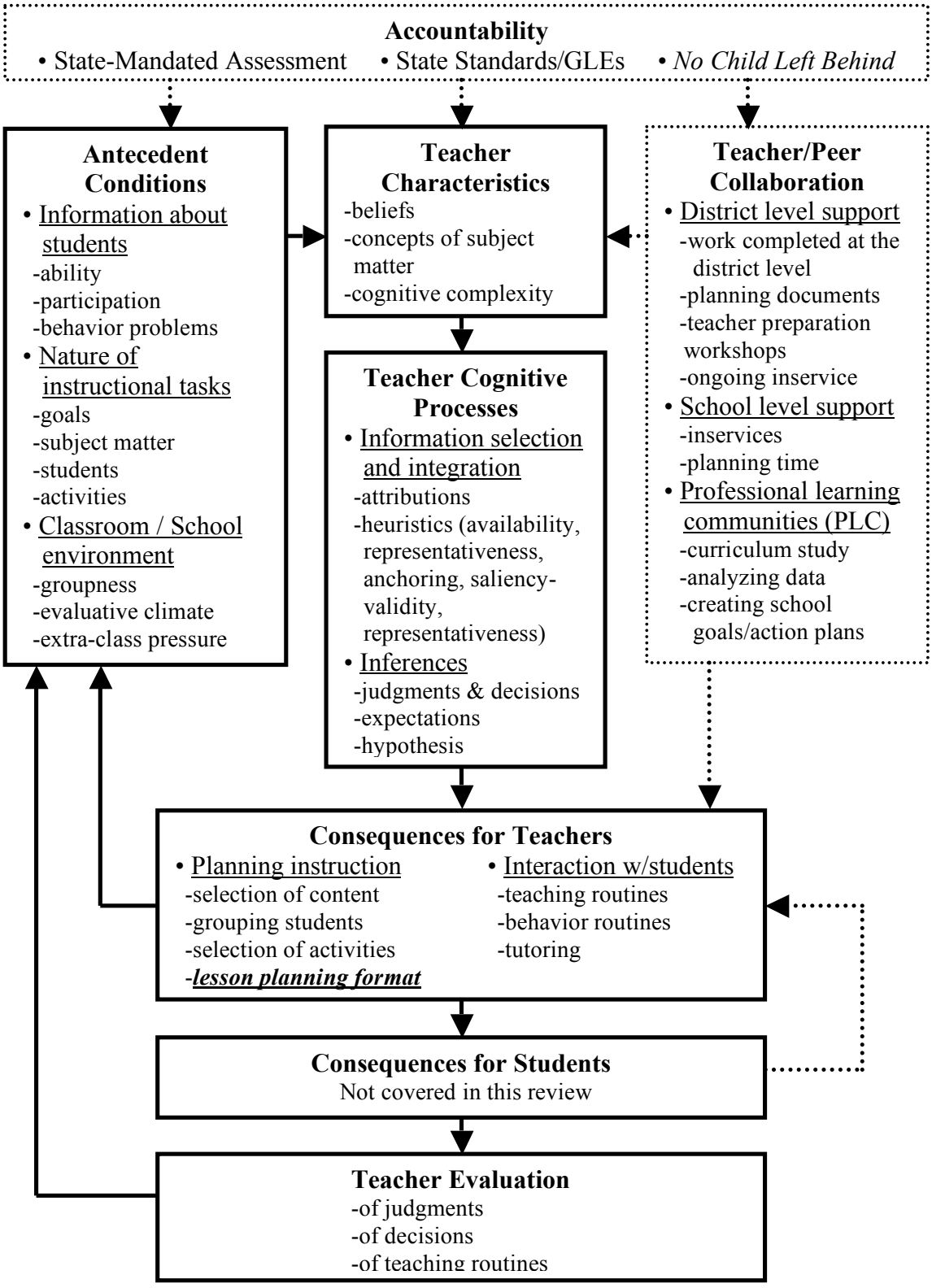


Figure 10. Conceptual framework for research on teacher lesson planning. [Modified from Shavelson and Stern (1981)]

First, the component that I determined to be widely influential on teachers' planning was Teacher/Peer Collaboration. This new category is located on the far right of the new framework and there was evidence these influences directly affected two of the categories in the original framework, Teacher Characteristics and Consequences for Teachers. Specifically, teacher's beliefs about planning and the *Investigations* curriculum were influenced by the work that was completed in collaborative sessions. Also, teachers' writing of lesson plans were directly affected through the processes of content selection teachers participated in during collaboration.

Three topics emerged in the new category Teacher/Peer Collaboration: District-level support, school-level support, and Professional Learning Communities (PLCs). It was apparent from this study that the federal levels of governance were not directly affecting teachers, as suggested by Jennings and Rentner (2006). Instead, the first level of direct influence came from the district-level support, which includes work completed under the direction of the school district, such as the alignment in District A of the state GLEs to the *Investigations* curriculum. Another aspect is the production of documents for teachers to use when planning, such as District A's pacing guide. This category also includes the district's support, in the form of ongoing workshops provided to teachers. Without the district-level support provided through ongoing professional development opportunities related directly to *Investigations*, teachers in this study received almost no guidance related to planning for mathematics. Teachers at Schools 1 and 2 suggested multiple direct influences from this district-level support, while teachers at Schools 3 and 4 made few references to any guidance from the school district, Math Coaches, Curriculum Coordinators, if available, or other district personnel.

At the school level, teachers were participating in team planning meetings at their sites and were encouraged and supported by individual school principals. Other examples of school-level support included interactions with Math Coaches, which occurred only at Schools 1 and 2. Finally, Professional Learning Communities were identified as opportunities to complete activities as an entire school staff, not necessarily just mathematics teachers, that focused on entire school issues. Action plans or school goals to address general topics in mathematics were results of PLCs.

The second new category, the aforementioned Accountability, has directional arrows to convey its influences on three specific components of the new framework: Antecedent Conditions, Teacher Cognitive Processes, and Teacher/Peer Collaboration. Three components of Accountability were influential on teachers' planning: state-mandated assessments, state standards/GLEs, and other policy issues related to *NCLB*. Although I use *NCLB* as the subgroup, this framework is designed for future research and *NCLB* may not continue to represent the defining educational policy in future years, but represents current educational policy as an influence on planning. State assessment scores influence the Antecedent Conditions and the Teacher/Peer Collaboration because teachers may consider these scores of students and grade levels to plan school goals prior to the beginning of the school year, and usually as an entire faculty.

Grade-Level Expectations, on the other hand, may influence teachers' beliefs because teachers have to consider what content they value enough to plan to teach, and decide whether such GLEs could be adequately addressed by *Investigations* or whether supplementary materials were warranted. In some cases, teachers sought out their peers to determine what content to teach. However, the components within the Accountability

category were not directly affecting the writing of lesson plans. Instead, these components affected other steps in the process, including collaboration. Therefore, although Accountability issues seemed to influence more categories in the new framework, Teacher/Peer Collaboration directly influenced the writing of lesson plans.

The final refinement to Shavelson and Stern's (1981) framework is an arrow from Consequences for Students, directly back to Consequences for Teachers. Following the pathway of the cycle in the original framework, Consequences for Students only had one arrow pointing toward Teacher Evaluation and on to Antecedent Conditions, as teachers considered the interactions from a previous day's lessons and possibly modified the next day's plans by returning through the entire process. Although observations were not included in this study, I discovered through the interviews that some teachers, at the conclusion of their mathematics lesson, essentially drew an arrow from that day to the next in their plan book to convey the lesson would carry over into the following day. That is, no new planning occurred and teachers merely continued the next day with the same lesson.

In summary, results of this study led to refinements of the original Shavelson and Stern (1981) framework which was published before several historically significant events in the past 25 years, including the NCTM's publication of three curriculum standards documents (1989; 2000; 2006), as well as enactment of the *NCLB* legislation in 2002. Although the NCTM *Standards* are particular to mathematics, other disciplines have published standards and recommendations for teachers of that particular content. Therefore, the new framework captures these additions as influences on the processes of lesson planning. Finally, the Shavelson and Stern (1981) framework referenced

"groupness" (p. 465), suggesting that teachers joined together to establish a community; this reference was interpreted to mean teachers worked together in some fashion. However, the nature of inquiry-based materials make it necessary for teachers to have more knowledge about the curriculum, which was manifested through collaboration experiences and are now represented exclusively in the framework under Teacher/Peer Collaboration.

Implications of the Study

Beyond the need to refine the Shavelson and Stern (1981) framework, four additional implications have been identified from this study: (1) Accountability Awareness, (2) Understanding Educational Policy, (3) Teacher Development Programs, and (4) Professional Development.

Accountability Awareness

Teachers in this study claimed the GLEs were influential in their planning for mathematics, particularly in the selection of content. Nearly all teachers supplemented with various activities in an attempt to address Grade 4 GLEs and prepare students for MAP testing. When teachers chose this approach to planning, they were essentially becoming "curriculum developers." Developing curriculum is not merely finding activities to teach specific concepts as the National Council of Teachers of Mathematics (2000) points out, "A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across the grades" (p. 14). *Investigations* is intended to be a coherent and comprehensive curriculum, designed to spiral mathematics concepts Kindergarten through Grade 5 (Mokros, 2003; Trafton et

al., 2001). However, the implication here is that students might not be experiencing these interrelated concepts when their teachers supplement *Investigations* with their selection of worksheets and other mathematics activities. How much teachers supplement an inquiry-based curriculum should be considered for further examination to determine the impact these decisions have on students' development of conceptual understanding and connections among mathematics topics.

The other key finding related to Accountability was that teachers were planning tasks to address *only* Grade 4 GLEs because they believed their students were to be tested exclusively on this content. However, by teaching only concepts in the Grade 4 GLEs, teachers may not be addressing other key concepts from previous grades that students need to continue to develop. Schmidt et al. (1997a) referred to the mathematics experienced in US curricula as a "mile wide and an inch deep," and suggested a large amount of repeated content in US mathematics textbooks from year to year, which was also the argument made by Reys & Reys (2006).

Moreover, Reys (2006b) reported many mathematics concepts span multiple grade levels from their introduction to a point of expected mastery, and therefore these concepts need to be addressed over multiple years. "Learning mathematics involves accumulating ideas and building successively deeper and more refined understanding … A well-articulated curriculum gives teachers guidance regarding important ideas or major themes, which receive special attention at different points in time" (National Council of Teachers of Mathematics, 2000, p. 16). Teachers who chose activities to plan from the GLEs were *only* addressing concepts at one specific time along a students' educational journey, and possibly ignoring continuances of concepts not outlined in the GLEs, but

occurring within the curriculum materials. I believe this "piecemeal implementation" of inquiry-based curricula likely jeopardizes its coherent and comprehensive nature, and we do not know the effects this approach has on students' understanding of mathematics concepts from year-to-year. We need to further explore how focusing solely on grade specific GLEs impact mathematical coherence for students across years of instruction.

Understanding Educational Policy

Another key finding was that numerous teachers in this study did not understand the expectations of the educational policies they operate within. Eight of the 18 teachers in this study were uninformed about *NCLB* and how it relates to mathematics. Teachers were also confusing the expectations of Senate Bill 319 by suggesting a relationship to *NCLB*, although these two policies were not related. The implication is that uninformed teachers may not be addressing students' mathematical needs because they believe they are not being held to the same level of accountability for mathematics as communication arts. It follows that teachers should become better informed about *NCLB*, as well as other educational policies they are accountable to.

Teacher Development Programs

This study has some implications for teacher development programs, especially when you consider the remarks teachers made regarding their experiences with lesson planning. Given that some teachers referred to the Madeline Hunter model of lesson planning as, "worthless" and "a waste of their time," it is difficult to determine the value of introducing preservice teachers to this model. Given the lack of planning time and inclination of teachers to use "planbook planning," it seems unlikely that teachers will create full lesson plans mirroring this model. Consequently, teacher development

programs need to consider introducing more practical methods for planning that promote the recording of notes that genuinely inform the instructional process.

It is clear that the typical Lesson Planning Book used by the majority of teachers, including the 2-inch by 2-inch squares for planning, does not afford teachers the space to properly plan lessons, especially given the complexity of planning with inquiry-based materials. Preservice teachers need to have the opportunity to think through the lesson planning process and understand the importance of writing down plans for implementation, particularly in their early years of teaching.

The refined conceptual framework I have suggested could be utilized in teacher development programs to provide teachers with a representation of the planning process and possible influences they need to consider when planning lessons. Given the complexity of planning and teaching inquiry-based mathematics curricula, I believe this updated framework provides a basis for teachers to understand the intricacies of planning. We should also consider finding a more useful and meaningful model for planning.

Professional Development

The final implication identified from this study relates to providing professional development to teachers using inquiry-based curriculum materials, such as *Investigations*. Teachers who had experienced some form of professional development related to *Investigations* reported feeling more prepared to implement the curriculum, and more confident in planning with the materials. On the other hand, teachers who had not experienced professional development related to *Investigations* were not frequently using the program. School districts spend tens of thousands of dollars on these programs and materials. However, teachers in two of the schools were using the instructional materials

less than half the time, and teachers in all four were rarely considering the detailed suggestions for planning included in *Investigations*. Instead, some teachers were essentially writing their own curriculum comprised of supplemental materials. It follows that, if school districts want their teachers to plan with the district-adopted materials, they need to provide teachers with the opportunities to understand how to use the materials more effectively through professional development experiences.

Limitations of the Study

The most significant limitation of this study is that all of the data collected were self-reported data from a relatively small sample of teachers and schools using the inquiry-based curriculum, *Investigations*. Districts were selected from one state (Missouri), and while multiple inquiry-based elementary mathematics curricula exist, only *Investigations* was considered for this study. In addition, the interviews with teachers were limited to one session and I was able to attend only one collaborative planning session.

It is possible that teachers were merely responding with answers that they felt I wanted to hear. However, Porter (2002) suggests that assuring teachers of anonymity validates their self-report data because teachers believe the researcher is not evaluating them. For this study, triangulation of data sources was used to validate results under the summarized limitations. However, a larger sample could have been utilized to validate the refined framework by conducting qualitative analyses to the point of "saturation," where no new themes, codes, or information emerged from the data being analyzed (Guest, Bruce, & Johnson, 2006).

In short, the only true way to capture the entire planning process would be to shadow a teacher through the complete process; to "get inside their heads" during their planning and record their thoughts as they happened. I was not present during the planning process because some teachers planned at home or on the weekends. To be confident the most accurate data were collected, I would have had to use additional methods, such as having teachers self audio-tape their planning sessions. The request for written lesson plans was intended to validate teachers' planning processes and influences, however the lesson plans yielded less information than I expected and therefore, in hindsight, were not a robust data source. It should be noted that teachers suggested their implemented lessons to include many more characteristics than those appearing in their lesson plans. This fact should not be misinterpreted to suggest that teachers did not plan, as all participating teachers provided some written document for a lesson plan.

Another limitation was the fact that I did not include an observation component to examine how teachers implemented lesson plans. Had observations been included, I may have been able to validate whether planned lessons were being implemented and identify other lesson plan components not included within the written plans. Observations could have yielded information on how teachers presented the content, in a traditional or nontraditional fashion, and/or how they modified lessons for individual students. Observations would have also afforded the opportunity to determine how faithfully teachers were implementing *Investigations* lessons. Among teachers who submitted *Investigations*-based lesson plans, it remains unclear whether they were teaching these lessons according to the authors' intentions.

By considering observations of consecutive lessons, I would have been able to address the component of Consequences for Students from the original framework. Since Shavelson and Stern (1981) did not conduct observations, they were unable to address the interactions with students, therefore, I could have possibly added to their framework through observations of lesson. Finally, observations would have provided me the opportunity to track a teachers' lesson plan as they taught it, then interview them after their teaching to determine *if* and *how* they reflect on the lesson. Determining how teachers' reflections influenced modifications to future lesson could have been explored with an observational component, as well as possibly examining MAP assessment data or including other levels of interviews.

The final limitation of this study was the fact that teachers were not directly asked about the mathematics content they taught, and therefore, its influence on planning was not documented. Although the teachers were planning mathematics content at the Grade 4 level, it should not be assumed that they fully understood all of the content, or activities addressing specific content, and this may have influenced how teachers chose to plan for specific content. Future studies of lesson planning should consider how the mathematics content influences teachers' planning.

Recommendations for Future Research

As recommended by Jackson (1966) over 40 years ago, and Castro (2006) more recently, research suggests a need to study teacher behaviors of planning in order to fully understand the process of teaching. We cannot fully understand what is happening during classroom instruction unless we have a clear picture of what the teacher planned to do in

the first place, enabling researchers insight into the adaptations teachers make during instruction. On the other hand, researching planning without following the plan through implementation leads to limited understanding of what influences teachers' decisions before, during, and after the lesson implementation. Therefore, I argue for additional research into identifying how teachers plan and implement lessons, including how their reflections influence future lessons. Moreover, we need to understand better why teachers write lesson plans in the first place. Is it to merely appease principals? Because school policies did not require the collection of lesson plans beyond formal observations, there must be another reason teachers write them. If they generally contain such limited information, what purpose do lesson plans serve for the teacher?

This research suggested an updated conceptual framework be considered when studying teacher planning. However, given the relatively small sample size in this study, there is a need for larger-scale research of teacher planning, including examining whether teachers' use of inquiry-based curriculum materials plan differently than teachers using other curricula. This includes research to explore the feasibility of this new framework in accurately identifying the processes and influences on teachers' mathematics lesson planning. The framework could also be used to conduct research in other content areas to determine if the framework is content specific, or whether it can be applied more broadly across disciplines.

There were also some interesting instances that emerged from the data that could be followed up on. Specifically, there were five teachers that were in their first or second year of teaching. However, their planning with the *Investigations* curriculum was very different based on their school site. It would be useful to study how lesson planning and

use of curriculum materials changes in the transition from preservice teacher to beginning teacher.

Reflections

This study sought to address a void in the research literature on teachers' decision making by identifying the processes teachers follow when planning inquiry-based mathematics lessons at Grade 4. Moreover, the research also sought to document the influences on teachers' planning, particularly in the present NCLB policy context.

Among the findings reported here, perhaps the most significant result is the influence of collaboration on how teachers planned. In schools where teachers had engaged with other teachers in *Investigations* workshops, the level of planning with the curriculum was much higher than in schools where teachers were provided materials without guidance on how they were to be used. Case-in-point was the 2nd edition *Investigations* materials at School 3 that were literally left in each teacher's room without announcement or guidance. Lacking awareness of what these materials were, teacher inferred they were a "supplement" to be used to "bridge" between *Investigations* and the GLEs at Grade 4. I can only speculate how different School 3 teachers' planning would be if they had attended specialized professional development to understand what the "bridge" materials were.

Perhaps the most interesting result of this research was how several teachers misunderstood key features of *NCLB*. Had a few relatively new teachers responded *NCLB* was not related to mathematics, this could be attributed to a lack of experience in

education, but clearly teacher development programs must bear at least some responsibility.

This research has provided me the opportunity to explore qualitative research, with the guidance of my advisor and members of my committee. I have discovered how difficult, yet how enlightening, this process is. Designing tools to collect qualitative data is a difficult task as researchers cannot account for all responses, nor can they consider all the variations of possible codes that may emerge from the data during analysis. While there was excitement in the process, there was also struggle in trying to determine how to legitimately make sense of the data. Having the opportunity to refine an existing framework makes this research worthwhile. The prospect of continuing to conduct research with the new framework makes this study the first step in my pursuit of a research agenda that seeks to better understand the processes of planning and implementing mathematics curricula at all levels.

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APPENDIX A

Complete Set of Raymond's (1997) Criteria for Traditional and Nontraditional Teachers

Table A1

Criteria for the categorization of teachers' beliefs about the nature of mathematics

(Raymond, 1997, pp. 556-557)

Traditional	• Mathematics is an unrelated collection of facts, rules, and skills. • Mathematics is fixed, predictable, absolute, certain, and applicable.
Primarily traditional	• Mathematics is primarily an unrelated collection of facts, rules, and skills. • Mathematics is primarily fixed, predictable, absolute, certain, and applicable.
Even mix of traditional and nontraditional	• Mathematics is a static but unified body of knowledge with interconnecting structures. • Mathematics is equally both fixed and dynamic, both predictable and surprising, both absolute and relative, both doubtful and certain, and both applicable and aesthetic.
Primarily nontraditional	• Mathematics is primarily a static but unified body of knowledge. • Mathematics involves problem solving. • Mathematics is primarily surprising, relative, doubtful, and aesthetic.
Nontraditional	• Mathematics is dynamic, problem driven, and continually expanding. • Mathematics can be surprising, relative, doubtful, and aesthetic.

Table A2

Criteria for the categorization of teachers' beliefs about learning mathematics

(Raymond, 1997, pp. 557-558)

Traditional	• Students passively receive knowledge from the teacher. • Students learn mathematics by working individually. • Students engage in repeated practice for mastery of skills. • There is only one way to learn mathematics. • Memorization and mastery of algorithms signify learning. • Student learns mathematics solely from the textbook and worksheets. • Many students are just not able to learn mathematics. • Students' learning of mathematics depends solely on the teacher.
Primarily traditional	• Students primarily engage in practice for mastery of skills. • Memorization and mastery of algorithms provide primary evidence of learning. • The teacher is more responsible for learning than the student. • Mathematics is learned primarily from the textbook and worksheets. • Students work individually except perhaps to work on homework. • Students are primarily passive learners, raising questions on occasions.
Even mix of traditional and nontraditional	• Students should learn mathematics through both problem solving and textbook work. • Students should both understand and master skills and algorithms. • Students should do equal amounts of individual and group work. • There is more than one way to learn mathematics. • Learning mathematics is equally the responsibility of students and teachers. • Trying hard is as likely to aid mathematics learning as being naturally good. • Repeated practice is as likely to help in the learning of mathematics as is having insights as a result of exploration.
Primarily nontraditional	• Students primarily learn mathematics through problem-solving tasks. • Students primarily learn mathematics from working with other students. • Learning is evidenced more through ability to explain understanding than through expert memorization and performance of algorithms. • Students are more responsible for their own learning than the teacher. • Students learn mathematics primarily as active learners.
Nontraditional	• The students' role is that of autonomous explorer. • Students learn mathematics only through problem-solving activities. • Students learn mathematics without textbook or paper-and-pencil activities. • Students learn mathematics through cooperative group interactions. • Students are active mathematics learners. • All students can learn mathematics. • Each student learns mathematics in his or her own way.

Table A3

Criteria for the categorization of teachers' beliefs about teaching mathematics

(Raymond, 1997, pp. 558-559)

Traditional	• The teacher's role is to lecture and to dispense mathematical knowledge. • The teacher's role is to assign individual seatwork. • The teacher seeks "right answers" and is not concerned with explanations. • The teacher approaches mathematical topics individually, a day at a time. • The teacher emphasizes mastery and memorization of skills and facts. • The teacher instructs solely from the textbook. • Lessons are planned and implemented explicitly without deviation. • The teacher assesses students solely through standard quizzes and exams. • Lessons and activities follow the same pattern daily.
Primarily traditional	• The teacher primarily dispenses knowledge. • The teacher primarily values right answers over process. • The teacher emphasizes memorization over understanding. • The teacher primarily (but not exclusively) teaches from the textbook. • The teacher includes a limited number of opportunities for problem solving.
Even mix of traditional and nontraditional	• The teacher includes a variety of mathematical tasks in lessons. • The teacher equally values product and process. • The teacher equally emphasizes memorization and understanding. • The teacher spends equal time as a dispenser of knowledge and as a facilitator. • Lesson plans are followed explicitly at times and flexibly at others. • The teacher has students work in groups and individually in equal amounts. • The teacher uses textbook and problem-solving activities equally. • The teacher helps students both enjoy mathematics and see it as useful.
Primarily nontraditional	• The teacher primarily facilitates and guides, with little lecturing. • The teacher values processes somewhat more than product. • The teacher emphasizes understanding over memorization. • The teacher makes problem solving an integral part of class. • The teacher uses the textbook in a limited way.
Nontraditional	• The teacher's role is to guide learning and pose challenging questions. • The teacher's role is to promote knowledge and sharing. • The teacher clearly values process over product. • The teacher does not follow the textbook when teaching. • The teacher provides only problem-solving, manipulative-driven activities. • The teacher does not plan explicit, inflexible lessons. • The teacher has students work in cooperative groups at all times. • The teacher promotes students' autonomy. • The teacher helps students to like and value mathematics.

Table A4

Criteria for the categorization of teachers' mathematics teaching practice (Raymond, 1997, pp. 559-560)

Traditional	• The teacher instructs solely from the textbook. • The teacher follows lesson plans rigidly. • The teacher approaches mathematics topics in isolation. • The teacher approaches mathematics instruction in the same pattern daily. • The teacher has students engage only in individual paper-and-pencil tasks. • The teacher creates an environment in which students are passive learners. • The teacher poses questions in search of specific, predetermined responses. • The teacher allows no student-to-student interactions. • The teacher evaluates students solely via exams seeking "right answers".
Primarily traditional	• The teacher instructs primarily from the textbook with occasional diversions from the text. • The teacher creates an environment in which students are passive learners, occasionally calling on them to play a more active role. • The teacher primarily evaluates students through standard quizzes and exams, only occasionally using other means. • The teacher primarily encourages teacher-directed discourse, only occasionally allowing for student-directed interactions.
Even mix of traditional and nontraditional	• The teacher teaches equally from textbook and problem-solving activities. • The teacher creates a learning environment that at times allows students to be passive learners and at times active explorers. • The teacher evaluates students' learning equally through standard quizzes and exams and alternative means, such as observations and writing. • The teacher encourages teacher-directed and student-directed discourse.
Primarily nontraditional	• The teacher primarily engages students in problem-solving tasks. • The teacher primarily presents an environment in which students are to be active learners, occasionally having them play a more passive role. • The teacher primarily evaluates students using means beyond standard exams. • The teacher encourages mostly student-directed discourse.
Nontraditional	• The teacher solely provides problem-solving tasks. • The teacher selects tasks based on students' interests and experiences. • The teacher selects tasks that stimulate students to make connections. • The teacher selects tasks that promote communication about mathematics. • The teacher creates an environment that reflects respect for students' ideas and structures the time necessary to grapple with ideas and problems. • The teacher poses questions that engage and challenge students' thinking. • The teacher has students clarify and justify their ideas orally and in writing. • The teacher has students work cooperatively, encouraging communication. • The teacher observes and listens to students to assess learning.

APPENDIX B

Practices and Beliefs Survey

Instructions

Please answer all of the questions to the best of your ability, keeping in mind that there are no "right" or "wrong" answers. All information on this survey will be kept confidential.

Estimated time of completion of the survey is 25-30 minutes.

If you have questions about the study or any items in the survey, please email Troy P. Regis, tprb62@mizzou.edu, or call (573) 823-1144.

Background Information (Your information will be kept confidential)

Name: _____ _____
First Last

School District: _____

Building: _____

How many years (including this year) have you taught from *Investigations*? _____

How well prepared do you feel you are to teach *Investigations*?

- ☐ Very Unprepared
- ☐ Somewhat Unprepared
- ☐ Somewhat Prepared
- ☐ Very Prepared

Questions 1-3: About the *Investigations* Curriculum

1. What role do the *Investigations* materials play in your planning? (Check all that apply)

- ☐ Help me plan daily instruction.
- ☐ Help determine the sequence of topics
- ☐ Provide activities to explore math topics.
- ☐ Help parents know what we are studying.
- ☐ Serve as source of example problems.
- ☐ Serve as source for homework problems.
- ☐ Serve as source of assessment items.
- ☐ Serve as a resource for student work.
- ☐ Other (please specify) _____

2. How would you rate the overall quality of the *Investigations* materials?

☐ Very Poor ☐ Poor ☐ Fair ☐ Good ☐ Very Good

3. Estimate the percentage of the *Investigations* Grade 4 curriculum you will "cover" this year?

☐ < 25% ☐ 25-49% ☐ 50-74% ☐ 75-90% ☐ > 90%

Questions 4-16: Planning for *Investigations* Lessons

4. Do you supplement the *Investigations* instructional materials? ☐ Yes ☐ No (If no, skip to #5)

   If YES, indicate each type of supplementary material that you have used.

   - ☐ Materials presenting special topic(s) not in *Investigations*
   - ☐ Worksheets for review
   - ☐ Worksheets for skill practice
   - ☐ Materials to prepare for out-of-course assessments (e.g., mandatory state exam)
   - ☐ Other commercial textbooks
   - ☐ Other curriculum materials (e.g., NCTM *Navigations* book)
   - ☐ Teacher-developed materials
   - ☐ Other (please specify) _____

   If you chose "Other textbooks" or "Other commercial curriculum materials," list the publishers of the textbooks and commercial curricula that you use to supplement?

   _____

   _____

5. Do you have the opportunity to plan mathematics lessons with colleagues? ☐ Yes ☐ No

6. What percentage of instructional days do you primarily plan to use the *Investigations* lessons during class to teach mathematics?

   ☐ < 25% ☐ 25-49% ☐ 50-74% ☐ 75-90% ☐ > 90%

About how often do plan to do each of the following when you teach *Investigations*?		Never	Rarely	Some-times	Often	All the Time
7	Introduce content through formal presentations.					
8	Pose open-ended questions.					
9	Engage in whole-class discussions.					
10	Require students to explain their reasoning when giving an answer.					
11	Ask students to explain concepts to one another.					
12	Ask students to offer alternative methods for solutions.					
13	Ask students to use multiple representations.					
14	Assign mathematics homework to be completed outside of class.					
15	Have students work in groups.					
16	Use manipulatives in class.					

Questions 17-49: Beliefs and Practices in Mathematics

	Please provide your level of agreement for each statement about your beliefs regarding mathematics and student learning:	Strongly Agree	Agree	Disagree	Strongly Disagree
17	Mathematics is a collection of facts, rules, and skills that students should memorize.				
18	Students receive mathematics knowledge from the teacher as passive participants in the classroom.				
19	All students can learn mathematics.				
20	The students' role is that of autonomous explorer in the mathematics classroom.				
21	The students' role is to engage in repeated practice for mastery of mathematics skills.				
22	Students learn best in mathematics by working individually.				
23	Students learn best in mathematics by working cooperatively in groups.				
24	Each student learns mathematics in his or her own way.				
25	Mathematics is dynamic, surprising, and continually expanding in the classroom.				
26	Students' ability to learn mathematics depends solely on the teacher.				
27	There is only one way to learn mathematics and many students are just not able to learn that way.				
28	Students learn mathematics only through problem-solving activities.				
29	When students master algorithms, they demonstrate learning in mathematics.				
30	Students are active learners in mathematics.				
31	Students should consider their own reasoning and the reasoning of others in the mathematics classroom.				

	Please provide your level of agreement for each statement about your beliefs regarding the teaching of mathematics:	Strongly Agree	Agree	Disagree	Strongly Disagree
32	The teacher's role is to guide learning, pose challenging questions, and provide problem-solving activities.				
33	The textbook guides instruction and the teacher follows the lessons without deviating.				
34	Formal, planned assessments (like tests or quizzes) should be used solely to assess students' progress.				

… beliefs regarding the teaching of mathematics:		Strongly Agree	Agree	Disagree	Strongly Disagree
35	The teacher's role is to promote students' autonomy and helps students to value and like mathematics.				
36	The teacher's role is to teach new, individual topics each day.				
37	The teacher communicates with students about mathematics by using pictures, models, orally, and in writing.				
38	The teacher's role is to focus students on getting the right answer.				
39	The teacher's plan is used to guide the mathematics lesson and deviation from the plan should be minimal.				
40	The teacher uses problems and examples only found inside the textbook.				

Please provide your level of agreement for each statement about how you plan for mathematics:		Strongly Agree	Agree	Disagree	Strongly Disagree
41	I only use the textbook to create my lesson plans and strictly follow those plans when teaching.				
42	I prepare questions for students to answer that have predetermined outcomes or responses.				
43	I create groups for students or allow them to work cooperatively in groups they choose in class.				
44	I provide students with as many problems and as much practice as possible in mathematics.				
45	I follow a routine in mathematics so that each day feels the same for the students.				
46	I create an environment that students feel comfortable in sharing their work, making mistakes, and supporting each other's learning.				
47	I solely use problem-solving tasks in mathematics.				
48	I consider students' interests when selecting mathematics tasks.				
49	I assess students with pencil-and-paper tasks most often.				

Thank you for participating in this survey. Please return your survey to:

Troy P. Regis
303 Townsend Hall
Mathematics Education
Columbia, MO 65211

APPENDIX C

Practices and Beliefs Interview

The Practices and Beliefs Interview

Planning for *Investigations* and the Possible Influence of the Curriculum

1. Describe the process you follow to plan a mathematics lesson using the *Investigations* curriculum. How much time to you typically take to plan one lesson?
   a. When and where do you typically plan your mathematics lessons?
   b. Do you typically plan day-to-day, a few days at a time, or weekly? Longer?
   c. What resources do you consult when planning for mathematics?
   d. (*If teaching more than 1 year*) How is planning with *Investigations* different than planning with other textbooks you have taught from?
2. How do you feel about teaching the *Investigations* curriculum?
   a. What opportunities have you had to learn about the *Investigations* curriculum?
   b. In what ways does your district support you in planning *Investigations* lessons?
   c. Do you tend to follow the *Investigations* curriculum word for word, page by page, or do you modify lessons when you plan? If so, how and why do you modify the lessons?
   d. Describe what you believe is the *Investigations* philosophy for instruction?
   e. Are you comfortable planning lessons based on the *Investigations* philosophy?
3. In what ways has your planning changed as a result of your experience teaching *Investigations*?

Possible Influences beyond the *Investigations* Curriculum

4. How do you determine the mathematics content you plan to teach?
   a. How do you decide what to skip?
   b. How do you determine what mathematics content deserves more emphasis?
   c. How do supplementary resources influence your planning of mathematics lessons?
5. Does the content you plan to teach appear in your district curriculum guides or the state standards/GLEs for Grade 4 mathematics?
   a. How have the latest version of the GLEs with the Depth-of-Knowledge component affected how you plan to teach mathematics?
6. What specific components of *NCLB* influence your planning?
   a. How is your planning different as a result of *NCLB*?
7. Does the content you plan to teach appear on state or district assessment tasks?
   a. How does assessment influence your planning of mathematics lessons?
   b. How do MAP scores influence your planning in mathematics?
8. Think back to your teacher training. How much was lesson planning emphasized in your teacher development program? Were you introduced to templates or models for planning?
   a. Do you plan the way you were taught to plan?
   b. What has influenced how you plan?

9. What characteristics about students influence your planning of mathematics lessons?
   a. How do special education, ELL, or gifted students influence your planning?
   b. Do you use groups in mathematics? How do you consider grouping students?
   c. In what ways does student behavior influence your planning?
   d. How does student ability influence your planning?
   e. When you finish teaching a lesson, how does the lesson you taught influence the lesson you will teach the next day?

Teachers' Beliefs and their Influence on Planning

10. Describe the atmosphere in your classroom if you were planning the most effective mathematics lesson. What would students be doing during the lesson?
    a. What would you be doing?
    b. What kinds of activities are being used for mathematics?
    c. Would you be using the *Investigations* curriculum? Why or why not?

Influences from Colleagues, Collaboration, or the School Environment

11. Describe your opportunity to collaborate with other teachers when planning lessons.
    a. Describe the level of influence your colleagues have on your planning to teach mathematics lessons.
    b. If you have collaborative planning time, what do you consider the benefits? Why?
12. Sometimes other people are influential in planning of mathematics lessons. How do the following people influence your lesson planning:
    a. The Principal?
    b. Parents and members of the community?
    c. The School Board?
    d. District Administration?
    e. Is there anyone else that influences your planning?
13. If your principal gave you one extra hour each day for planning of mathematics, what would you do differently?

Last Chance to Identify Possible Influences on Planning

14. What other resources, not already mentioned, do you feel you rely on to plan for mathematics lessons?

APPENDIX D

Sample Grade 4 Pacing Guide

Sample Grade 4 Pacing Guide

Name of Unit	Investigation	# of Sessions	Total # of Days	
			INV	District
Arrays & Shares *Aug 21-Sept 24*	1. Multiples on the 100s chart	3	16	**24**
	2. Arrays	8		
	3. Multiplication & Division with 2-digit numbers	5		
Landmarks in the 1000s *Sept 27- Oct 23*	1. Working with 100	3	16	**18**
	2. Exploring multiples of 100	5		
	3. How Much is 1000?	5		
	4. Making a 10,000 Chart	4		
Money, Miles & Large Numbers *Oct 26-Nov 28*	1. Everyday Uses of Money	8	16	**18**
	2. How Far? Measuring in Miles and 1/10's	4		
	3. Calculating longer distances	4		
Seeing Solids & Silhouettes *Dec 5-Dec 20*	1. Making and Visualizing Cube Buildings	2	14	**14**
	2. Exploring Geometric Solids	4		
	3. "How to" Instructions for Cube Buildings	3		
	4. The Cube Toy Project-opt.	4		
Different Shapes, Equal Pieces *Jan 2- Jan 25*	1. Parts of Squares: halves, fourths and eights	5	14	**16**
	2. Parts of Rectangles: thirds, sixths, & twelfths	4		
	3. Ordering Fractions	5		
Three Out of Four Like Spaghetti *Jan 29- Feb 13*	1. Using Fractions to describe data	4	11	**11**
	2. Looking at Data in categories	7		
Sunken Ships *Feb 15-March 4*	1. Locating Houses & Ships on a Grid	6	15	**10**
	2. Rectangles, Turns and Coordinates	9(4)		
The Shape of the Data *March 5-March 21*	1. Introduction to Data analysis	3	15	**12**
	2. Landmarks in the data	7		
	3. A Data Project: Investigating Sleep	5		
Packages & Groups *April 21- May-30*	1. Multiplication Tables	5	18	**25**
	2. Double-digit multiplication	3		
	3. Multiplication & Division Clusters	10		

APPENDIX E

Sample Lesson Planning Guide with Aligned GLEs for Grade 4

Sample Lesson Planning Guide with Aligned GLEs for Grade 4

Arrays and Shares (Multiplication and Division)

- Use grouping strategies for multiplication
- Use area model (arrays) for multiplication
- Explore multiplication patterns and relationships
- Divide quantities into equal shares
- Partition quantities into equal shares
- Identify and create multiplication and division situations

GLE Unit Focus

- describe geometric and numeric patterns **(A1A4)**
- analyze patterns using words, tables, and graphs **(A1B4)**
- represent a mathematical situation as an expression or number sentence **(A2A4)**
- apply the commutative property of multiplication to whole numbers **(A2B4)**
- identify and justify the unit of linear measure including perimeter (customary and metric) **(M1A4)**
- represent and recognize multiplication using various models including sets and arrays **(N2A4)**
- apply commutative and identity properties of multiplication to whole numbers **(N2C4)**
- apply and describe the strategy used to compute a given multiplication problem up to a 2-digit by 2-digit; division problem up to a 3-digit by 1-digit **(N3C4)**

Ten-Minute Math GLE Focus

- **Counting Around the Class** p. 61-62
  - apply commutative and identity properties of multiplication to whole numbers **(N2C4)**
  - demonstrate fluency with basic number relationships (12x12) of multiplication and division **(N3B4)**
  - estimate and justify the results of multiplication of whole numbers **(N3D4)**
  - describe geometric and numeric patterns **(A1A4)**
- **Multiple BINGO** p. 62-63
  - demonstrate fluency with basic number relationships (12x12) of multiplication and division **(N3B4)**
  - describe the effects of multiplying and dividing whole numbers as well as the relationship between the two operations **(N2B5)**

APPENDIX F

Samples of the Madeline Hunter Lesson Plan

Madeline Hunter Lesson Plan Model – EXAMPLE 1
From: http://template.aea267.iowapages.org/lessonplan/

Class: ***Unit:*** ***Teacher:***

Objectives
Before the lesson is prepared, the teacher should have a clear idea of what the teaching objectives are. What, specifically, should the student be able to do, understand, care about as a result of the teaching. informal. Bloom's Taxonomy of Educational Objectives which is shown below, gives an idea of the terms used in an instructional objective. See Robert Mager [library catalog] on behavioral objectives if writing specificity is required.

Standards
The teacher needs to know what standards of performance are to be expected and when pupils will be held accountable for what is expected. The pupils should be informed about the standards of performance. Standards: an explanation of the type of lesson to be presented, procedures to be followed, and behavioral expectations related to it, what the students are expected to do, what knowledge or skills are to be demonstrated and in what manner.

Anticipatory Set
Anticipatory set or Set Induction: sometimes called a "hook" to grab the student's attention: actions and statements by the teacher to relate the experiences of the students to the objectives of the lesson. To put students into a receptive frame of mind.

- to focus student attention on the lesson.
- to create an organizing framework for the ideas, principles, or information that is to follow (c.f., the teaching strategy called "advance organizers").
- to extend the understanding and the application of abstract ideas through the use of example or analogy...used any time a different activity or new concept is to be introduced.

Teaching: Input
The teacher provides the information needed for students to gain the knowledge or skill through lecture, film, tape, video, pictures, etc.

Teaching: Modeling
Once the material has been presented, the teacher uses it to show students examples of what is expected as an end product of their work. The critical aspects are explained through labeling, categorizing, comparing, etc. Students are taken to the application level (problem-solving, comparison, summarizing, etc.).

Teaching: Checking for Understanding
Determination of whether students have "got it" before proceeding. It is essential that students practice doing it right so the teacher must know that students understand before proceeding to practice. If there is any doubt that the class has not understood, the concept/skill should be retaught before practice begins.

Questioning strategies: asking questions that go beyond mere recall to probe for the higher levels of understanding...to ensure memory network binding and transfer. Bloom's Taxonomy of Educational Objectives provides a structure for questioning that is hierarchical and cumulative. It provides guidance to the teacher in structuring questions at the level of proximal development, i.e., a level at which the pupil is prepared to cope. Questions progress from the lowest to the highest of the six levels of the cognitive domain of the Taxonomy of Educational Objectives: knowledge, comprehension, application, analysis, synthesis, and evaluation.

Guided Practice
An opportunity for each student to demonstrate grasp of new learning by working through an activity or exercise under the teacher's direct supervision. The teacher moves around the room to determine the level of mastery and to provide individual remediation as needed.

Closure
Those actions or statements by a teacher that are designed to bring a lessor presentation to an appropriate conclusion. Used to help students bring things together in their own minds, to make sense out of what has just been taught. "Any questions? No. OK, let's move on" is not closure. Closure is used:

- to cue students to the fact that they have arrived at an important point in the lesson or the end of a lesson,
- to help organize student learning,
- to help form a coherent picture, to consolidate, eliminate confusion and frustration, etc.,
- to reinforce the major points to be learned...to help establish the network of thought relationships that provide a number of possibilities for cues for retrieval. Closure is the act of reviewing and clarifying the key points of a lesson, tying them together into a coherent whole, and ensuring their utility in application by securing them in the student's conceptual network.

Independent Practice
Once pupils have mastered the content or skill, it is time to provide for reinforcement practice. It is provided on a repeating schedule so that the learning is not forgotten. It may be home work or group or individual work in class. It can be utilized as an element in a subsequent project. It should provide for decontextualization: enough different contexts so that the skill/concept may be applied to any relevant situation...not only the context in which it was originally learned. The failure to do this is responsible for most student failure to be able to apply something learned.

Materials
List materials needed.

Duration
Type the amount of time needed to complete this lesson.

Madeline Hunter Lesson Plan Model – EXAMPLE 2
From: http://www.windows.ucar.edu/teacher_resources/sci_schools/HunterLessonP.pdf

"The Madeline Hunter Model"

Lesson Date and Time:	**No. of Students:**
Room Number:	**Miscellaneous Information:**
Teacher's name:	

What is the lesson objective?
(What will the students learn and/or demonstrate?)

Standards addressed and expectations of students:

Anticipatory Set:
("The Hook" -- something to excite the student about the subject matter)

Teaching/Instructional Process:
(Input, modeling, and checking for understanding)

Guided practice and monitoring:
(Monitor orally individually or together; monitor via written language or via a task performance; monitor via group sampling or visual answers, e.g., "thumbs" -- you monitor to know if students are learning and lesson objectives are being met)

Closure:
(Statements or actions by you that help students make sense out of what has just been taught, to help form a coherent picture, to eliminate confusion and frustration, and to reinforce major points to be learned)

Independent Practice:
(This can be a question or problem for students to ponder on their own or in small groups or pairs. The aim is to reinforce and extend the learning beyond the lesson and ideally into real world settings.)

VITA

Troy Patrick Regis was born on September 18, 1972 in Battle Creek, Michigan, the son of John and Jacklyn Regis of Hickory Corners, Michigan. He attended the Gull Lake Public Schools in Richland, Michigan, graduating in the top 10% of his 1990 class, and playing the role of the Blue Devil Mascot for the school. Troy has earned the following degrees: Bachelor of Arts (B.A.) in Elementary Education, with minors in Middle Grades Mathematics, Science, and Physical Education, from Western Michigan University (1995); Masters of Education (M.Ed.) in Mathematics Education from Arizona State University (2001); and Doctor of Philosophy (Ph.D.) in Mathematics Education from the University of Missouri (2008). He also taught Grade 4 at the former Lincoln Elementary in the Battle Creek Public Schools (Michigan), as well as Grades 6 and 8 at Madison Park Elementary in the Madison School District (Phoenix). Troy is currently the Teacher Education and Research Developer for the Math Forum at Drexel University, located in Philadelphia, Pennsylvania.