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Differences between teachers who use a mathematics textbook more than fifty percent of the time and teachers who use a mathematics textbook less than fifty percent of the time

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San Jose State University, 1994

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DIFFERENCES BETWEEN TEACHERS WHO USE A MATHEMATICS
TEXTBOOK MORE THAN FIFTY PERCENT OF THE TIME AND TEACHERS
WHO USE A MATHEMATICS TEXTBOOK LESS THAN FIFTY PERCENT OF
THE TIME

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Master of Arts

by

Linda Jeanne Earnest Rackley

August, 1994

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ABSTRACT

DIFFERENCES BETWEEN TEACHERS WHO USE A MATHEMATICS TEXTBOOK MORE THAN FIFTY PERCENT OF THE TIME AND TEACHERS WHO USE A MATHEMATICS TEXTBOOK LESS THAN FIFTY PERCENT OF THE TIME

by Linda J. Rackley

Traditional methods of teaching mathematics in the United States are being widely questioned and serious attempts at reform are occurring in the areas of curriculum, assessment and pedagogy. Both state and national reform documents encourage the implementation of mathematics education programs that are significantly different from those found in most current textbooks. The study reported here was undertaken to explore factors associated with teachers' backgrounds and attitudes about mathematics that might be related to their choices concerning the use of mathematics textbooks.

Using an extensive structured interview, teachers were placed in one of two groups: those who rely on the mathematics textbook more, and those who rely on the textbook less, than fifty percent of the time. Analyses of the data highlight differences in beliefs, attitudes, and professional development between the two groups. This information may be useful in furthering current knowledge about influences on teachers' classroom behaviors.

TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
I. INTRODUCTION.....	1
II. REVIEW OF THE LITERATURE.....	6
The Problem.....	6
New Ideas of Mathematical Competence and Their Influence on Curriculum.....	6
Constructivism and Its Implications for Teaching Behaviors.....	8
Teacher Beliefs and Teaching Behaviors.....	12
Changing Teaching Behaviors and Practices.....	15
Student Influences on Teaching Behaviors.....	18
Other Influences on Teacher Behaviors.....	20
Conclusion.....	24
III. METHODOLOGY.....	27
Subjects.....	27
Instruments.....	29
Procedures.....	31
Analysis.....	32
Limitations.....	32
IV. RESULTS	34
Introduction.....	34
Demographic Information.....	35
Professional Development.....	38

Attitudes about Mathematics.....	40
Professional Activity.....	42
Involvement in Reform.....	45
Teaching Behaviors.....	45
Summary	57
V. SUMMARY	59
REFERENCES.....	65
APPENDICES.....	70
Appendix A. Teacher Survey.....	71
Appendix B. Raw Data By Question.....	76

LIST OF TABLES

TABLE		PAGE
1.	Number and Percentage of Teachers in Each Experimental Group Who Teach Grades 1-4 and Grades 5-8.....	36
2.	Number and Percentage of Teachers in Each Experimental Group with Various Years of Teaching Experience.....	37
3.	Means and Standard Deviations for Attitude Towards Mathematics Scores Across the Life Span of Teachers in Each Experimental Group.....	41
4.	Total Number of Professional Organizations and Professional Magazine Subscriptions Reported in Each Experimental Group.....	44
5.	Total and Median Number of Hours Per Year Teachers in Each Experimental Group Reported Spending on Activities Sponsored by Professional Organizations and Reading Professional Journals.....	44
6.	Number of Teachers in Each Experimental Group Reporting Various Textbook Characteristics Strengths.....	47

7.	Number of Teachers in Each Experimental Group Reporting Various Textbook Characteristics as Weaknesses.....	48
8.	Means and Standard Deviations for Responses to Questions Regarding Collegial Communication about Mathematics.....	50
9.	Means and Standard Deviations for Importance Ratings of Various Classroom Activities for Each Experimental Group.....	53
10.	Means and Standard Deviations for Percentage of Class Time Devoted to Various Activities by Each Experimental Group.....	54
11.	Means and Standard Deviations for the Ideal Amount of Time Students Should Spend under Various Conditions as Recommended by Teachers in Each Experimental Group.....	56

CHAPTER I

Introduction

Continuing changes in mathematics as a field, and in the technology available for mathematics have precipitated the need for a change in our current notions about the meaning of mathematical competence. In addition to computational skill, competence now involves reasoning, logical thinking, problem solving and the ability to communicate mathematical understandings (National Research Council, 1989). These changes have encouraged some mathematics teachers to move away from standard textbook methods of teaching mathematics that focus primarily on computational drill and practice, and move toward methods that place greater emphasis on understanding of mathematical concepts and on the ability to solve problems. Little information is currently available about the backgrounds, beliefs and attitudes of teachers who are engaged in this type of teaching. Not enough is known about the differences between teachers who depend primarily on textbooks and those teachers who use a variety of sources to support their mathematics curriculum. How such differences might affect the teaching of mathematics is an important subject for further study.

When mathematics achievement scores of students in the

United States are compared to those of students in other industrialized countries of the world, the American students lag far behind (Gill & Billups, 1992; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987; and Prawat, 1992b). Because of these and other recent research results, new guidelines for mathematics curricula and for teaching mathematics have been suggested by the National Council of Teachers of Mathematics (representing almost 100,000 members), the National Research Council and the California Department of Education, to name but a few. Most teachers, however, continue to use standard textbooks which focus on computation despite the new suggestions. Some teachers, perhaps because of different beliefs about or experiences with mathematics, are moving more in the direction of the recommendations and are, therefore, moving away from standard mathematics textbooks.

In 1989, realizing the importance of modernizing the curriculum, the National Council of Teachers of Mathematics (hereafter referred to as NCTM) took a first step by publishing the Curriculum and Evaluation Standards for School Mathematics (hereafter referred to as the NCTM Standards). This document was designed to establish a broad framework to be used as a reference for reform and as a guide for measuring success in mathematics. While the changes proposed in the document have not yet been

thoroughly tested in practice, mathematics educators throughout the country generally agree they are a step in a promising direction.

Some of the major changes recommended in the NCTM Standards involve the expansion of mathematical content and activities to include things not commonly emphasized in drill and practice oriented mathematics programs. These include increased emphasis on: problem solving which encourages development of strategies to solve mathematical problems, and verification and interpretation of the results; communication between students as well as among students and the teacher; reasoning so students can make logical conclusions, use patterns and relationships, and believe that mathematics makes sense; and connections among various mathematical ideas as well as with the daily lives of children (NCTM Standards, 1989).

In 1991, NCTM followed up the NCTM Standards with the Professional Standards for Teaching Mathematics. This document recommends that teachers become better skilled in selecting mathematical tasks that match students' interests and provide conceptual understanding. Additional suggestions for teachers include helping students become proficient with technology and other tools necessary for mathematical investigations, helping students seek connections with previous work, and encouraging small group

and whole class work as well as individual work. Emphasis on the mechanics of memorizing procedures and finding the one correct answer is decreased. It is hoped that students will be able to verify their own work and decrease their dependency on the teacher as the source of right answers (NCTM, 1991).

NCTM is currently in the process of publishing the final volume in its standards series: Assessment Standards for School Mathematics (NCTM, 1993). This document presents standards to be used for assessing mathematics achievement. The assessment standards include sections on enhanced learning, equity, openness, valid inferences and consistency (NCTM, 1993). Again, this represents a great change from mathematics assessments that focus on one correct numerical answer to each computational problem. Together, these three documents form a blueprint for proposed reforms in the mathematics education of U.S. students. Certainly not all recommendations in the NCTM documents are universally accepted. Professional discussions concerning various details will go on in the literature for many years to come. The documents do, however, outline a new direction on which there is considerable agreement.

What factors do influence the way teachers teach? Research on teachers' beliefs and their teaching methods has produced contradictory results. Thompson (1984), for

example, concluded that teachers' beliefs about mathematics would be evident in their style of teaching. Therefore, a teacher who professes belief in the guidelines set by the NCTM Standards would teach accordingly. Prawat (1992a), however, found that the beliefs a teacher holds are not necessarily reflected in teaching methods. The familiar methods of teaching, even if they do not produce the desired results, may seem safer than stepping out of a long held practice and trying something new. Teachers who rely predominately on mathematics textbooks to shape their mathematics program may have different views and beliefs than those teachers who choose to make up their own curriculum and to use materials other than textbooks.

Research on factors that influence teaching methods and teachers' beliefs suggests that a reasonable next step might be to compare selected characteristics of teachers who currently use the textbook more than fifty percent of the time with those teachers who depend on standard textbooks less than fifty percent of the time. Such comparisons may prove useful in adding to our understanding of the relations between teachers' backgrounds and beliefs and the classroom methods they choose when teaching mathematics.

CHAPTER TWO

Review of the Literature

The Problem

In the current environment of reform in mathematics education, some teachers have moved away from the drill and practice method of teaching to programs that focus on problem solving, reasoning and logical thinking. These teachers are in various stages of employing the teaching methods recommended in the reform documents. Other teachers persist in the textbook-guided method of teaching. Little information is known about the differences between these two groups of teachers and the effect these differences may have on their teaching of mathematics. Better understanding of the backgrounds and beliefs of these two groups of teachers might lead to a greater understanding of teaching behaviors and the factors that influence how teachers teach mathematics. In an effort to determine possible areas of differences, research articles concerning mathematics reform, teachers' backgrounds, and teachers beliefs about teaching and how students learn were reviewed.

New Ideas of Mathematical Competence and Their Influence on Curriculum

In this rapidly changing society, the mathematical skills a person needs for survival are changing and will

continue to change (NCTM, 1989). Advancements in computers, microcomputers and hand-held calculators are just some of the changes responsible for this shift. Paper and pencil computation skills now command only a small proportion of the time devoted to mathematics. Davis and Hersh (1981) claim that half of all mathematics has been invented since World War II. Phillips and Soltis (1985, p. 59) describe math as, "a body of knowledge that is in constant flux, growing and changing." There is much more to mathematics than computation.

Problem solving, according to the NCTM Standards, should play a large role in the mathematics program and generally receives little attention in current mathematics textbooks. Problem solving requires the student to use, among other things, logic, critical thinking and computation. There is frequently more than one answer and the student must justify his or her particular answer with mathematical reasoning. When a problem is taken from a "real world" situation, there are many factors to be considered. Depending on the choices one makes, for example, to buy the best quality and expect the product to last nine years, or to buy the least expensive and replace again in two years, the answer may vary. The content of the problem, if taken from a situation the child has had experience with or can relate to, is more likely to give

meaning to the task, helping to convince students that mathematics is meaningful and does have application to their lives.

Constructivism and Its Implications for Teaching Behaviors

One of the goals of the NCTM Standards is to make mathematics meaningful and applicable to today's world. Research, however, shows that schools are still teaching skills in isolation. Cobb (1988) found that students would routinely use the algorithm they had been taught and get "the" answer. When these same students were interviewed, they frequently had little or no understanding of the concept. Cobb cited as an example a first grade child who did mathematics in two different contexts. Using the prescribed algorithm on a worksheet, "Auburn" added $16 + 9$ and got 15, but when she used her fingers to solve a "word problem" using the same numbers, she got 25. When questioned about this discrepancy and asked which answer was correct, she had no response. According to her, the way she did it on the worksheet was the way she was supposed to do it. Cobb concluded

...the arithmetic she was currently studying in school had nothing to do with the world of physical objects and real-life problems or her self-generated methods. For her, school arithmetic seemed to be an isolated, self-contained context in which the possibility of

doing anything other than attempting to recall prescribed methods did not arise (p. 98).

Piaget (1968) might have further explained her lack of consistency by pointing out that her actions were consistent with the behavior of a pre-operational child. For a task to have meaning for a student, the student should be able to relate it and knowledge, usually about the physical world, that she or he already possesses (Fennema, Carpenter, and Lamon, 1991; Hiebert, 1984).

In addition to seeing that mathematics is useful to their daily lives, students should understand how different mathematical topics relate, how mathematics relates to other curriculum areas and why an algorithm works after experimenting with manipulatives. Mathematics should include observation of patterns, testing conjectures, seeing relationships among concepts, problem solving, estimating and verifying results (Carpenter & Fennema, 1991; Gill & Billups, 1992; NCTM Standards, 1989).

In an attempt to teach for understanding, not merely correct performances, an approach to teaching and learning different from the paper and pencil method is suggested by some. The authors of the NCTM Standards (1989), Everybody Counts (1989), the California Framework (1992), and researchers such as Carpenter and Fennema (1991), Fennema,

Carpenter, Peterson, Carey (1988), Lampert (1991), Cobb (1988), and Prawat (1992b), suggest that individuals learn best when they construct their own understanding. To promote this construction of knowledge, the teacher's role must change from one who doles out information for students to memorize and repeat back to one whose primary responsibility is to provide opportunities that provoke questions and cause disequilibrium (Prawat, 1992b).

Cobb (1988) presents the case that teachers who are constructivists are better able to teach mathematics since their concern is with students developing their own understanding, not their ability to use algorithms, such as those presented in the textbooks that often lack meaning. Cobb contends that the teacher remains a critical influence although the role has changed from the one who contains all wisdom to the one who presents challenging situations and questions. The teachers' job, according to a constructivist point of view, is to look for clues that students have built understandings of concepts, unconcerned that their algorithms may vary from the conventional method. Diversity of thinking and methods is not only accepted but also encouraged.

Prawat (1992b), another supporter of the constructivist approach, agrees with Cobb (1988) that teachers ought to change from being "transmitters" of knowledge and that the

traditional "telling - listening" relationship be replaced (p. 357). Prawat proposes that teachers begin to interact with students, an approach which is much different from the way most teachers learned mathematics when they were in school, in which the teacher talked and demonstrated an algorithm and the students listened and then duplicated the task. During the interaction recommended by constructivists, teachers encourage discussion of tasks so that students develop a mathematical vocabulary and thinking skills along with their ability to calculate.

Prawat continues by suggesting that students should be given mathematical problems that relate to a child's experiences and then be given the time and tools necessary to make sense out of the answer. Based on the student's explanation, more than one answer is acceptable. For example, a problem may require that students determine how many one by six pieces of lumber are required to fence in an eight by ten foot pen. Students who build a pen for a small animal may need to place the boards closer together than the student who anticipates enclosing a large animal. Even incorrect answers are teaching opportunities. Prawat and other constructivists believe that there is benefit in allowing a student to propose ideas that are incorrect because the discussion of the class and the resulting thinking will encourage the students to construct new

understandings.

Teacher Beliefs and Teaching Behaviors

If teachers believe that talking and writing about mathematics, integrating mathematics, and problem solving are important, will this be reflected in their teaching? Thompson (1984) studied whether teachers' beliefs and ideas about mathematics influence their teaching styles. She began her case studies by selecting three of 13 teachers who had participated in a pilot study with her the year before. She states that the criterion used for selecting the teachers was their willingness and interest to participate and that they had each been teaching mathematics at their current level for a minimum of three years. Two of the teachers who volunteered were heads of the department in their respective schools and the third was in charge of the mathematics program for "gifted" students.

Thompson observed each teacher daily for a total of four weeks. During the first two weeks, the researcher observed and made conjectures about the teachers' beliefs based on her observations. Interviews about the lessons taught were conducted at the end of each day during the last two weeks. Recordings of the lessons were available for teachers during the interviews to help recall specific events. During the four weeks, teachers were also asked to

respond in writing to several questions which included topics such as their goals in mathematics instruction and reasons why some students do poorly in mathematics. They were also asked to critique their own effectiveness.

"Jeanne," the first teacher observed, saw mathematics as a consistent, organized and logical subject and described it as being like a game in which one must understand the symbols, follow the rules, and practice. She did not relate topics to real life situations. As a teacher, she felt her role was to present the lesson in a clear manner. Jeanne believed that her students learned best by listening carefully, responding to her questions, and then practicing the procedure. Her teaching methods mirrored her beliefs. Jeanne described her own background in mathematics as weak.

"Kay," the second teacher observed, was confident about her knowledge of mathematics and believed this confidence came from her own positive experiences in mathematics classes. Thompson described Kay as enthusiastic and excited about mathematics and as one who viewed mathematics as useful, meaningful, and necessary. She felt students learned best by being actively involved and that she, as the teacher, was to play a supporting role rather than a leading role. Problem solving tasks, which related to real life situations, were often the tasks of the day with students encouraged to explore, question, and rediscover mathematical

ideas. Kay stressed that part of the mathematical process was having students be able to verify their solution to others. Kay regularly reflected on her teaching methods and the remarks made by students in class believing that this made her a better teacher.

"Lynn," the last teacher observed, viewed mathematics as a static collection of facts, methods and rules. She described herself as being similar to a tape recorder when the "play" button is pushed. Lynn's class followed a daily routine with a lecture first and the remaining time spent practicing the procedure. Lynn believed her responsibility as the teacher was to transfer information. Her goal was for students to be able to perform mathematical tasks using standard methods.

Thompson sought to identify key factors that may play a role in teachers' effectiveness. She discussed the similarities and differences among the teachers and their teaching styles. She concluded, "teachers' beliefs, views, and preferences about mathematics and its teaching, regardless of whether they are consciously or unconsciously held, play a significant, albeit subtle, role in shaping the teachers' characteristic patterns of instructional behaviors," (pps.124-125). The teachers' stated beliefs about mathematics were evident in their teaching styles. Two of the teachers viewed mathematics as an unchanging body

of knowledge and this was reflected in their lessons that focused on algorithms, drill and practice and following rules. Only one teacher, Kay, saw mathematics as undergoing changes and related it to daily life. Lessons generally revolved around problem solving. Thompson also concluded that Kay's habit of regularly reviewing and evaluating the lesson and the responses of the students provided important feedback which helped to shape her teaching method.

Changing Teaching Behaviors and Practices

Thompson concluded that beliefs do influence the way teachers teach. If the beliefs of teachers change, will teaching methods also change to reflect the new ideas? Prawat (1992a), like Thompson, investigated the influence beliefs have on teaching methods. Believing in the need for the changes recommended in the NCTM Standards (1989) and the California Framework (1992), he questioned how teaching methods might be changed. While he accepted the idea that beliefs influence teaching styles, he suspected that teaching practices would not necessarily change as a result of changing beliefs.

Prawat's (1992a) case study focuses on "Karen," a fourth/fifth grade teacher with 18 years of teaching experience. Karen taught in a school in the largest district in the state of California which did well on

standardized tests. Students came from upper-middle class families with about 20% of the students minority in ethnicity. The principal, a supporter of the California Framework (California State Department of Education, 1985), felt that the standardized test scores for mathematics needed to be improved. To accomplish this a new textbook was selected and teachers attended mathematics in-services and workshops.

Prawat (1992a) interviewed Karen in December and observed her teach two times during that same month. He returned in March to duplicate the December process. In the three or so months between the two interviews, Karen's views on some subjects changed considerably. She began to value some of the ideas of which she had once been critical, such as manipulatives and estimation. By March, Karen's beliefs had undergone a substantial change as measured by interviews. Prawat observed outward changes in the appearance of her class and teaching; however, these changes were only cosmetic. Students were now in groups, but Prawat observed that the groups had little time to function as a group or to talk together. Karen still used the direct teaching method and controlled the learning by remaining the center of attention rather than allowing the children time to discover and build their own understandings of a concept.

Prawat credits Karen for thinking through and changing

some of her beliefs and at times learning along with her students. He does not see enough change by observing her teaching practices to say that changing beliefs will cause a change in teaching style. Had Prawat observed Karen later in the year he might have seen changes evolving. More visits would have increased the chances of seeing a new method of teaching if it was happening. It may be argued that more than three months is required to put one's changes of beliefs into action.

Leinwand (1992) argues that time is a significant factor in the process of change. "The substantive, lasting constructive change advocated by the Standards (1989) occurs best when teachers are given adequate time and support to assume ownership of the proposed changes" (1992 p. 468). Time, and the desire of the individual teacher to change, appear to be required for change to occur. Research shows (Berman & McLaughlin, 1977; Brophy & Good, 1986; Lieberman & Miller, 1988) that if teachers are already concerned about the issue, and help to identify the problem and develop the solutions, it is more likely that the teachers will change their practices. It appears that "Karen" did not personally see the need for changing her mathematics program, but that the requirement to change was forced upon her.

To instill lasting and meaningful change in teachers' beliefs and behaviors, the NCTM Standards (1989) advises

against the "top-down" management style that businesses use in advocating change, and suggests professional development for teachers. Changes that are mandated from administrators, school boards and others up the chain of command, are frequently met with resistance and "suspicion" and produce little more than cosmetic change, if that. Radical change develops over a period of time and not by attending workshops or being handed a "how to" manual (Gill & Billups, 1992, p. 6). According to Gill and Billups (1992) it is not surprising that there was little evidence of change in Karen. "Top down management" and "a couple of workshops" apparently do not cause change. This raises the question of what factors shape teachers' beliefs and behaviors.

Student Influences on Teaching Behaviors

It may be useful to consider other factors that influence the way teachers teach. The literature review, done by Sullivan and Leder (1992) prior to their research, led them to hypothesize that there are three significant factors that influence the way that teachers teach. They conjectured

...experiences prior to teaching influence teachers' classroom practices. Once on the school site, there is covert pressure from the school community for beginning teachers to conform to existing school

norms. And finally, it also appears that students' actions and responses in the classroom are important determinants of the way teachers teach (p. 625).

Sullivan and Leder surveyed 120 student teachers. Fifty-five members of the original group were interviewed again at the end of the first year of teaching. Seven of these 55 were observed and interviewed and case studies were finally done on two of the seven. Data for the case studies were collected by surveys and three classroom observations. Additional information was obtained for the study from interviews during their last year of teacher education and their first year of teaching.

Sullivan and Leder found that student behavior during the lesson was the factor most teachers mentioned as central to their decisions about teaching. When the lesson was teacher directed, routine, with specific instructions given, the class was likely to be well-behaved. A quiet, controlled class was deemed by these teachers and their peers to be reflective of good teaching. Open-ended or problem solving lessons were avoided as they generally created a noisier class, and teachers felt less in control. Doyle (1986) confirms the idea that students are more apt to work quietly on tasks that require the use of algorithms than during higher level thinking task, such as problem solving. Doyle concluded that when students were engaged in

problem solving and other higher level activities, they have difficulty anticipating the response desired by the teacher and their anxiety level is raised. Lampert (1988) suggests another possible reason for seemingly unruly students during non-traditional mathematical tasks. Problem solving and open ended questions do not meet the students' expectations of what a mathematics lesson should be and they therefore do not take the lesson seriously unless it relates to the textbook.

Sullivan and Leder concluded that teachers need to be aware that behaviors of students are important but suggest that this not be allowed to be a controlling influence. They also suggest that teachers reflect on and evaluate the students' responses to the lessons. Teachers and students could be helped to recognize that an expanded mathematics program including such activities as problem solving are beneficial to learning.

Other Influences on Teacher Behaviors

A teacher who is displeased with a program is likely to consider making a change, perhaps a change in teaching methods. Posner, Striken, Hewson & Gertzog (1992) sought to investigate the causes of change of teaching methods. They found that before individuals are willing to change they must be dissatisfied with their existing actions in some

way. The alternative must connect with their existing knowledge and then extend the earlier conceptions. Some teachers become dissatisfied and realize a change is necessary when they understand that a student may be using an algorithm and producing correct answers but not necessarily have any deeper understanding; that correct performance is not equal to true understanding (Brophy, 1986; Cobb, 1988; Cobb, Yackel, & Wood, 1991; Lampert, 1991).

Lampert (1988) was also interested in what causes teachers to teach the way they do and how to improve teaching methods. She proposes that better teacher education may produce a teacher who is more skilled at guiding students along their journey to mathematical competency. The question then arises as to what kind of teacher education is specifically needed. Lampert (1988) begins with the statement "Students in the United States are not learning what we want them to learn in mathematics" (p. 157), and proceeds to suggest ideas for the improvement of teacher education as a possible solution.

Lampert examined the research on student teaching which shows that while instructional strategies are learned in education classes, they are not evident in the classroom. The time the teachers spent in elementary school, high school and college, as students, may have as much affect on

teaching strategies as pre-service classes. She concludes her section on pre-service education with, "we have learned from research that learning how to teach does not begin and end with the upper division pre-professional courses, taught by colleges of education" (p. 161). The skills Lampert believes necessary for good teaching include:

- * figuring out how a student thinks
- * listening to students
- * managing complex social interactions
- * providing intellectually challenging work
- * presenting ideas in a variety of different ways
- * assessing student learning

This list identifies abilities which are very different from those required for lectures and paper and pencil drills. While Lampert is able to provide a list of what a teacher should be able to do, she searches for the way that a teacher is to acquire these talents. The number of mathematics classes and the grades the teacher received in these classes, the score on the Graduate Record Exam are considered as possible solutions. Later, she indicates that researchers have found little correlation between subject matter knowledge and teacher quality but goes on to say that the teachers with the most subject matter knowledge were the best conceptual teachers and the teachers with the least

subject matter knowledge were the worst conceptual teachers. It appears that subject matter knowledge does play a role to some extent.

Still in search for the key to good teaching, Lampert considers the idea that giving teachers better curricula will improve their teaching methods. Evidence showed that teachers who were not specifically instructed to use the material, no matter how well the directions were written, did not get the same results as those teachers who received instruction for the materials. It is valuable for teachers to become students and to spend time going through the material with an instructor. Spending time in such a situation gives the teacher a chance to experience the new style of mathematics teaching and adjust to the fact that mathematics is no longer limited to calculation. Lampert found problem solving and open-ended tasks were particularly difficult for some teachers because they did not meet the preconceived notion of what mathematics was supposed to be. The uninitiated teachers felt that during problem solving lessons the class was less orderly and the end results were not as easily measured as the results of typical paper and pencil, one correct answer assignments.

Lampert concludes that teachers can attain a better understanding of mathematical concepts and this is beneficial but exactly how this conceptual understanding is

obtained is uncertain. Teachers' own experiences as students themselves and their understanding of the subject are factors that influence their teaching. She does not believe that teacher education alone is the answer.

Conclusion

Little is known about why teachers teach the way they do. Understanding the differences in backgrounds and beliefs of two groups of teachers, those who rely on a mathematics textbook more than fifty percent of the time and those who do not, may hold clues that will help educators better to understand teaching behaviors.

In an effort to explore variables that affect the way teachers teach, Sullivan and Leder (1992) found that teachers' experiences as students, the beliefs and practices of other teachers at their school sites, and the behavior of their students during math lessons influenced their teaching the most. Thompson (1984) also studied the antecedents of teacher behaviors in the classroom. She concluded that teachers' beliefs and views about mathematics and their beliefs about how students learn are major influences on the way they teach. Prawat's (1992a) work however, suggests just the opposite. Using a case study method, he describes a teacher who experienced a change in many of her beliefs about teaching mathematics but these beliefs were not

reflected in her teaching methods.

Many researchers (Carpenter & Fennema, 1991; Cobb, 1988; Fennema, Carpenter, Lamon, 1991; Lampert, 1991; Piaget, 1968; and Prawat, 1992b) advocate what has come to be called constructivist approaches to teaching. It is their belief that students learn best when they are actively involved in the task and are making connections with preexisting knowledge. This approach represents a major change for many teachers who have seen their role shift from that of "one who doles out knowledge" (Prawat, 1992a, p. 208) to that of one who orchestrates experiences from which children can create their own knowledge and understanding. Research (Cobb, 1988) provides evidence that students can compute but often do not understand what they are doing. Constructivists contend that if students build their own understanding such instances would be less likely to occur.

While much has been said about the influence teachers' beliefs have on their teaching methods, more research is needed to identify and examine which beliefs are associated with particular styles of teaching and how differences in beliefs might influence differences in teaching. The attitudes, backgrounds, and beliefs of teachers who use a mathematics textbook less than fifty percent of the time need to be compared to the attitudes, backgrounds, and beliefs of the teachers who use a textbook more than fifty

percent of the time in order to provide more knowledge about potential antecedents to particular teaching behaviors. The current study, therefore, was designed to compare teachers who use mathematics textbooks more than fifty percent of the time to those who use them less than fifty percent of the time on a variety of characteristics identified in the literature as potentially important.

CHAPTER THREE

Methodology

Research on the ways children learn mathematics, factors that influence how teachers teach mathematics, and factors that may influence change in the teaching of mathematics were considered in designing a study to investigate differences between teachers who use a standard mathematics textbook more than fifty percent of the time and teachers who use a mathematics textbook less than fifty percent of the time. Differences between teachers who use a mathematics textbook more than fifty percent of the time and those who use a textbook less than fifty percent of the time may help to explain why teachers teach the way they do.

Subjects

To recruit a sample that included both teachers who use a mathematics textbook more than fifty percent of the time and teachers who use their textbooks less than fifty percent of the time, the research was described to approximately 35 elementary teachers at a meeting of the Santa Clara Valley Mathematics Project (SCVMP). Becker (1994), the project's director, described the project as follows:

The Santa Clara Valley Mathematics Project is the newest site of the state-wide California Mathematics Project. The

main purpose of this California Mathematics Project site is to develop teacher leaders who can provide leadership in their schools and districts to accomplish reform in mathematics education. The Santa Clara Valley site includes teachers K-14, and specifically works to "increase teachers' content and pedagogical knowledge in mathematics; investigate alternate methods of assessment; develop strategies for increasing the achievement and participation in mathematics of students of color; and develop leadership skills.

In its first year, 1993-1994, the SCVMP included an 11 day summer institute and six days of academic year follow-ups for 40 teachers. The project proposes to include an Advanced Leadership Group of year two people as well as new participants in successive years. This model will allow us to provide for further leadership development. Also, more efforts will be made to attract teachers of color.

Several of the SCVMP teachers volunteered to participate in the study, and six were actually chosen to be interviewed. Of the six, four were teachers who use a mathematics textbook less than fifty percent of the time and two reported using a mathematics text more than fifty percent of the time. Additional participants in the study were nominated by the original six teachers, as well as by three local principals contacted by the author.

For the purpose of this study, the two experimental groups were determined on the basis of the respondents' answers to a question on the survey which asked approximately what percentage of their mathematics program

was taught using the district adopted textbook and/or worksheets that went along with it. Those who reported using the textbook more than fifty percent of the time are referred to as the T>50 Group. Those who reported using the textbook less than fifty percent of the time are referred to as the T<50 Group. The final sample included ten teachers in the T>50 Group and ten teachers in the T<50 Group.

All of the subjects in the T>50 Group were Caucasian. The T<50 Group consisted of nine Caucasians and one Asian teacher. The average ages of the teachers, as well as their average number of years of teaching experience were matched as closely as possible between the two experimental groups. Reflecting the general teacher population in Santa Clara County, teachers interviewed were mostly females and over 35 years of age. All but one of the teachers taught full time and one teacher job-shared, working 50% of the time. All teachers had at least five years teaching experience. The teachers interviewed teach at 15 different public elementary or middle schools in the area.

Instruments

A structured interview form was developed by the researcher especially for this study. It incorporated categories discussed in the literature review, including questions related to demographic information, professional

development, attitudes about mathematics, professional activity, involvement in the mathematics reform movement, and teaching behaviors. Questions in the professional development category included questions such as, "Approximately, how many hours of voluntary staff development/in-services, workshops, seminars, or conferences, in any curriculum area, have you attended in the last year?" and "Have you taken any college credit mathematics classes since receiving your teaching credential?" To obtain information about respondents' attitudes about mathematics, teachers were asked how they felt about mathematics in high school, as an undergraduate student, while in their teaching credential program, and since they have been teaching.

Professional activity questions included, "What professional associations do you belong to and how many hours a year would you say that you are involved in the activities of each one?" and "What professional journals or magazines do you subscribe to and approximately how many hours a month do you spend reading these journals?" Questions designed to gauge the teachers' involvement in the reform movement asked about their familiarity with the National Council of Teachers of Mathematics and the Mathematics Framework for California Public Schools, as well as about their feelings toward the two documents.

Procedures

Since the structured interview form for this study was researcher developed, it was first given to another researcher with expertise in the field of survey design for her review and criticism. After preliminary revisions were made, the survey was pilot tested for feasibility, clarity of questions, and administration time. Three teachers at the researcher's school participated in the pilot test of the survey. Based on that test, further revisions were made and a final version was prepared for use in the fall and winter of 1993-1994.

Initial calls were made to each participating teacher to arrange a convenient time for the actual phone interview. Participants were advised that the interview would take somewhere between 20 and 30 minutes. Some teachers chose to respond to the survey at the time of the initial call while others chose to make an appointment for a future date. Those teachers were called at the prearranged time and all interviews were completed within five days of the initial call.

During administration of the questionnaire, the researcher often provided additional clarifications for respondents. For example, for a question like what mathematics classes were taken in college, the researcher might prompt with possible answers like "College Algebra" or

"Calculus." If a teacher requested restatement of a question or part of a question, that request was always granted. Questions were sometimes rephrased whenever a respondent seemed unsure of what he or she was being asked. At times a respondent would provide more information than the question asked in which case an effort was made to record the entire answer on that subject's survey form.

Analysis

Each of the 29 interview questions was analyzed separately and data were aggregated for each of the two experimental groups. Frequency distributions, cross-tabulations, histograms, means, medians, standard deviation and t-tests were computed where appropriate to analyze differences in the two groups' responses.

Limitations

Several factors limit the generalizability of this study. The small sample size, the lack of geographical diversity, as well as the lack of ethnic diversity make generalizations beyond the actual sample questionable. Teachers were self-selected volunteers and were not directly observed in the classrooms. The author relied on teachers'

self-reporting and was not able to verify the information given. Future research to control for these factors would add more to the available knowledge in this area.

CHAPTER IV

Results

Introduction

The current study was designed to explore differences in the behaviors, beliefs, and attitudes of teachers who use a math textbook more than fifty percent of the time to guide their mathematics instruction and those who use a standard mathematics textbook less than fifty percent of the time. A greater understanding of the differences between these two groups might provide further insights into factors which affect teaching behaviors and could also prove helpful in designing staff development plans for those schools or districts seeking to reduce the emphasis on computational drill and practice and move in the direction of newer national standards advocated by the National Council of Teachers of Mathematics (1989).

Members of the Santa Clara Valley Mathematics Project and other nominated teachers volunteered to participate in this current study. After a researcher-made questionnaire was developed, critiqued, and pilot tested, the twenty teachers were interviewed on the telephone. Based on respondents' answer to a question on the survey, teachers were placed in one of two groups. The T>50 Group reported using a mathematics textbook more than fifty percent of the

time. Teachers in the T<50 Group reported using the textbook less than fifty percent of the time in their mathematics class. After the surveys were completed, the questions were then divided into five categories: demographic information, professional development, attitudes about mathematics, professional activity, involvement in reform, and teaching behaviors.

Demographic Information

The T>50 Group and the T<50 Group were very similar demographically. Both were comprised of two men and eight women. The two groups were also similar in age. The average age of the T>50 Group was 43 years and the average age of the T<50 Group was 44.5 years. All ten members of the T>50 Group were Caucasian. Nine members of the T<50 Group were Caucasian and one was Asian. Grade levels taught and the length of time that each teacher had been teaching at their current level were considered. For convenience of analysis, grade levels were divided into two ranges, grades one through four, and grades five through eight. The T>50 Group had two more teachers in the primary grades than the T<50 Group. The T<50 Group had two more teachers on the upper grades range than the T>50 Group. Table 1 shows this distribution.

Table 2 displays data comparing the number of years of

Table 1

Number and Percentage of Teachers in Each Experimental Group
Who Teach Grades 1-4 and Grades 5-8

Group	Grade	
	1-4	5-8
T>50		
N	4	6
%	40%	60%
T<50		
N	6	4
%	60%	40%

Note. T>50 refers to teachers who use their textbook more than 50% of the time. T<50 refers to teachers who use their textbook less than 50% of the time.

teaching experience among subjects in the two groups. The T>50 Group on the average, had taught two years longer than the teachers in the T<50 Group. The average number of years taught in the T>50 Group was 15.2. The average number of years taught in the T>50 Group was 17.9. The number of years teachers had taught at their current grade levels was also considered. The average number of years the T>50 Group had taught at the current level was eight years. The T<50 Group was comparable at 7.3 years.

Table 2

Number and Percentage of Teachers in Each Experimental Group with Various Years of Teaching Experience

Group	Experience				
	1-3	4-6	7-10	11-15	16+
T<50					
N	0	3	1	2	4
%		30%	10%	20%	40%
T>50					
N	0	3	0	2	5
%		30%		20%	50%

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time.

The mathematics backgrounds of teachers in the two groups were carefully explored. Data collected included detailed information on mathematics classes taken in high school, as an undergraduate, in their teaching credential programs, and after receiving their teaching credential. The two groups varied in their responses to questions concerning mathematics backgrounds. High school classes taken by the T>50 Group ranged from Algebra I to Analysis/Trigonometry while the T<50 Group ranged from Geometry to Calculus. Only twenty percent of teachers in the T>50 Group

took mathematics in high school beyond Algebra II, while 40% of teachers in the T<50 Group progressed beyond Algebra II. In general, the high school mathematics experiences of the T<50 Group were slightly more extensive than the T>50 Group.

Four teachers in the T>50 Group took more than three units of mathematics classes as undergraduates, while five teachers in the T<50 Group took more than three units. Titles of these classes included Analytic Geometry and Calculus, Trigonometry, Finite Math, and College Algebra. Mathematics classes taken as part of a teaching credential program were considered next. One teacher in each of the two groups reported not having to take any mathematics classes as part of their credential programs. Of the nine teachers in the T>50 Group who took such classes, six reported taking three units, two reported taking six units and one reported taking nine units. Each of the nine teachers in the T<50 Group took one three unit class. The median number of credential program mathematics units in both groups was three.

Professional Development

The first question in the professional development section of the questionnaire concerned the number of college level mathematics classes teachers took after receiving their teaching credentials. Teachers in the T<50 Group took

more mathematics units than the T>50 Group after receiving their credentials. Three teachers in the T>50 Group had taken one additional mathematics class each for a group total of nine post-credential mathematics units. Four teachers in the T<50 Group reported having taken mathematics classes after earning their teaching credentials. These teachers reported a total of 38 post-credential mathematics units. Titles of classes included Algebra for Electronics, Math Research, Finite Math, Trigonometry, Calculus I, II, and III.

In addition to professional development through college level classes, teachers were asked about workshop attendance. The teachers were asked to estimate the number of hours, during the last 12 months, they had spent in voluntary staff development, in-services, workshops, seminars or conferences in any curriculum area. The T<50 Group reported spending considerably more time in voluntary professional development activities than the T>50 Group. The T>50 Group had a median of 130 hours while the T<50 Group had a median of 205 hours.

The question was further refined and subjects were asked how many of the above mentioned hours were devoted to mathematics. The range for hours spent in mathematics in-service was zero to 275. The T>50 Group had a median of 100 hours while the median for the T<50 Group was 165 hours.

Five teachers in the $T > 50$ Groups reported spending 150 or more hours in mathematics in-service over the last year. Seven teachers in the $T < 50$ Group reported 150 or more hours in mathematics in-service for the same period of time.

Finally, teachers were asked how many hours of mathematics in-service their district had required them to attend in the past three years. Only one teacher in the $T > 50$ Group had been required to attend any in-service and reported the seminar to be "very useful" in her teaching. Six of the teachers in the $T < 50$ Group had been required to attend some kind of mathematics in-service. The feelings of these teachers about the usefulness of the in-service ranged from somewhat useful to very useful.

Attitudes about Mathematics

Attitudes about mathematics were rated on a scale that went from zero to five, where "0" meant "I hated it," and "5" meant "I loved it." Subjects were asked how they felt about mathematics when they were taking classes at different points in their lives: as a high school student, as an undergraduate student, while in their credential program, and since receiving their teaching credential. The results for these questions are displayed in Table 3. Scores of three or more were considered to represent positive attitudes. Feelings about mathematics were reported to be

Table 3

Means and Standard Deviations for Attitude Towards
Mathematics Scores across the Life Span of Teachers in Each
Experimental Group

Group	Stage			
	High School	Under Grad.	Cred Prog.	Post Grad
T>50				
M	3.6	2.1	3.2	4.0
SD	(0.7)	(1.2)	(1.5)	(1.0)
T<50				
M	4.1	2.8	3.4	4.8
SD	(0.7)	(1.9)	(1.6)	(0.5)

Note. Attitude towards mathematics scores vary from zero to five, where "0" meant "I hated it," and "5" meant "I loved it." T>50 refers to teachers who use the math textbook more than 50% of the time. T<50 refers to teachers who use the math textbook less than 50% of the time.

the most positive by both groups at the post-credential level. Mathematics classes taken at this point are more likely to be elective and taken because of interest and desire to learn rather than because of a requirement of some sort. All three teachers in the T>50 Group who took post-credential classes rated their feelings about those classes at the four or five level as did the four teachers in the

T<50 Group who took post-credential classes. Attitudes about mathematics seemed to improve for both groups following receipt of their credentials.

The final question regarding attitude about mathematics asked how teachers felt about teaching mathematics at the present time. Feelings toward teaching mathematics were scored on a scale from zero to five, where "0" meant "I hate it," and "5" meant "I love it." In general, the teachers in the T<50 Group enjoyed teaching mathematics more than the T>50 Group. The teachers in the T>50 Group reported a mean score of 3.6 while teachers in the T<50 Group reported a mean of 4.2. Four teachers in the T<50 Group rated their feelings "I love it" (a "5" on the scale) while only one teacher in the T>50 Group reported this. Four teachers in the T>50 Group rated their feelings about teaching mathematics as a "3" or below while only two teachers in the T<50 Group did so.

Professional Activity

Teachers' membership in professional organizations were examined. Unions, such as the California Teachers Association and the National Education Association, were not counted in this category since they are generally mandatory and do not focus on curricular issues. Each teacher was asked whether he or she belonged to any professional

organizations. The number of organizations to which each teacher belonged was noted and totals were computed for each group. Therefore, a group total of nine, for example, would not necessarily indicate nine different organizations. When subjects were questioned about the professional journals and magazines to which they subscribed, publications of the California Teachers Association and the National Education Association were not included for the same reasons described above. In addition to memberships and subscriptions, the subjects were asked approximately how many hours a year they spent participating in each organization's activities and how many hours a month they spent reading the magazines and/or journals.

Teachers in the T<50 Group belonged to more than twice as many professional organizations and devoted eight times as many hours to the organizations activities as did teachers in the T>50 Group. Table 4 illustrates this data. A surprising discovery was that not a single teacher in the T>50 Group subscribed to any magazine or journal. Teachers in the T<50 Group subscribed to 17 journals and spent, as a group, 32 hours a month reading the publications. This information is shown in Table 5.

Table 4

Total Number of Professional Organizations and Professional Magazine Subscriptions Reported for Each Experimental Group

Group	Organizations	Subscriptions
T>50	9	0
T<50	22	17

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time.

Table 5

Total and Median Number of Hours Per Year Teachers in Each Experimental Group Reported Spending on Activities Sponsored by Professional Organizations and Reading Professional Journals

Group	Activities	Reading
T>50		
Total Hours	21	0
Median Hours	0	0
T<50		
Total Hours	168	32
Median Hours	6	4

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time.

Involvement in Reform

Reform documents chart a course for a new direction in the teaching of mathematics. Teachers were asked to rate their familiarity with two of these documents, the Curriculum and Evaluation Standards for School Mathematics (National Council of Mathematics Teachers, 1989) and the Mathematics Framework for California Public Schools (California State Department of Education, 1992). Their familiarity was rated on a scale from zero to five, where "0" meant "I've never heard of them," and "5" meant "I've read the document and would be comfortable discussing it."

Both groups reported having similar levels of knowledge about the Standards (T>50 2.2 and T<50 2.4) and the Framework (T>50 3.6 and T<50 3.8). The most interesting difference between the two groups became evident when they rated their feelings about the ideas expressed in the documents. Their feelings were rated on the scale from zero to five, where "0" meant "very negative feelings" and "5" meant "extremely positive feelings." The T<50 Group looked upon the documents more favorably (4.5) than did the T<50 Group (3.6).

Teaching Behaviors

Amount of time teachers spent in the district's adopted mathematics textbook was the basis for dividing the teachers

into the two experimental groups. It is therefore no surprise that the T>50 Group spends more time in the mathematics textbook, using it an average of 69.3% of the time. The T<50 Group reported using the textbook an average of 15.4% of class time.

Teachers were asked their opinions of the strengths and weakness of the textbook. The most frequently cited strength of the textbook by both groups was the large quantity of problems available for practice and the organization of the text. The T>50 Group frequently cited the convenience of using the textbook. Opinions about weaknesses of the textbook was more widespread. Several members of each group mentioned that few lessons incorporated the use of manipulatives. The T<50 Group frequently cited that the textbook did not follow the framework, especially its lack of emphasizing the different strands. The T<50 Group was concerned that problems were presented in isolation and not related to real life. The lack of problem solving that required higher level thinking was mentioned by three teachers in the T<50 Group and one teacher in the T>50 group.

Teachers who use the textbook more than fifty percent of the time, the T>50 Group, made more positive comments and saw more strengths in textbooks than the T<50 Group (18 to 9). The teachers who use mathematics textbooks less than

fifty percent of the time, the T<50 Group, commented on more weaknesses in the textbooks than the T>50 Group. Reported textbook strengths are recorded on Table 6 and weakness on Table 7. When the question was asked during the survey, some teachers gave no answer, some gave one strength or weakness while others gave multiple answers. For purposes of the tables, each time a response was made, it was recorded under the appropriate category. For ease of recording, similar responses were grouped together.

Table 6

Number of Teachers in Each Experimental Group Reporting
Various Textbook Characteristics as Strengths

Textbook Strengths	Group	
	T>50	T<50
Organized, logical progression of skills	6	2
Easy to use; decreases prep time	4	1
Plentiful source for homework assignments	5	4
Good to assign for homework	2	1
Good reference, a resource	1	1
<u>Totals</u>	<u>18</u>	<u>9</u>

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time. Numbers do not add to ten because some teachers gave no response, some teachers gave one response and some teachers gave multiple responses.

Table 7

Number of Teachers in Each Experimental Group Reporting
Various Textbook Characteristics as Weaknesses

Textbook Weaknesses	Group	
	T>50	T<50
Does not follow the Framework; does not cover all required content areas	0	4
Skills are taught out of context	0	3
Repetitive approach; too much review	1	3
Difficult for ESL students	2	1
Little variety, boring, not motivating	2	2
Few lessons promote group work	1	0
Few problems require higher level thinking	1	6
Too much drill, paper and pencil focus	2	1
Few lessons incorporate manipulatives	2	3
Text does not relate one concept to another	1	3
Poor tests	1	0
<u>Totals</u>	<u>13</u>	<u>26</u>

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time. Numbers do not add to ten because some teachers gave no response, some teachers gave one response, and some teachers gave multiple responses.

Thompson (1984) expressed the opinion that reflecting on one's teaching and discussing lessons and mathematical ideas with others were beneficial in promoting the process of Change from the drill and practice, paper and pencil method of teaching. The next block of questions was designed to determine how regularly teachers talk about mathematics in various professional contexts. Questions included how frequently they talk to peers about ideas presented in reform documents, assessment of student work, portfolios or other alternate assessment, and their teaching of a particular lesson.

Responses were coded from zero to five on a six point scale. The questions were first analyzed separately to examine patterns and then aggregated to form a scale measuring frequency of professional dialogue across all situations. Table 8 displays results for each of the eleven questions in this category.

Several of the topics show interesting results because the differences are larger than one-half a standard deviation. In questions that were in line with recommendations in the NCTM Standards (1989), such as portfolio and alternate assessment, assessment of student work, and reflecting on one's own understanding and teaching, the T<50 Group reported more professional conversation. The T<50 Group also reported more

Table 8
Means and Standard Deviations for Responses to Questions
Regarding Collegial Communication about Mathematics

Topics		Group	
		T>50	T<50
Students' mathematical ideas or concepts	M (SD)	2.7 (1.5)	3.3 (1.6)
Your teaching of a particular lesson	M (SD)	2.9 (2.0)	3.8 (0.6)
Ideas for lessons based on the textbook	M (SD)	1.7 (1.6)	0.3 (0.5)
Ideas for non-textbook lessons	M (SD)	2.6 (1.4)	3.8 (1.1)
Problems teaching particular mathematics topics	M (SD)	2.3 (1.6)	2.9 (1.5)
Your own understanding of particular mathematical topics	M (SD)	1.2 (1.3)	1.8 (1.3)
Assessment of student work/understanding	M (SD)	1.2 (1.3)	3.0 (1.1)
Assessment of student progress/grading	M (SD)	1.4 (1.4)	1.9 (1.5)
Portfolio or other alternative ideas for assessment	M (SD)	1.5 (1.4)	2.7 (1.3)
Ideas presented in mathematics reform documents	M (SD)	1.3 (1.3)	3.1 (0.9)
Ideas for teaching mathematical algorithms	M (SD)	1.9 (1.5)	2.5 (1.4)

Note. Responses given on a scale from zero to five where "0" meant never and "5" meant daily. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50%

conversations about reform documents. If the sample size had been larger a t-test could have been done and the results may well have been shown to be significant.

A surprising finding was that the T<50 Group spent more time talking about algorithms than the T>50 Group even though the second group spent more class time teaching and practicing algorithms. Several teachers in the T<50 Group commented that when algorithms were used that they wanted to be sure that they "made sense" in term of the manipulative work that had preceded the algorithm.

A one-tailed t-test for the significance of the difference between two independent means was calculated to compare the T>50 Group and the T<50 Group on their frequency of professional communication about mathematics. An overall score for each teacher on the eleven items was calculated. Then individual scores were used to calculate a mean for each of the experimental groups. The mean for the T>50 Group was 2.0 and T<50 Group's mean was 2.9. T-test results indicate a significant difference (at the $p < .05$ level) in the amount of professional discussions that teachers reported.

In an effort to assess teachers' beliefs concerning the importance of various classroom activities to students'

success in mathematics, teachers were asked to rate the effectiveness of six different teaching strategies. Teachers rated their feelings on a scale from zero to five, where "0" meant "not at all effective" and "5" meant "extremely effective." Table 9 shows the results of teachers' beliefs concerning various classroom activities.

The T<50 Group devoted more class time to practices recommended in the NCTM Standards, such as problem solving, investigations, use of manipulatives and paired or group activities that would facilitate mathematical communication. In activities closely related to drill and practice, the T>50 Group spent more class time than the T<50 Group.

The previous set of questions was asked to determine teachers' beliefs about the importance of various activities. The next block of questions was asked to determine the amount of time actually devoted to various activities in the classroom. The teachers were asked to estimate the percentage of their class time spent on specific types of activities. Teachers were told in advance that their totals did not have to add up to one hundred percent as the categories overlapped. For instance, students might be working in pairs during a problem solving activity. Results are reported on Table 10.

Table 9

Means and Standard Deviations for Importance Ratings
of Various Classroom Activities for Each Experimental
Group

Activity		Group	
		T<50	T>50
Having students talk to each other about math tasks	(M) (SD)	4.4 (0.7)	4.2 (1.2)
Having students write about solutions to math problems	M (SD)	4.1 (1.3)	4.7 (0.7)
Giving students plenty of supplementary drill and practice	M (SD)	3.0 (1.4)	2.0 (0.9)
Having students use manipulatives	M (SD)	4.4 (0.7)	4.7 (0.5)
Having students work on open-ended problems or problems with more than one solution	M (SD)	4.2 (0.9)	4.8 (0.4)
Having students study the math textbook	M (SD)	2.0 (1.4)	1.2 (0.8)

Notes. Responses given on a scale from zero to five where "0" meant "not at all effective" and "5" meant "extremely effective." T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time.

Table 10

Means and Standard Deviations for Percentage of Class Time
Devoted to Various Activities by Teachers in Each
Experimental Group

Activities		Group	
		T>50	T<50
Practicing computations and algorithms	M (SD)	43% (22.8)	20% (11.9)
Timed drill of basic facts	M (SD)	6% (4.5)	3% (3.5)
Manipulative based activities	M (SD)	34% (26.0)	59% (19.0)
Problem solving	M (SD)	36% (21.6)	61% (16.0)
Investigations that last 52% more than a period (26.9)	M (SD)	20% (20.9)	
Paired or group activities	M (SD)	43% (32.7)	67% (16.0)

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less than 50% of the time. Percentages do not add up to 100% as categories overlap.

Since the sample size was small a t-test was not appropriate, However, the size of the difference of the

means to the difference in the standard deviation makes it clear there is a large difference. If there had been more subjects the differences would most likely have been significant. In practices recommended in the NCTM Standards (1989), such as problem solving, investigations, use of manipulatives, and paired or group activities that would facilitate mathematical communication, the T<50 Group devoted more class time. Using the textbook less than fifty percent of the time helped to bring this group of teachers' mathematics program closer to the one suggested in reform documents. The T>50 Group reported spending more class time than the T<50 Group on activities that closely relate to drill and practice such as practicing computations and algorithms and timed drill of basic facts.

Teachers were asked about several additional aspects of their approaches to teaching mathematics. A strong recommendation in the NCTM Standards (1989) is that students be provided with many opportunities to communicate their mathematical ideas. Therefore, teachers were asked how much on-task talking they were comfortable with during mathematics class time. Ninety percent of the T<50 Group reported being comfortable with a large amount of talking while only forty percent of the T>50 Group were comfortable with a large amount of talking. The remaining teachers in each group were comfortable with a medium amount of talking.

Again in response to other recommendations in the NCTM Standards (1989), teachers were asked to consider their mathematics class and report how much of the time in such a class they thought students should spend under various conditions. See report of data in Table 11.

Table 11

Means and Standard Deviations for the Ideal Amount of Time Students Should Spend under Various Conditions as Recommended by Teachers in Each Group

Condition		Group	
		T>50	T<50
Having Access to a calculator	M (SD)	72% (21.5)	86% (19.0)
Having Access to a computer	M (SD)	72% (27.0)	90% (17.0)
Doing Extended Investigations or Projects	M (SD)	66% (21.2)	67% (14.1)
Presenting Mathematical Findings/Observations/ Strategies to a Small Group or the Whole Class	M (SD)	72% (25.3)	64% (28.0)

Note. T>50 refers to teachers who use the textbook more than 50% of the time. T<50 refers to teachers who use the textbook less and than 50% of the time. Percentages do not add to 100% as the categories may overlap.

The T<50 Group believed students should have more access to computers and calculators, thus closer in alignment with the recommendation in the NCTM Standards (1989) where it is suggested that students always have access to such tools. The T>50 Group was more hesitant to put calculators and computers in the students' hands.

Summary

Teachers in the T<50 Group, in general, reported more favorable feelings about mathematics since high school and had a more extensive mathematics backgrounds. It appears that at the post-credential level, both groups enjoy mathematics classes taken at the college level, possibly because enrollment at this point is a choice not a requirement. Teachers in the T<50 Group took more mathematics classes after receiving their teaching credentials than the T>50 Group.

There were interesting differences in the professional development histories of subjects in the two groups. More teachers in the T<50 Group were required to attend inservices than the other group. The T<50 Group also spent more hours in voluntary workshops, belonged to more professional organizations, attended more of the activities sponsored by those organizations and spent more time reading

professional journals and magazines.

Both groups of teachers had similar knowledge about the NCTM Standards (1989) and the California Framework (1992). However, the T<50 Group reported more favorable feelings toward the recommendations in these reform documents.

Teachers in the T<50 Group, on average, spent more time discussing mathematical ideas with their colleagues such as alternative assessment and their teaching of a lesson. These teachers also encouraged more mathematical communication in their classrooms among students than did the T>50 Group did.

Finally, teachers who used the textbook less than fifty percent of the time reported valuing, and spending more class time on implementing, practices recommended in the NCTM Standards (1989). They reported more classroom time devoted to such things as problem solving, investigations, use of manipulatives and paired or group activities. They also reported spending less time on drill and practice, allowing for a more diversified mathematics program.

CHAPTER V

Summary

Advancements in mathematics as a field, and in the technology available for mathematics have precipitated the need for a change in our current notions about mathematical competence. This has encouraged some mathematics teachers to move away from computational drill and practice oriented mathematics programs toward programs that focus on problem solving and mathematical thinking. Little is known about the beliefs, behaviors, and attitudes of teachers who no longer focus on this typical textbook driven curriculum that emphasizes calculation. Identifying the differences between teachers who use mathematics textbooks more than fifty percent of the time and those who use them less than fifty percent of the time may be helpful in understanding more about the antecedents of teachers' instructional decisions.

Research articles suggest possible reasons for decisions about teaching. Teachers' attitudes and beliefs toward mathematics appear to affect the way teachers teach. Beliefs about how students learn and their responses to particular lessons also seem to influence teachers' methods. Another possible factor relating to teaching practices, according to the literature is teacher education programs, both pre-service and inservice.

A researcher designed survey was developed, critiqued,

pilot tested and then given to teachers who volunteered to be in the study. Areas covered by the questionnaire were demographic information, professional development, attitude about mathematics, professional activity, involvement in the reform movement and teaching behaviors. Teachers were questioned on the telephone and responses were recorded for each teacher. Data were analyzed separately and then aggregated for each of the two groups.

Results of the survey showed that teachers who used the textbook less than fifty percent of the time (T<50 Group), have had a more favorable attitude about mathematics since high school and have more extensive mathematics backgrounds. These teachers also attended more in-services, voluntary workshops, spent more hours in professional organizations and reading professional journals and magazines. Their feelings about the recommendations in reform documents, such as the NCTM Standards (1989) and the California Framework (1992), were more positive than the feelings of the teachers who use a mathematics textbook more than fifty percent of the time (T>50 Group). Finally, the T<50 Group spent more time discussing mathematical ideas with their colleagues.

Based on the findings of this study, it appears that there are important differences in the beliefs, behaviors and attitudes of teachers who use their mathematics textbook more than fifty percent of the time and those who use the

textbook less than fifty percent of the time. Teachers who use the textbook less than fifty percent of the time, and whose classroom practice is more in line with current mathematics education reform recommendations, share several characteristics. These are factors which may merit consideration by districts and mathematics educators who are interested in moving in the direction of recommendations contained in current reform documents. The most noteworthy differences between the two experimental groups and suggestions based on these differences are discussed in greater depth in the conclusions below.

Teachers who reported using the district-adopted textbook less than fifty percent of the time ($T < 50$) varied on several dimensions from those teachers who reported using the textbook more than fifty percent of the time ($T > 50$). In general, the $T < 50$ Group reported having had more positive feelings about mathematics ever since their high school years and actually have more extensive mathematics backgrounds than teachers in the $T > 50$ Group. These two characteristics may give teachers in this group a greater feeling of comfort with the subject thus allowing them to take the risk of leaving the textbook. Their confidence in mathematics may decrease the need for the well developed and structured lesson plans of the textbook, freeing them to try something different.

The T<50 Group teachers belong to more professional organizations, and subscribe to more professional journals and magazines. The T<50 Group also reported spending more time conversing with peers about mathematics and about their mathematics teaching. Their classroom practices focus less on drill and practice and more on problem solving, mathematical communication, connections among mathematical ideas and strands, and reasoning activities. The time spent reading and talking to others may well serve as a source for new ideas, for professional encouragement and for validation.

Teachers who use their mathematics textbooks less than fifty percent of the time also reported attending more hours of professional development. Because both voluntary and district mandated inservices seem to be effective in changing teacher beliefs, districts might reasonably consider providing teachers with opportunities to participate in either kind of professional development.

Results of this study show that teachers who are professionally involved and who read professional journals and magazines also seem to rely less on the mathematics textbook. While a principal or district may subscribe to a selection of journals for faculty members, that certainly will not guarantee that publications will be read. To promote such reading, teachers might be encouraged to form

support groups to read and discuss selected articles from professional journals.

To verify and extend the findings of this study, additional research would be beneficial. A larger, more ethnically and geographically diverse sample would increase reliability. Actual researcher observation of teachers might lead to more credible information than that acquired through self-report data. Findings indicate that while some teachers report believing one thing, their actions indicate something different. Teachers in the T>50 Group reported believing that the use of manipulatives was "very important," but reported that they actually used such tools only 34% of the time. Researcher observation could help to clarify such discrepancies.

In conducting telephone interviews, it is often difficult for the researcher to be sure that the respondent understands such terms as "extended investigations," and "open-ended problems." These terms can have considerably different meanings for various individuals. In-person interviews can provide skilled researchers with more feedback concerning participants' interpretations.

Teaching behaviors are generally assumed to be based on long held beliefs and habits and are therefore not easy to change. The more we can learn about differences in behaviors and factors which may be related to those

differences, the better we will be at designing effective professional development.

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APPENDICES

APPENDIX A

Survey

This survey is part of a thesis project on educational change and I would greatly appreciate your participation. Please answer the following questions about mathematics and your teaching of mathematics.

I. Your Background.

1. Male Female

2. Grade level that you currently teach _____

3. Number of years teaching at current grade level _____

4. Number of years teaching _____

5. Age 30-34 35-39 40-44 45-49
 50-54 55-59

6. Can you remember the title of the highest math class you took in high school?

General Math

Algebra I

Intro to Algebra

Algebra II

Geometry

Analysis/Trig

Calculus

7. On a scale that goes from 0 to 5, where 0 means "I hated it," and 5 means "I loved it," how would you describe your feelings about math when you were in high school?

0 1 2 3 4 5

8a. What math classes did you take as an undergraduate in college?

b. What math classes did you take for your credential?

Content

Units

Methods

Units

9a. On that same scale from 0 to 5, where 0 means "I hated it," how would you describe your feelings about math when you were an undergraduate student?

0 1 2 3 4 5

9b. When you were in the teaching credential program?

0 1 2 3 4 5

10. Have you taken any college credit math classes since receiving your teaching credential?

Content	Units	Methods	Units
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

11. Again, on the same scale from 0 to 5, how would you describe your feelings about math since you have been teaching?

0 1 2 3 4 5

12. Approximately, how many hours of voluntary staff development/in-services, workshops, seminars, or conferences, in any curriculum area, have you attended in the last year? _____ hours

13. Approximately, how many of those hours were devoted to math? _____ hours

14. What professional associations do you belong to?

Member	Attend Conf?	Hrs/yr	Active	hrs/mo
___ Nat'l Reading	___	___	___	___
___ Loc/St. Reading	___	___	___	___
___ NCTM	___	___	___	___
___ SCVMA	___	___	___	___
___ CMC	___	___	___	___
___ Loc.Sci	___	___	___	___
___ CA Mid.Sch	___	___	___	___
___	___	___	___	___
___	___	___	___	___

15. What professional journals or magazines do you subscribe to? Approximately, how many hours a month do you spend reading these journals?

Reading Teacher	___
Mathematics Teacher	___
Arithmetic Teacher	___
Communicator	___
Teacher	___
Learning	___
Teaching K-8	___

II Teaching Mathematics

16. Rate your familiarity with the NCTM Standards on a scale that goes from 0 to 5, where 0 means "I've never heard of them," and 5 means "I've read the document and would be comfortable discussing it."

0 1 2 3 4 5

17. Rate your familiarity with the 1992 Mathematics Framework for the State of California using the same scale as in the last question.

0 1 2 3 4 5

18. If you are familiar with the above mentioned documents, please give me an indication of your feelings about them on a scale that goes from 0 to 5 where 0 means very negative feelings and 5 means extremely positive feelings.

0 1 2 3 4 5

19. Have you been required by your district to attend any math inservices in the past three years? _____ Can you remember what they were about? Please list.

Content	Hrs	Content	Hrs
-----		-----	
-----		-----	
-----		-----	

20. On a scale from 0 to 5 where 0 means, "not at all useful to your teaching," and 5 means "extremely useful to your teaching," how would you rate those seminars?

0 1 2 3 4 5

21. With respect to your math teaching, can you tell me about how often, almost Daily, Weekly, Monthly, Rarely, Never, you have conversations with other teachers concerning the following:

Student's mathematical ideas or concepts
Your teaching of a particular lesson
Ideas for lessons based on the textbook

D	W	M	R	N
D	W	M	R	N
D	W	M	R	N

Ideas for non-textbook lessons
Problems teaching particular mathematical topics
Your own understanding of particular math concepts

D	W	M	R	N
D	W	M	R	N
D	W	M	R	N

Assessment of student work/understanding
Assessment of student progress grading
Portfolio or other alternative ideas for assess.

D	W	M	R	N
D	W	M	R	N
D	W	M	R	N

Ideas presented in math reform documents such

as NCTM Standard, State Framework or
Everybody Counts
 Ideas for teaching mathematical algorithms

D W H R N
 D W H R N

22. Approximately, what percentage of your math program would you say that you use your district's mathematics textbook and/or the worksheets that accompany it? _____

23. What do you see as the textbook's strengths?

24. What do you see as the textbook's weaknesses?

25. Approximately, what percentage of your math program time is spent on the following. (These will not add up to 100%)

_____ Practicing computations/algorithms
 _____ Timed drill of basic facts
 _____ Manipulative-based activities
 _____ Problem Solving
 _____ Investigations that take more than a period
 _____ Paired or group activities

26. During math time, how much talking or on task discussion among students are you comfortable with?

a small amt. a med amt. a lg amt.

27. Please rate your feelings about the importance of the following on a scale that goes from 0 to 5, where 0 means "not at all effective" and 5 means "extremely effective."

Having students talk to each other about the math task
 Having students write about their solutions to math problems
 Giving students plenty of supplementary drill and practice in computation
 Having students use manipulatives to explore math

0 1 2 3 4 5

0 1 2 3 4 5

0 1 2 3 4 5

0 1 2 3 4 5

Having students work on open ended problems or on
 problems with more than one solution
 Having students study the math textbook

0 1 2 3 4 5
 0 1 2 3 4 5

28. On a scale that goes from 0 to 5 where 0
 means never and 5 means 100% of the time,
 approximately how much of their math time do
 you think students should spend

Having access to a calculator
 Having access to a computer
 Doing extended investigations or projects
 Presenting their mathematical findings/
 observations/strategies to a small group
 or the whole class

0 20 40 60 80 100
 0 20 40 60 80 100
 0 20 40 60 80 100

 0 20 40 60 80 100

30. On the scale that goes from 0 to 5
 where 0 means "I hate it," and 5 means "I
 love it," how would you describe your
 current feelings about teaching math?

0 1 2 3 4 5

Can you recommend a teacher who might also be willing to participate in
 this survey?

Name _____ Telephone _____

APPENDIX B
RAW DATA BY QUESTION NUMBER

1. GENDER Male Female

	#	%	#	%	Total Subjects
T>50	2	20	8	80	10
T<50	2	20	8	80	10

2. Grade level that you currently teach.

	Subjects										
	1	2	2/3	3	3/4	4	5	6	6/7	7	8
T>50		1	1	1	1		1	2	1	1	1
T<50	1	1	2	1		1		3		1	

3. Number of years teaching at current grade level.

	Subjects										Mean	S.D.
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
T>50	1	10	15	2	8	3	15	2	30	7	9.3	8.92
T<50	9	4	3	10	4	15	1	6	4	17	7.3	5.33

4. Number of years teaching.

	Subjects										Mean	S.D.
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
T>50	5	30	22	9	15	17	5	5	30	14	15.2	9.66
T>50	28	14	13	25	6	24	5	6	28	30	17.9	10.1

5. Age

	Subjects										Mean	S.D.
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
T>50	37	52	57	37	37	52	32	37	52	37	43	9.07
T<50	47	47	37	47	32	47	32	42	57	57	44.5	8.90

6. Can you remember the title of the highest math class you took in high school?

	High School Math Class						
	Intro Algebra	Algebra 1	Geo-metry	Algebra 2	Analysis Trig	Calc.	
T>50	# %		1 10%	3 30%	4 40%	2 20%	
T<50	# %			4 40%	2 20%	3 30%	1 10%

7. On a scale that goes from 0 to 5, where 0 means "I hated it," and 5 means "I loved it," how would you describe your feelings about math when you were in high school?

	("I hate it")					("I love it")			Mean	S.D.
	Scale: 0	1	2	3	4	5				
T>50	# %				5 50%	4 40%	1 10%		3.6	0.70
T<50	# %				2 20%	5 50%	3 30%		4.1	0.74

8a. How many total math units did you take as an undergraduate?

	Subjects									
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
T>50	12			3		3	15	5	10	3
T<50		4	6	8	9		14			

- 9a. On a scale from 0 to 5, where 0 means "I hated it," and 5 means "I loved it," how would you describe your feelings about math when you were an undergraduate student?

		("I hate it")			("I love it")			Mean	S.D.
Scale:		0	1	2	3	4	5		
T>50	#	1	1	1	4			2.1	1.21
	%	10%	10%	10%	40%				
T<50	#	1		1	1	1	1	2.8	1.92
	%	10%		10%	10%	10%	10%		

Note: Some respondents could not reply because they did not take undergraduate math units.

- 8b. How many units of math did you take for your credential?

Subjects											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Median
T>50	0	3	3	3	3	6	3	3	9	6	3
T<50	3	3	3	3	0	3	3	3	3	3	3

- 9b. On that same scale from 0 to 5, where 0 means "I hated it," to 5 means "I loved it," how would you describe your feelings about math when you were in the credential program?

		("I hate it")			("I love it")			Mean	S.D.
Scale:		0	1	2	3	4	5		
T>50	#		2		3	2	2	3.22	1.48
	%		20%		30%	20%	20%		
T<50	#		1	2	1	1	3	3.38	1.60
	%		10%	20%	10%	10%	30%		

Note: Some respondents could not reply because they took no math in their credential program.

10. How many post-credential credit math units have you earned since receiving your teaching credential?

	Subjects										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total
T>50	3	3	0	0	3	3	0	0	0	0	9
T<50	0	8	0	3	21	0	0	6	0	0	38

11. On a scale of 0 to 5, how would you describe your feelings about math classes you've taken since you have received your credential?

("I hate it")

("I love it")

Scale: 0 1 2 3 4 5

T>50	# %				1 33.3%	1 33.3%	1 33.3%
T<50	# %					1 25%	3 75%

Note: Since not all subjects took post-credential math classes, some did not respond to the question.

12. Approximately how many hours of voluntary staff development/in-services, workshops, seminars or conferences, in any curriculum area have you attended in the last year?

	Subjects					
	T1	T2	T3	T4	T5	T6
T>50	100	160	50	215	310	175
T<50	250	300	0	200	175	210

T7	T8	T9	T10	Mean	S.D.	Median
12	210	3	80	132	99.32	130
40	210	300	25	171	111.13	205

13. Approximately how many of those hours were devoted to math?

	Subjects					
	T1	T2	T3	T4	T5	T6
T>50	18	160	0	160	210	160
T<50	15	170	150	200	200	160

T7	T8	T9	T10	Mean	S.D.	Median
10	160	3	40	92	84.14	100
160	275	0	15	134.5	92.96	165

14. How many professional organizations do you belong to (#) and how many hours (hrs) a year do you spend in activities affiliated with the organization?

Number of professional Organizations:

	Subjects										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total
T>50	0	2	0	2	1	1	0	1	1	1	9
T<50	1	2	0	4	2	3	2	3	4	1	22

Hours per year in activities:

	Subjects								
	T1	T2	T3	T4	T5				
T>50	0	0	0	10	0				
T<50	0	0	0	10	26				

T6	T7	T8	T9	T10	Total	Mean	S.D.	Median
0	0	0	3	8	21	2.1	3.78	0
4	8	56	64	1	169	16.9	24.4	6

15. How many professional magazines or journals do you subscribe to and how many hours a month do you spend reading these?

Professional magazines or journals:

Subjects											
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total
T>50	0	0	0	0	0	0	0	0	0	0	0
T<50	0	1	3	3	2	1	0	2	4	1	17

Hours spent reading magazines or journals:

Subjects													
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Total	Mean	S.D.
T>50	0	0	0	0	0	0	0	0	0	0	0	0	0
T<50	0	1	5	4	4	4	0	0	8	6	32	3.2	2.8

16. Rate your familiarity with the NCTM Standards on a scale of 0 to 5, where 0 means "I've never heard of them," to 5 means "I've read the document and would be comfortable discussing it."

(never)						(comfortable)		Mean	S.D.
0	1	2	3	4	5				
T>50	1 10%		5 50%	4 40%				2.2	0.92
T<50	2 20%	1 10%		5 50%	2 20%			2.4	1.51

17. Using the same scale, rate your familiarity with the 1992 Mathematics Framework for the state of California.

	(never) 0	1	2	3	(comfortable) 4	5	Mean	S.D.
T>50			1 10%	4 40%	3 30%	2 20%	3.6	0.97
T<50		1 10%		2 20%	4 40%	3 30%	3.8	1.23

18. Please give me an indication of your feelings about the two documents described above on a scale that rates 0 as very negative to 5 as very positive.

	(-) 0	1	2	3	(+) 4	5	Mean
T>50				5 50%	4 40%	1 10%	3.6
T<50					5 50%	5 50%	4.5

19. How many hours has your district required you to attend math in-service in the past 3 years?

	Subject									
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
T>50	40	0	0	0	0	0	0	0	0	0
T<50	0	12	14	0	9	0	0	7	7	21

20. On a scale of 0 to 5, where 0 means "not at all useful to your teaching," and 5 means "extrememly useful," how would you rate those seminars?

(not useful) (extremely useful)
 0 1 2 3 4 5

T>50						1 100%
T<50			3 60%	1 20%	1 20%	

21. With respect to your math teaching, can you tell me about how often, almost daily (4), weekly (3), monthly (2), rarely (1), never (0) you have conversations with other teachers concerning the following?

21a) Student's mathematical ideas of concepts:

	never 0	1	3	4	daily 5	Mean	S.D.
T>50	1 10%	2 20%	3 30%	4 40%		2.7	1.49
T<50	1 10%	1 10%	1 10%		1 10%	3.3	1.57

21b) Your teaching of a particular lesson:

	never 0	1	3	4	daily 5	Mean	S.D.
T>50	2 20%	1 10%	3 30%	1 10%	3 30%	2.9	1.97
T<50			3 30%	6 60%	1 10%	3.8	0.63

21c) Ideas for lessons based on the textbook:

	never 0	1	3	4	daily 5	Mean	S.D.
T>50	3 30%	3 30%	2 20%	2 20%		1.7	1.64
T<50	7 70%	3 30%				0.3	0.48

21d) Ideas for non-textbook lessons:

	never 0	1	3	4	daily 5	Mean	S.D.
T>50	1 10%	2 20%	4 40%	3 30%		2.6	1.43
T<50		1 10%	1 10%	6 60%	2 20%	3.8	1.14

21e) Problems teaching particular math topics:

	never 0	1	3	4	daily 5	Mean	S.D.
T>50	2 20%	2 20%	3 30%	3 30%		2.3	1.64
T<50	1 10%	1 10%	5 50%	2 20%	1 10%	2.9	1.45

21f) Your own understanding of particular math topics:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	4 40%	3 30%	3 30%			1.2	1.32
T<50	2 20%	3 30%	5 50%			1.8	1.32

21g) Assessment of student work/understanding:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	3 30%	5 50%	1 10%	1 10%		1.2	1.32
T<50		2 20%	4 40%	4 40%		3.0	1.15

21h) Assessment of student/progress grading:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	3 30%	4 40%	2 20%	1 10%		1.4	1.43
T<50	3 30%	1 10%	6 60%			1.9	1.45

21i) Portfolio or other alternative ideas for assessment:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	3 30%	3 30%	4 40%			1.5	1.35
T<50	1 10%	1 10%	6 60%	2 20%		2.7	1.25

21j) Ideas presented in math reform documents such as NCTM Standard, State Framework or Everybody Counts:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	3 30%	4 40%	3 30%			1.3	1.25
T<50		2 20%	6 60%	1 10%	1 10%	3.1	.88

21k) Ideas for teaching mathematical algorithms:

	never 0	1	3	4	5 daily	Mean	S.D.
T>50	2 20%	3 30%	4 40%	1 10%		1.9	1.45
T<50	1 10%	2 20%	5 50%	2 20%		2.5	1.35

22. Approximately, what percentage of your math program would you say that you use your districts mathematics textbook and/or the worksheets that accompany it?

	T1	T2	T3	T4	T5	T6
T>50	80%	73%	60%	75%	60%	60%
T<50	10%	25%	49%	5%	5%	0%

T7	T8	T9	T10	Mean	S.D.
55%	90%	60%	80%	69.3%	11.80
5%	25%	10%	20%	15.4%	14.73

23. What do you see as textbook's strengths? (Listed by teacher.)

T>50

- T1 Lots of practice problems
- T2 Easy to use
- T3 Source of practice
- T4 Well organized
- T5 Source of practice, logical progression of skills,
- T6 Well organized, source for homework
- T7 Logical organization
- T8 Easy to use
- T9 Organized, decreases prep time, lots of practice problems, a good resource
- T10 Organized, good for homework assignments, lots of practice, decreases prep time

T<50

- T1 Organized
- T2 Good source for practice
- T3 Plenty of practice exercises
- T4 Practice
- T5
- T6 Assigning homework
- T7 Easy to use
- T8 Practice material, reference
- T9 Structured
- T10

24. What do you see as the textbook's weaknesses?

T>50 T1

- T2 Not enough hands on activities, too much drill
- T3 Too much drill
- T4 Too repetitive
- T5 Difficult for ESL students, poor tests
- T6 Lacks continuity, few ideas for use of manipulatives
- T7 Too much drill
- T8 Not enough activities for group work, no higher level thinking required
- T9 Boring
- T10 Not motivating

T<50 T1 Lacks higher level thinking, doesn't cover all strands, few hands on lessons

- T2 Lacks activities & ideas for manipulatives
- T3 Doesn't follow the framework, skills are taught out of context, difficult for ESL students
- T4 Doesn't follow Framework, lacks higher level thinking, not enough activities for manipulatives
- T5 Lacks higher level thinking, repetitive, boring
- T6 Doesn't relate one concept to another, boring
- T7 Concepts taught out of context, lacks higher level thinking, too much review
- T8 Lacks higher level thinking, concepts do not relate to each other
- T9 Doesn't cover all strands, lacks higher level thinking, repetitive
- T10 Doesn't relate to real life, concepts do not relate to each other

25. Approximately, what percentage of your math program time is spent on the following?

25a) Practicing computations and algorithms:

	T1	T2	T3	T4	T5	T6
T>50	60%	6%	0%	50%	60%	40%
T<50	30%	25%	30%	10%	5%	0%

T7	T8	T9	T10	Mean	S.D.
50%	50%	70%	40%	42.6%	22.82
15%	33%	25%	30%	20.3%	11.87

25b) Timed drill of basic facts:

	T1	T2	T3	T4	T5	T6
T>50	10%	10%	0%	2%	10%	10%
T<50	5%	0%	0%	0%	0%	5%

T7	T8	T9	T10	Mean	S.D.
2%	5%	10%	0%	5.9%	4.53
0%	10%	5%	0%	2.5%	3.53

25c) Manipulative-based activities:

	T1	T2	T3	T4	T5	T6
T>50	20%	10%	80%	40%	60%	60%
T<50	70%	75%	40%	95%	50%	50%

T7	T8	T9	T10	Mean	S.D.
5%	15%	40%	10%	34%	26.01
75%	40%	50%	40%	58.5%	19.01

25d) Problem solving:

	T1	T2	T3	T4	T5	T6
T>50	30%	20%	90%	25%	40%	25%
T<50	70%	70%	70%	75%	75%	70%

T7	T8	T9	T10	Mean	S.D.
40%	20%	50%	20%	36%	21.58
60%	33%	50%	35%	60.8%	15.98

25e) Investigations that take more than a period:

	T1	T2	T3	T4	T5	T6
T>50	20%	20%	70%	0%	30%	10%
T<50	60%	70%	30%	50%	50%	60%

T7	T8	T9	T10	Mean	S.D.
5%	10%	30%	0%	19.5%	20.88
80%	0%	90%	30%	52%	26.85

25f) Paired or group activities:

	T1	T2	T3	T4	T5	T6
T>50	20%	20%	100%	40%	50%	50%
T<50	75%	90%	70%	60%	75%	60%

T7	T8	T9	T10	Mean	S.D.
25%	20%	100%	10%	43.5%	32.66
80%	33%	75%	55%	67.3%	15.97

26. During math time, how much talking or on task discussion among students are you comfortable with?

	small amt.	medium amt.	large amt.
T>50		60%	40%
T<50		10%	90%

27. Please rate your feelings about the importance of the following on a scale that goes from 0 to 5, where 0 means "not all all effective" and 5 means "extremely effective."

- 27a) Having students talk to each other about the math task:

	not effective					ext. effective	Mean	S.D.
	0	1	2	3	4	5		
T>50				1 10%	4 40%	5 50%	4.4	0.70
T<50			2 20%		2 20%	6 60%	4.2	1.23

- 27b) Having students write about their solutions to math problems:

	not effective					ext. effective	Mean	S.D.
	0	1	2	3	4	5		
T>50		1 10%		1 10%	3 30%	5 50%	4.1	1.29
T<50				1 10%	1 10%	8 80%	4.7	0.67

27c) Giving students plenty of supplementary drill and practice in computation:

	not effective					ext. effective		
	0	1	2	3	4	5	Mean	S.D.
T>50	1 10%		2 20%	3 30%	3 30%	1 10%	3.0	1.41
T<50		3 30%	5 50%	1 10%	1 10%		2.0	0.94

27d) Having students use manipulatives to explore math:

	not effective					ext. effective		
	0	1	2	3	4	5	Mean	S.D.
T>50				1 10%	4 40%	5 50%	4.4	0.70
T<50					3 30%	7 70%	4.7	0.48

27e) Having students work on open-ended problems or on problems with more than one solution:

	not effective					ext. effective		
	0	1	2	3	4	5	Mean	S.D.
T>50				3 30%	2 20%	5 50%	4.2	0.92
T<50					2 20%	8 80%	4.8	0.42

27f) Having students study the math textbook:

	not effective					ext. effective		
	0	1	2	3	4	5	Mean	S.D.
T>50	2 20%	1 10%	4 40%	1 10%	2 20%		2.0	1.41
T<50	1 10%	7 70%	1 10%	1 10%			1.2	0.79

28. On a scale that goes from 0 to 5, where 0 means never and 5 means 100% of the time, approximately how much of their math time do you think students should spend.

28a) Having access to a calculator:

	0	20%	40%	60%	80%	100%	Mean	S.D.
T>50			2 20%	2 20%	4 40%	2 20%	72%	21.50
T<50			1 10%		4 40%	5 50%	86%	18.97

28b) Having access to a computer:

	0	20%	40%	60%	80%	100%	Mean	S.D.
T>50		1 10%	1 10%	2 20%	3 30%	3 30%	72%	27.00
T<50				2 20%	1 10%	7 70%	90%	17.00

28c) Doing extended investigations or projects:

	0	20%	40%	60%	80%	100%	Mean	S.D.
T>50		1 10%		5 50%	3 30%	1 10%	66%	21.19
T<50			1 10%	4 40%	4 40%	1 10%	67%	14.1

28d) Presenting their mathematical findings/observations/strategies to a small group or the whole class:

	0	20%	40%	60%	80%	100%	Mean	S.D.
T>50		1 10%		4 40%	2 20%	3 30%	72%	25.3
T<50		1 10%	3 30%	1 10%	3 30%	2 20%	64%	27.97

29. On the scale of 0 to 5, where 0 means "I hate it," to 5 means "I love it," how would you describe your current feelings about teaching math?

	("I hate it")			("I love it")			Mean	S.D.
	0	1	2	3	4	5		
T>50			1 10%	3 30%	5 50%	1 10%	3.6	0.84
T<50				2 20%	4 40%	4 40%	4.2	0.79