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The effects of block scheduling on the implementation of the NCTM Standards

by

Angela Therese Pierce

A thesis submitted to the graduate faculty
In partial fulfillment of the requirements for the degree of
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This is to certify that the Master's thesis of

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has met the thesis requirements of Iowa State University

Signatures have been redacted for privacy
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CHAPTER 1. INTRODUCTION

Background of the Study

In recent years the public secondary school system has been the subject of many reform efforts to improve teaching and learning. Two of these efforts include the implementation of national standards, and the implementation of alternative time schedules.

The field of mathematics, through the work of the National Council of Teachers of Mathematics (NCTM) has been a leader in the design of national standards in mathematics. The efforts and cooperation of professional mathematicians and mathematical educators produced the *Curriculum and Evaluation Standards for School Mathematics*, by the National Council of Teachers of Mathematics (NCTM, 1989) and the *Professional Standards for School Mathematics* (NCTM, 1991). The standards were created in response to concern throughout the United States about the performance of students in math and the demands of an increasingly technological world. These documents provide a broad framework used to guide school mathematics reform. They provide goals and principles against which curriculum and instruction practices can be examined. Included in the NCTM Standards is a vision of mathematics curriculum for improving the teaching and learning of mathematics.

The NCTM Standards has as its vision:

- "mathematical powers for all in a technological society;"
- mathematics as something one does – solve problems, communicate, reason;
- a curriculum for all that includes a broad range of content, a variety of contexts, and deliberate connections;
- the learning of mathematics as an active, constructive process;
- instruction based on real problems;
The *Curriculum and Evaluation Standards for School Mathematics* promote the idea that every student must

- learn to value mathematics;
- become confident in their ability to do mathematics;
- become mathematical problem solvers;
- learn to communicate mathematically;
- learn to reason mathematically. (NCTM, 1998)

They also describe the mathematics content that all students should know and be able to do. They identify the basic skills and understandings that students should have in number and number theory, geometry, measurement, probability and statistics, patterns and functions, discrete mathematics, algebra and beyond (NCTM, 1998). The *Professional Standards for teaching Mathematics* shows teachers how to structure classroom activities to encourage the goals and principles promoted by the Curriculum Standards. They encourage teachers to help create opportunities for student understanding by:

- choosing worthwhile mathematical tasks
- establishing and promoting classroom discussion
- creating an environment for learning
- analyzing one’s own teaching, including the effectiveness of assessing students’ learning. (NCTM, 1991)

Since the introduction of the Standards, mathematics teachers have struggled to implement the curriculum and instructional changes they advocate. Several barriers to implementing the standards have been noted, they include incompatible texts and materials, inaccessible technology, inappropriate assessments, inadequate professional development, incompatible educational beliefs, and lack of time (Brosnan, Edwards, and Erickson, 1996; Edgerton, 1993; Wiske and Levinson, 1993). Studies have found that mathematics teachers are supportive of the kind of mathematics instruction promoted by the NCTM Standards (Weiss, 1997; Fagan, 1996). Teachers agree with the standards about what is important for
effective mathematics instruction, and they accept the reform goals. “However, the instruction strategies teachers used to achieve these goals often were not the ones they themselves said were most effective, leaving classroom instruction far from the vision described in the NCTM Standards” (Weiss, 1997 p. 7)

Many secondary school systems have implemented alternative schedules to better address the educational needs of students. These alternative schedules or block schedules usually consist of longer blocks of instructional time that are alternated on an odd-even basis or are compressed into shorter grading periods. This study focuses on the use of 4x4 or intensive block scheduling, referred to from now on as block scheduling. In this type of block schedule students enroll in four courses which meet for approximately 90 minutes every day for 90 days. A course that would have traditionally been a “full year course” under a block schedule would be completed in one semester. Canady and Rettig (1995) cite a number of basic advantages to block schedules:

- school climate is improved;
- teaching is more active;
- assessment is more accurate;
- teachers deal with a smaller number of students; and
- subjects are explored in greater detail.

Journal articles have promoted block scheduling plans as instrumental in promoting classroom innovation and as more closely aligned to the real work world (Edward, 1995; O’Neil, 1995). Canady and Rettig (1995) refer to block scheduling as a “catalyst for change” (1995). Irmscher (1996) believes that larger blocks of time allow for a more flexible and productive classroom environment, along with more opportunities for using varied and interactive teaching methods. The atmosphere promoted by block scheduling supporters is one that encourages innovation, increases active teaching and becomes an agent of change.
This atmosphere may help advance other reform efforts, like the implementation of the NCTM Standards in the classroom. However, just changing from a 50-minute class period to a 90-minute class period may be all the change teachers can handle. If this is the case other improvements, like the implementation of the standards may get neglected through the adoption of a block schedule.

**Statement of the Problem**

Block scheduling has been promoted as being a “catalyst for change” (Canady and Rettig, 1995) and conducive to classroom innovation (Edwards, 1995; O’Neil, 1995). However, very little research has been done on the effects of block scheduling on the instructional change effort in the mathematics classroom. This study will look at the connection between the adoption of a block schedule and mathematics teachers’ implementation of the NCTM Standards.

**Purposes of the Study**

The purpose of this study was to attempt to determine if there is a connection between teachers’ level of implementation of the NCTM Standards and the adoption of a block schedule. The NCTM Standards, specifically, the use of alternative teaching techniques, the amount of emphasis on establishing connections among mathematical ideas, the use of calculators and computers, the amount of emphasis on student communication of mathematical ideas, the use of real life applications, the integration of mathematics with other areas and the amount of emphasis on problem solving will be used as indicators of
change. Effects of other factors such as age, gender, awareness of the NCTM Standards, preparation for using the NCTM Standards and teaching experience will also be analyzed.

**Research Questions**

The relationship between block scheduling and high school mathematics teachers' implementation of the NCTM Standards will be analyzed using the following questions.

1. *Do teachers in block scheduled schools report a greater use of alternative teaching techniques such as small groups, individual explorations, peer instruction, whole-class discussions, and project work than teachers in a traditional schedule?*

2. *Do teachers in block scheduled schools report more calculator and computer use in instruction than teachers in a traditional schedule?*

3. *Do teachers in block scheduled schools report more emphasis on establishing connections among mathematical concepts than teachers in a traditional schedule establish?*

4. *Do teachers in block scheduled schools report more emphasis on student communication of mathematical ideas than teachers in a traditional schedule?*

5. *Do teachers in block scheduled schools report more emphasis on students solving real life applications of problems than teachers in traditional schedules?*

6. *Do teachers in block scheduled schools report more integration of mathematics with other subject areas than teachers on traditional schedules?*

7. *Do teachers in block scheduled schools report a greater emphasis on problem solving than teachers on traditional schedules?*

8. *Do teachers in block scheduled schools report greater support from colleagues and administration than teachers on traditional schedules?*

**Assumptions of the Study**

1. Using a mailed questionnaire that is distributed by a contact person as a tool to collect the needed data for the research is valid and reliable.
2. All the respondents interpreted the questions on the questionnaire correctly and replied honestly.

**Limitations of the Study**

1. This study is limited to high schools in Iowa and may not be generalizable to other settings.
2. The block-scheduling factor is difficult to isolate.
3. The small number of schools involved in the sample limits the generalizability of this study.

**Definition of Terms**

For the purpose of this study, the following definitions are used:

1. **NCTM Standards**: The NCTM Standards were developed in 1989 by the National Council of Teachers of Mathematics (NCTM, 1989). The standards are a broad framework used to guide school mathematics reform. They provide clear goals for students and teachers, outlining what students should know and be able to do.
2. **Block Scheduling**: In this study block scheduling is defined as a 4x4 or accelerated block schedule. In this type of block students enroll in four courses which meet for approximately 90 minutes every day for 90 days.
3. **Secondary Mathematics Teacher**: Any person whose primary teaching assignment is mathematics in grades 9-12 at a public, state accredited institution.
CHAPTER 2. LITERATURE REVIEW

This section presents the research on the National Council of Teachers of Mathematics (NCTM) Standards, the implementation of the NCTM Standards, the adoption of block scheduling, and the advantages and disadvantages to block scheduling.

NCTM Standards

The National Council of Teachers of Mathematics created the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1998) and the *Professional Standards for Teaching Mathematics* (NCTM 1991) in response to nationwide concern about the performance of students and the demands of an increasingly technological world. The standards reflect current thinking about how students learn, emphasizing practices that allow students to construct their own knowledge and take an active role in the learning process. The standards also believe in the principle that all students can rise to meet high expectations (NCTM, 1989). The national standards for mathematics provide goals that outline what students should know and be able to do. They were developed by professional mathematicians and mathematical educators from the experiences of educators, and research on effective practices. The standards called for the introduction of challenging mathematics content to all students beginning in the early grades and de-emphasizing arithmetic computation in favor of having students develop reasoning, problem-solving, and communication skills. The NCTM Standards focus on meaningful problems and active learning (Stepanek, 1997). The Curriculum standards outline five general goals for all students:
• Students should learn to value mathematics. Students should appreciate the role of mathematics in the development of our society and explore relationships among mathematics and the disciplines it serves.

• Students should become confident in one’s own ability. Students need to view themselves as capable of using their growing mathematical power to make sense of new problems in the world around them. They need to understand that doing mathematics is a common human activity.

• Student should become a mathematical problem solver. Students need to work on a variety of problems that may take hours, days and even weeks to solve, that required both independent and cooperative work and that are both formulated and open-ended.

• Students should learn to communicate mathematically. Students need to learn the signs, symbols, and terms of mathematics by reading, writing and discussing mathematical ideas so that the language of mathematics becomes natural.

• Students should learn to reason mathematically. Students need to practice the fundamental steps of making conjectures, gathering evidence and building arguments to support their thinking about a problem (NCTM, 1989).

NCTM advocates that all students must be actively engaged in learning mathematics—using manipulatives to investigate mathematics concepts, and using calculators, computers and other technology to explore mathematics concepts. They stress that teachers use cooperative learning groups, problems that reflect daily life, and a variety of assessment strategies. NCTM encourages teachers to make connections among concepts, to cover fewer topics in greater depth, and to integrate mathematical concepts like algebra, geometry and probability together in one year.

Changes in instruction described by Curriculum and Evaluation Standards (NCTM, 1989, p. 129) include increased attention to:

• The active involvement of students in construction and applying mathematical ideas
• Problem solving as a means as well as a goal of instruction.
• Effective questioning techniques that promote student interaction.
The use of a variety of instructional formats (small groups, individual explorations, peer instruction, whole-class discussions, project work)

- The use of calculators and computers as tools for learning and doing mathematics
- Student communication of mathematical ideas orally and in writing.
- The establishment and application of the interrelatedness of mathematical topics.
- The systematic maintenance of student learning and embedding review in the context of new topics and problem situations.
- The assessment of learning as an integral part of instruction.

Changes in the patterns of assessment that the Curriculum and Evaluation Standards (NCTM, 1989, p. 191) emphasize are:

- Assessing what students know and how they think about mathematics.
- Having assessment be and integral part of teaching.
- Focusing on a broad range of mathematical tasks and taking a holistic view of mathematics.
- Developing problem situations that require the applications of a number of mathematical ideas.
- Using multiple assessment techniques, including written, oral and demonstration formats.
- Using calculators, computers and manipulatives in assessment.

The NCTM Professional Teaching Standards emphasize that teachers play the key role in implementation. Teaching standards were developed to help guide and assist teachers in modifying their instructional practices. They suggest roles that teachers might engage in to make the learning called for in the curriculum standards possible. They also provide guidelines for teachers to consider when designing or selecting tasks. (Stepanek, 1996) The standards address the four major aspects of teachers’ work in the classroom: planning tasks, guiding discourse, creating a positive learning environment and evaluating teaching and learning. The Professional Standards for Teaching Mathematics describes the central aspects of good mathematics teaching as posing tasks, orchestrating discourse, promoting discourse,
encouraging and accepting the use of technology, creating a learning environment, and engaging in ongoing analysis of teaching and learning (NCTM 1991).

- Teachers pose tasks that are based on significant mathematics; knowledge of students' understandings, interests, and experiences; and the diverse range of ways that students learn mathematics. Tasks should develop students' mathematical understanding and skills, promote communication, and call for problem solving, problem formulation, and reasoning.

- Teachers orchestrate discourse by posing questions and tasks that engage and challenge students, by listening to students' ideas, and by monitoring participation. Teachers ask students to clarify and justify their thinking both orally and in writing. They also decide when and how to provide information and when to let a student struggle with a difficulty.

- Teachers promote discourse in which students listen to, question, and respond to one another; initiate problems and questions; and use a variety of tools to reason, make connections, solve problems, and communicate.

- Teachers encourage and accept the use of technology, including calculators and computers; pictures, diagrams, and graphs; and oral presentations and dramatizations in order to enhance discourse.

- Teachers create a learning environment that provides the time necessary to work with significant ideas and problems. Teachers respect and value students' ideas and encourage them to take risks by raising questions and formulating conjectures.

- Teachers engage in ongoing analysis of teaching and learning in order to make plans, adapt activities, and challenge and extend students' ideas. Teachers observe and listen to students and examine the effects of the tasks, discourse, and environment on student's knowledge, skills, and dispositions.

**Implementation of the NCTM Standards**

In this section, two studies, which tracked the implementation of the NCTM Standards, will be summarized. The first is a 1995 survey of the beliefs and concerns of teachers regarding the implementation of mathematics and science reform in Iowa.
This study is of interest because it uses similar population, Iowa teachers, as our research. Fagan collected data on the reform of math and science curriculum programs in Iowa with regard to the NCTM and NRC Standards. A sample of 1858 Iowa math and science teachers grades 1-12 were included in the survey (Fagan, 1996). The second is the 1993 National Survey of Science and Mathematics Education (Weiss, 1995). This study is of interest because the survey instrument used by Weiss was adapted for use in our study. This study collected data regarding the status of science and mathematics education as they relate to the NCTM and NRC Standards. The national sample included 1250 schools and approximately 6,000 teachers in grades 1-12 throughout the United States (Weiss, 1997). Our research focused on the implementation of the NCTM Standards therefore this summary will address only the implementation of the NCTM Standard, not the implementation of the NRC Standards.

Fagan’s study of Iowa teachers indicated that the majority agreed with the underlying NCTM philosophy (1996). The national study by Weiss agreed that generally, teachers reported instructional objectives that were consistent with reform goals, but class activities that were not very well aligned with the recommendations of the NCTM (1997). Specific topics discussed by the two studies are tracking, cooperative learning groups, use of computers and calculators, and the mastery of computational skills before algebra. Weiss also discussed the use of classroom time, the use of alternative instructional strategies, preparation to use the standards and the amount of support teachers felt from their peers and their administration.
The majority of Iowa teachers (51.1%) felt that homogeneous groups foster better learning (Fagan, 1996). A majority (50.8%) also felt that tracking by ability encourages mathematics for all students while 49.5% felt that students learn more in heterogeneous grouped classes (Fagan, 1996). Nationally 7 out of 10 teachers at the high school level, believed that students learn mathematics best when grouped with students of similar abilities (Weiss, 1997). At the high school level 46% of schools assigned students to a mathematics course by ability (Weiss, 1997).

Iowa teachers expressed support for the use of cooperative learning groups. Fagan reports that most (87%) disagreed/strongly disagreed that cooperative learning groups are a hindrance (1996). Seventy-nine percent disagreed/strongly disagreed that it was important for students to learn how to work independently rather than to work with others, and 85.9% disagreed/strongly disagreed that working independently was a skill needed for the future (Fagan, 1996). The national study found similar results with 8 out of 10 high school teachers indicating that cooperative learning was important for effective instruction (Weiss, 1997).

Fagan’s study showed that the majority of Iowa teachers supported the appropriate use of calculators and computers. The majority (90.6%) agreed that calculators should be an integral tool in the mathematics classroom (Fagan, 1996). Weiss found that nationally a large percent (89%) of high school math teachers believed that calculators should be used in mathematics instruction, with 73% agreeing that calculators should be used “most of the time” (1997). This study also found that more than 80% of teachers believed computers are important for effective instruction (Weiss, 1997).
The teachers in Fagan's study held beliefs that closely parallel the underlying philosophy of the NCTM Standards on the issues of drill vs. application problems, the use of the textbook, and the effect of instructional strategies on student learning. The need to master computation skills before studying algebra was one area where Iowa teachers did not agree with the standards, more than half, (56.6%) agreed that computational skills must be mastered before studying algebra (Fagan, 1996). This finding paralleled national beliefs. Weiss found that the majority of mathematics teachers indicated that students must master arithmetic computation before going to algebra (1997).

Iowa teachers expressed beliefs that philosophically align with the overall goals stated by NCTM. “Eighty-eight percent of the teachers agreed/strongly agreed that almost all children can learn to think mathematically, that parental involvement is important (92.8%), that knowing mathematics is doing mathematics (64.3%), that mathematics should be a pump and not a filter (78.2%), and that learning to value mathematics is important (95.8%)” (Fagan, 1996 p. 57).

Both Fagan and Weiss expressed concern about how well teachers' beliefs correspond to the reality of what actually happens in the classroom. Fagan's study looked at the concerns and beliefs of teachers and did not specifically ask what activities they used in the classroom. Weiss looked at both beliefs and practices regarding the NCTM Standards. She found that the typical high school mathematics class spent “48 percent of class time on whole group lecture/discussion, only 14 percent on small group discussions, and only 7 percent working with manipulatives” (1997 p. 3). When asked how often different classroom activities occurred,
lecture/textbook methodologies dominated. Ninety-four percent of classes listened and took notes during presentations by the teacher at least once a week, and 60% did so daily (Weiss, 1997). Ninety-eight percent of classes did mathematics problems from their textbooks at least once a week, and 86% did so on a daily basis (Weiss, 1997).

Alternative classroom activities such as engaging in making conjectures and exploring possible methods to solve a mathematics problems were used in only 40% of classes once a week (Weiss, 1997). Only 30% of classes were asked at least weekly to write out the reasoning used to solve a problem (Weiss, 1997). The majority (56%) of mathematics classes never worked on projects of a week’s duration or longer and 62% had never used computers (Weiss, 1997). One bright point, the majority of classes worked in small groups at least once a week with about 25% working in small groups every day (Weiss, 1997).

The 1993 survey also shows that although teachers believe in the reform, they do not feel that they are well prepared to use the various instructional strategies recommended by the NCTM Standards. For example:

- A least half of mathematics teachers did not feel well prepared to use the computer as an integral part of instruction.
- More that 50% of high school mathematics teachers felt unprepared to involve parents in the education of their children.
- About 40% felt they lacked preparation in the use of performance based assessment.
- 25% of mathematics teachers felt less than well prepared to use textbooks as a resource rather than as the primary instructional tool.
- About 20% of teachers did not feel well prepared to take into account students’ prior conceptions when planning curriculum and instruction (Weiss, 1997).
Mathematics teachers nationally felt supported by their colleagues and their administrations. At the high school level 80% of teachers felt supported by their colleagues to try out new ideas (Weiss, 1995). The majority (67%) regularly shared ideas and materials, and felt they had many opportunities to learn new things in their job (57%) (Weiss, 1995). Eighty percent of high school teachers reported they felt supported by their administration (Weiss, 1995). Although these teachers felt their colleagues supported them, teachers also reported that they had little time to work with them. Only 16% of high school teachers reported that they had time during the regular school week to work with peers on mathematics curriculum and instruction (Weiss, 1995). Only 11% of high school teachers reported regularly observing each other teaching classes as a part of sharing and improving instructional strategies (Weiss, 1995).

Overall, both Weiss and Fagan found that mathematics teachers were quite supportive of the kind of mathematics instruction described in the NCTM Standards. Teachers agreed with the standards about what is important for effective mathematics instruction and embraced the reform goals. However, Weiss found “the instructional strategies teachers used to achieve these goals often were not the ones they themselves said were most effective, leaving classroom instruction far from the vision described in the NCTM Standards” (1997, p. 7). Weiss concluded that “in the short run, greatly increased opportunities for high-quality in-service education are essential to meet the needs of the many mathematics teachers who are not prepared to implement the NCTM Standards” (1995, p. 16).
Adoption of Block Scheduling

In this section the block scheduling reform movement will be reviewed. Block scheduling is a separate reform movement that is working to improve learning in secondary schools. Many of the advantages that are offered by block scheduling should promote the goals of the NCTM Standards.

Many schools around the country are adopting block scheduling. A 1994 national survey by Gordon Cawelti, and a survey in Virginia by Michael Rettig in 1995 show that an estimated 50% of high schools in the United States are either using or considering some form of block scheduling. Block scheduling generally falls into two forms, the alternate day schedule and the 4x4-semester plan. The first, the alternate day schedule would typically allow a student to take eight courses. Each course would meet for 80-95 minutes every other day for the entire school year. The second form is the 4x4, intensive or semestered block which is the focus of this study (referred to as block scheduling throughout). In block scheduling typically a student would take four courses which meet for 80-95 minutes daily for ninety days. In a block plan students can take up to 8 classes per year, in a traditional schedule students generally took up to 7 classes per year. Teachers teach three courses each semester. Courses that traditionally took a full year are completed in one semester on a block schedule.

Many schools have altered the purest forms of these schedules to include singleton classes that meet daily for 50+ minutes, and some schools have pared classes to provide even greater flexibility for advanced placement and other special courses. These adjustments help satisfy the needs of music, band, physical education and foreign language programs that need to meet every day.
Advantages and Disadvantages of Block Scheduling

This section summarizes the literature about the block scheduling movement. The advantages and disadvantages will be discussed along with some neutral issues that surround the adoption of block scheduling.

Advantages of block scheduling

Block is gaining popularity for many reasons. The advantages fall in both academic and non-academic categories. The academic advantages include more time each day for in-depth study, fewer classes to prepare for on a daily basis, reduced failure rates, reduced dropout rates, and reduction of the student-to-teacher ratio. The non-academic advantages include reduced discipline problems, and improved school atmosphere.

Block scheduling offers the advantage of having more time each day for in-depth study. This claim is supported by the studies done by King et al. (1978), Carroll (1994), Meadows (1995), Sessoms (1995), Canady and Rettig (1995) and Queen, Algozzine, and Eaddy (1997). Teachers feel that they can cover material in more depth, which allows student to develop a deeper understanding of the material.

In a block schedule students and teachers have fewer classes to prepare for on a daily basis (Queen, Algozzine, and Eaddy, 1997; Francka and Lindsey, 1995; Carroll, 1994; and Reid, 1995a). The reduction in the number of classes to prepare allows students to focus on only four classes and teaching styles at a time. The reduction of classes also helps students to be better organized.

The reduction of failure rates is well supported when a block schedule is adopted. Six case studies (Hottenstein and Malatesta, 1993; Johnson HS, 1995; Schoenstein, 1995; Reid 1995b; Hackmann, 1995 and Pisapia and Westfall, 1997) reported decreases in failure rates
at schools with block schedules. Several reasons for this are noted. The first reason is the reduction of the number of courses a student takes at one time. The development of classes to help low-achieving students may also create a reduction in the failure rate. The third reason noted was the opportunity for students to retake a failed course in the next semester and remain on track with their age-mates (Edwards, 1995; Kramer, 1997).

Most schools on a block schedule report a reduction in dropout rates, however Pisapia and Westfall (1997) report that three schools reported higher dropout rates while three reported no change. Guskey and Kifer (1995) also report no change in dropout rates in their study of a high school in Maryland. Case studies indicating reduced dropout rates were reported by Carroll (1994), Hottenstein and Malatesta (1993), Pulaski County High School (1995), and Reid (1995a). A study by Sharman (1990) also found that students in block scheduled schools had significantly lower dropout rates.

Block scheduling offers another advantage of giving teachers' significantly smaller student loads and students significantly fewer teachers to satisfy. Because teachers spend more time with fewer students and vise versa, student-teacher relationships improve (Moodie, 1971; Glendow, 1975; Davis et al., 1977; Brophy, 1978; Munroe, 1989; Whita et al., 1992; Carroll, 1994; Canady and Rettig, 1995; Guskey and Kifer, 1995; Reid, L. 1995; Eineder and Bishop, 1997).

In schools that adopt block schedules student discipline problems are reduced, as measured by suspensions and or discipline referrals. Carroll's (1994) study reported reduced suspension rates, with reduction ranging from 25 to 75 percent. Other studies found similar results (Guskey and Kifer, 1995; Hackmann, 1995; Hillcrest HS, 1995; Meadows, 1995; Reid, 1995; Sessoms, 1995; Eineder and Bishop, 1997; Pisapia and Westfall, 1997).
Findings suggest that the adoption of a block schedule creates an improved school climate with a less stressful atmosphere where students and teachers are more relaxed and focused (Carroll, 1994; Canady and Rettig, 1995, Francka and Lindsey 1995, Guskey and Kifer, 1995; Hackmann, 1995; Meadows 1995; Reid, 1995; Sessoms, 1995, Pisapia and Westfall, 1997).

Disadvantages of block scheduling

Block scheduling also has disadvantages. The disadvantages include loss of retention from one level of a course to the next, too few teaching strategies being used in the classroom, the need for appropriate staff development, lack of adequate counseling, ill-prepared substitute teachers, and student transfers from schools not on block.

The retention issue is a persistent disadvantage to the block schedule. Because courses are completed in one semester it is possible that an entire year might elapse before students take the next course in the sequence. Studies that note retention as a disadvantage include Canady and Rettig (1996), and Queen, Algozzine, and Eaddy (1997).

Several authors including Canady and Rettig (1996), O'Neil (1995) have noted the importance of using a variety of teaching strategies. O'Neil states that “although longer classes support instructional innovations they don’t necessarily result in it.” (1995 p 14). Block scheduling creates an atmosphere where instructional changes must be made in the classroom. A pure, direct instruction/lecture mode of instruction does not work as well in a longer time block (King et al., 1975; Canady and Rettig, 1994; Meadows, 1995; O'Neil, 1995; Reid, 1995; Queen, Algozzine, and Eaddy, 1997).

The need for appropriate staff is directly related to the need for a variety of teaching strategies. In order for teachers to use more active learning strategies they must be given
support and staff development training prior to the change to block (King et al., 1978; Canady and Rettig, 1995; Guskey and Kifer, 1995; Francka and Lindsey, 1995; O’Neil, 1995; Hundley, 1996; George, 1997; Queen, Algozzine, and Eaddy, 1997). In fact, Canady and Rettig (1996), comment that “appropriate staff development activities are necessary to help teachers successfully use time in a block schedule. If proper staff development is not provided, we strongly recommend that schools not go to block scheduling.”

The need for adequate counseling is necessary so students can develop a schedule that balances the difficulty of students’ course load across the semesters (Guskey and Kifer, 1995; Queen, Algozzine, and Eaddy, 1997).

Guskey and Kifer (1995) note two other disadvantages to block scheduling, students transferring from a traditional or other type of schedule into a block schedule and ill-prepared substitute teachers.

Other issues

Attendance changes due to block scheduling are mixed. Two case studies report improvements (Cameron, 1995; O’Neil, 1995). Most other studies reported little or no change in attendance figures (Cox, 1995; Guskey and Kifer, 1995; Meadows, 1995; Pulaski County HS, 1995). Carroll (1994), Reid (1995), Sessoms (1995), and Pisapia and Westfall (1997) showed mixed results in multi-school studies where some schools showed increased attendance, some showed decreased attendance, and others, no change at all. More study needs to be done to make firm conclusions about the effect of block scheduling on attendance.

The literature shows a strong positive attitude from teachers and students who are on the block schedule. “I would never go back” seems to sum up the feelings of those involved.

**Block Scheduling and Mathematics**

Although most teachers on block scheduling say they would never go back, often math teachers are less than supportive of the move to a block schedule (Reid, 1995; Usiskin, 1995). They fear that the math curriculum will not fit well into longer blocks of time. They are also concerned about the gaps created in sequential math instruction (Kramer, 1997; Wronkovich, Hess and Robinson, 1997). The 90-minute class period poses the problem of holding students’ attention, and the need for assimilation time between practice sessions (Wronkovich, Hess and Robinson, 1997). Studies that describe the effect of block scheduling specifically on the mathematics classroom are scarce. Some studies look at the effects on achievement tests in general, while other leave questions about the validity of their findings by testing students before the class in over, putting block scheduled students at a disadvantage, or by not having representative samples from both groups. In general it is apparent that more study needs to be done on the effects of block scheduling on mathematics.

The best data currently available come from studies in North Carolina, British Columbia, and Ohio. Block scheduling appears to have a positive effect in North Carolina, while in British Columbia and Ohio it has a negative effect.

Averett, (1994) compared the test scores at a large number of schools in North Carolina that switched from a traditional schedule in 1992-93 to a block schedule in 1993-94. Standardized end-of-course tests were given in algebra II, geometry, English I, U.S. history
and economic, legal, and political systems. Overall, Averett’s (1994) data seem to indicate that switching to a block schedule had either no effect or a slightly positive effect on achievement on these five subject areas. This is true despite a reduction of at least 15 hours of in class time for the block classes.

Marshall et al. (1995) reported data from British Columbia’s 1995 Mathematics and Science assessment. This study indicated that traditional students scored higher than block scheduled students. One limitation of this study is that the test was administered in May 1995, so block students had not yet completed the course.

Wronkovich et al. (1997) reported data from the Ohio Colleges EMPT an achievement test, designed to measure skills that directly relate to success in college level math classes. The performance of students on this test seems to indicate that those involved in traditional studies in math should perform better in collegiate level mathematics than those involved in block scheduling when comparing students of similar ability. This study also may be limited due to when the test was administered.

The research on mathematics achievement while in a block schedule is inconclusive. Clearly more research needs to be done which tests students at the end of their course work and compares samples of similar students.
CHAPTER 3. MATERIALS AND METHODS

This chapter is the summary of the research methodology of this study and is organized as follows: 1. Research Design, 2. Development of the Instrument, 3. Population and Sample, 4. Data Collection, 5. Data Analysis.

Research Design

This study was designed to collect descriptive information using a cross-sectional survey. There are a number of ways to collect this information, the survey could be administered face to face, over the phone, by mail, or to a group. Mailed questionnaires provide the advantage of being relatively inexpensive and the researcher alone can accomplish the data collection. It also permits the respondents to take sufficient time to give thoughtful answers to the questions asked (Fraenkel and Wallen 1996). The disadvantages of mail surveys are that there is less opportunity to encourage the cooperation of the respondents and to provide assistance (Fraenkel and Wallen 1996). Since the population of this study covered the school districts in the state of Iowa, a mailed questionnaire was the most practical way to save time and expense, and to gather data for the study.

Survey Instrument

The survey instrument was originally designed, tested and used in the 1993 National survey of Science and Mathematics Education (Weiss, 1995). Permission to use the survey was granted via e-mail on December 16, 1997 (see Appendix B. Permission to use Survey). Reliabilities were not establish for the entire instrument, however Weiss created composites of those items as part of other work, and generally found Cronbach alphas in the 0.75-0.9
range for clusters of 5 or more conceptually related items. Questions from the 1993 National survey of Science and Mathematics Education survey were selected to reflect the focus of this study. The research advisory committee reviewed these questions and offered suggestions on items that should be omitted from the new instrument. Of the original 259 questions 92 were used to create the new instrument. This survey instrument consisted of several sections (see Appendix C Survey Instrument). The first section consisted of 14 statements using a 5-point Likert scale. The statements were designed to reflect the participants' attitudes and beliefs about mathematics. The second section consisted of 18 statements using a 5-point Likert scale to probe teachers' beliefs about mathematics teaching as envisioned by the NCTM Standards. The third section was comprised of 10 statements that address how well teachers are prepared to teach using strategies suggested by the NCTM Standards. A 4-point Likert scale was used in section three. The fourth section used fill in the blank format to assess the participants' education level and area. The fifth section identifies how many hours of in-service training teachers have had in the past 3 years. The sixth and seventh sections use statements to determine the participants' familiarity with the NCTM Curriculum and Evaluation Standards, and the NCTM Professional Standards for teaching Mathematics. The eighth and ninth sections focus on the activities that take place in the classroom. Section eight looks specifically at how much emphasis is placed on different objectives, 15 questions using a 6-point Likert scale. Section nine looks at how frequently students participate in different learning, 14 questions on a 5-point Likert scale. Section ten consists of six items that look at what type of equipment is available and how often that equipment is used. The last section collects demographic information and information on what type of schedule is used at the school.
Population and Sample

The population for this study was high school mathematics teachers in the state of Iowa. Ten high schools were chosen to be part of the sample, the schools were Bettendorf, Davenport Central, Eldora, Fort Dodge, South Tama, Davenport North, East Marshall, Marshalltown, Mason City, and Nevada. See Figure 1 below for location of the cities in the sample. Five of these schools, Bettendorf, Davenport Central, Eldora, Fort Dodge, and South Tama were on a block-schedule, and were randomly chosen. The other 5 schools, Davenport North, East Marshall, Marshalltown, Mason City and Nevada were traditionally scheduled and were chosen to roughly match the block schools in size and demographics (See Table 1. Block and Traditional Pairs).

Figure 1. Location of Sample Cities
Table 1. Block and Traditional Pairings

<table>
<thead>
<tr>
<th>TRADITIONAL</th>
<th>BLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nevada</td>
<td>South Tama</td>
</tr>
<tr>
<td>Marshalltown</td>
<td>Bettendorf</td>
</tr>
<tr>
<td>Davenport North</td>
<td>Fort Dodge</td>
</tr>
<tr>
<td>Mason City</td>
<td>Davenport Central</td>
</tr>
<tr>
<td>East Marshall</td>
<td>Eldora</td>
</tr>
</tbody>
</table>

The school districts in the sample ranged in enrollment from 788 students to 17,657 students. The enrollment at the high schools in these districts ranged from 267 students to 1550 students. The population of the cities that the districts are in ranged from 4,237 people to 102,829 people (see Table 2. Population)

The block high schools and traditional high schools had a similar average free and reduced lunch percent with block at 22.97% and traditional at 21.23. Block high schools had a wider range, from 6.92% to 30.58%. Traditional schools ranged from 17.45% to 24.35% (see Table 3 Free and Reduced Lunch Percents).

Table 2. Population

<table>
<thead>
<tr>
<th>District</th>
<th>District Population</th>
<th>District Enrollment</th>
<th>High School Enrollment</th>
<th>Traditional Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bettendorf</td>
<td>20,607</td>
<td>4,559</td>
<td>1,539</td>
<td>Block</td>
</tr>
<tr>
<td>Bettendorf High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davenport</td>
<td>102,829</td>
<td>17,657</td>
<td>1,340</td>
<td>Block</td>
</tr>
<tr>
<td>Central High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North High School</td>
<td></td>
<td></td>
<td>1,289</td>
<td>Traditional</td>
</tr>
</tbody>
</table>

Table 2. (continued)

<table>
<thead>
<tr>
<th>District</th>
<th>District Population</th>
<th>Enrollment</th>
<th>High School Enrollment</th>
<th>Traditional Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Marshall</td>
<td>4,237</td>
<td>866</td>
<td>267</td>
<td>Block</td>
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<tr>
<td>East Marshall Senior High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eldora-New Providence</td>
<td>4,479</td>
<td>788</td>
<td>281</td>
<td>Block</td>
</tr>
<tr>
<td>Eldora-New Providence High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fort Dodge</td>
<td>30,952</td>
<td>4,812</td>
<td>1,421</td>
<td>Block</td>
</tr>
<tr>
<td>Fort Dodge High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marshalltown</td>
<td>28,320</td>
<td>5,001</td>
<td>1,550</td>
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<tr>
<td>Marshalltown High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mason City</td>
<td>30,261</td>
<td>4,832</td>
<td>1,360</td>
<td>Traditional</td>
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<tr>
<td>Mason City High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nevada</td>
<td>7,462</td>
<td>1,627</td>
<td>512</td>
<td>Traditional</td>
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<tr>
<td>Nevada High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Tama</td>
<td>8,679</td>
<td>1,713</td>
<td>514</td>
<td>Block</td>
</tr>
<tr>
<td>South Tama County High School</td>
<td></td>
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</tr>
</tbody>
</table>

a. 1990 Census data  

Table 3. Free and Reduced Lunch Data by District and School

<table>
<thead>
<tr>
<th>District</th>
<th># of Students Eligible</th>
<th># of Students Enrolled</th>
<th>Free &amp; Reduced Lunch Percent</th>
<th>Block or Traditional</th>
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</thead>
<tbody>
<tr>
<td>EAST MARSHALL *</td>
<td>302</td>
<td>828</td>
<td>36.47</td>
<td>Traditional</td>
</tr>
<tr>
<td>East Marshall Sr. High</td>
<td>55</td>
<td>250</td>
<td>22.0</td>
<td>Traditional</td>
</tr>
<tr>
<td>ELDORA-NEW PROVIDENCE</td>
<td>249</td>
<td>771</td>
<td>32.3</td>
<td>Block</td>
</tr>
<tr>
<td>Eldora-New Providence High School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARSHALLTOWN</td>
<td>1886</td>
<td>4872</td>
<td>38.71</td>
<td>Traditional</td>
</tr>
<tr>
<td>Marshalltown High</td>
<td>363</td>
<td>1639</td>
<td>22.15</td>
<td>Traditional</td>
</tr>
</tbody>
</table>

a. Bold is data for entire district
Table 3. (continued)

<table>
<thead>
<tr>
<th></th>
<th># of Students Eligible</th>
<th># of Students Enrolled</th>
<th>Free &amp; Reduced Lunch Percent</th>
<th>Block or Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BETTENDORF</strong></td>
<td></td>
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<tr>
<td>Bettendorf High</td>
<td>511</td>
<td>4552</td>
<td>11.23</td>
<td>Block</td>
</tr>
<tr>
<td></td>
<td>106</td>
<td>1532</td>
<td>6.92</td>
<td></td>
</tr>
<tr>
<td><strong>NEVADA</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Nevada High</td>
<td>325</td>
<td>1599</td>
<td>20.33</td>
<td>Traditional</td>
</tr>
<tr>
<td></td>
<td>85</td>
<td>487</td>
<td>17.45</td>
<td></td>
</tr>
<tr>
<td><strong>SOUTH TAMA COUNTY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Tama County High</td>
<td>630</td>
<td>1768</td>
<td>35.63</td>
<td>Block</td>
</tr>
<tr>
<td></td>
<td>122</td>
<td>499</td>
<td>24.45</td>
<td></td>
</tr>
<tr>
<td><strong>MASON CITY</strong></td>
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</tr>
<tr>
<td>Mason City High</td>
<td>1417</td>
<td>4662</td>
<td>30.39</td>
<td>Traditional</td>
</tr>
<tr>
<td></td>
<td>265</td>
<td>1311</td>
<td>20.21</td>
<td></td>
</tr>
<tr>
<td><strong>DAVENPORT</strong></td>
<td></td>
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</tr>
<tr>
<td>Central High</td>
<td>7187</td>
<td>17157</td>
<td>41.89</td>
<td>Block</td>
</tr>
<tr>
<td>North High</td>
<td>422</td>
<td>1380</td>
<td>30.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>289</td>
<td>1187</td>
<td>24.35</td>
<td></td>
</tr>
<tr>
<td><strong>FORT DODGE</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fort Dodge High</td>
<td>1471</td>
<td>4487</td>
<td>32.78</td>
<td>Block</td>
</tr>
<tr>
<td></td>
<td>313</td>
<td>1345</td>
<td>23.27</td>
<td></td>
</tr>
</tbody>
</table>

a. Bold is free and reduced data for entire district

**Data Collection**

In preparation to collect the data, a letter was sent to the principals of the schools asking for their permission and cooperation with the study. They were asked to provide the name, phone, and e-mail address of a contact person (head of the math department) from within the mathematics department that could help with the distribution of the surveys, and the number of mathematics teachers in their buildings (see Appendix D. Principal’s Letter). Four of the principals responded by letter or by e-mail, the other six were contacted by phone and gave verbal permission to survey their mathematics teachers. A letter was then sent to the contact people asking them if they would be willing to help in the data collection process.
by distributing the surveys to the staff of the math department, collecting the completed surveys and to returning them by mail (see Appendix E. Contact’s Letter). The surveys with cover letter (see Appendix F. Cover Letter) and confidentiality envelope, and postage paid return mail envelope were sent to the contact people, 72 surveys in all. Seven of the ten contact people distributed and returned the surveys. The three others were issued a reminder by phone. One had lost the return envelope and needed the proper address, one had not handed them out yet, and one had just put them in the mail. Once all the contact people had responded a total of 63 surveys were returned at a rate of 87%. The use of a contact person within each school's math department and communication with the principals and contact people by phone whom did not respond appeared to have a strong positive effect on the high rate of return.

Data Analysis

First the demographic data for the respondents were analyzed using descriptive statistics. Second the items on the survey were classified to correspond to the appropriate variable and the data were reversed where appropriate. There were eight variables, which corresponded to the research questions, used to classify the survey items. These eight variables were 1) alternative teaching techniques, 2) calculator and computer use, 3) connections to mathematics, 4) communication of mathematical ideas 5) real life applications, 6) integration with other areas, 7) problem solving and 8) support. The questions were classified and reviewed by the research advisory committee. The following questions apply to each variable.

1) Alternative teaching techniques
How much emphasis will each of the following student objectives receive?
1. Learn mathematical concepts (reversed)
2. Learn mathematical algorithms (reversed)

How often do students take part in the following types of activities?
3. Work in small groups
4. Work in class on mathematics projects that take a week or more
5. Work at home on mathematics projects that take a week or more
6. Use manipulative materials or models

2) Calculator and computer use

How often do students take part in the following types of activities?
1. Use computers/calculators to explore problems
2. Use computers/calculators to do computations
3. Use computer/calculators to develop an understanding of mathematics concepts

3) Connections to mathematics

How much emphasis will each of the following student objectives receive?
1. Learn how mathematical ideas connect with one another
2. Understand the logical structure of mathematics

4) Communication of mathematical ideas

How much emphasis will each of the following student objectives receive?
1. Learn to explain mathematical ideas effectively

How often do students take part in the following types of activities?
2. Write their reasoning about how to solve a problem
3. Participate in dialogue with the teacher to develop and idea

5) Real life applications

How much emphasis will each of the following student objectives receive?
1. Increase awareness of the importance of mathematics in daily life
2. Learn about the applications of mathematics in science
3. Learn about the applications of mathematics in business and industry

How often do students take part in the following types of activities?
4. Learn about mathematics through real-life applications

6) Integration with other areas

How much emphasis will each of the following student objectives receive?
1. Learn about the applications of mathematics in science
2. Learn about the applications of mathematics in business and industry
7) Problem solving

How much emphasis will each of the following student objectives receive?
1. Learn how to solve problems
2. Learn to reason mathematically

How often do students take part in the following types of activities?
3. Make conjectures and explore possible methods to solve a mathematical problem
4. Use calculators/computers to explore problems

8) Support

1. I feel supported by colleagues to try out new ideas in teaching mathematics
2. I receive little support from the school administration for teaching mathematics (reversed)
3. Mathematics teachers in this school regularly share ideas and materials
4. Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies
5. I feel that I have many opportunities to learn new things in my present job
6. I have time during the regular school week to work with my peers on mathematics curriculum and instruction.

The data for each research question were analyzed using a t-test. In addition a regression analysis was done using implementation of the NCTM Standards as a dependent variable and awareness, preparation, experience, age, gender, type of scheduling and support as independent variables. The dependent variable: implementation of the NCTM Standards was found by summing the scores on the implementation sections of the survey instrument (sections 8 and 9). The higher the score, which could range from 11 to 130, the more the standards had been implemented. The questions from section 8 included in the implementation sum were:

Think about the mathematics class you most often teach. How much emphasis will each of the following student objectives receive?

a. Increase interest in mathematics
b. Learn mathematical concepts (reversed)
c. Learn mathematical algorithms (reversed)
d. Learn how to solve problems
e. Learn to reason mathematically
f. Learn how mathematical ideas connect with one another

g. Prepare for further study in mathematics (reversed)

h. Understand the logical structure of mathematics

i. Learn about the history of mathematics

j. Learn to explain mathematical ideas effectively

k. Increase awareness of the importance of mathematics in daily life

l. Learn about the applications of mathematics in science.

m. Learn about the application of mathematics in business and industry

n. Learn to perform computations with speed and accuracy (reversed)

o. Prepare for standardized tests (reversed)

The questions from section 9 included in the implementation sum were:

Think about the math class you most frequently teach. About how often do students in this mathematics class take part in the following types of activities?

a. Work in small groups

b. Work in class on mathematics projects that take a week or more

c. Work at home on mathematics projects that take a week or more

d. Make conjectures and explore possible methods to solve a mathematical problem

e. Learn about mathematics through real-life applications

f. Write their reasoning about how to solve a problem

g. Use manipulative materials or models

h. Use computers/calculators to explore problems

i. Use computers/calculators to do computations

j. Use computers/calculators to develop an understanding of mathematics concepts

k. Participate in dialogue with the teacher to develop an idea

The independent variables of awareness, preparation and support were found using a method similar to that for implementation, while experience, gender and type of scheduling were taken directly from the survey questions, age was found by finding the difference between 98 and the year born.

The awareness variable was found by finding the sum of the scores in section 6 and 7 of the survey instrument. Question 6a and 7a were reversed so a high score correlated to more awareness of the standards. The awareness sum could range from 6 to 28. The questions included in the awareness sum were:

6. a. The National Council of Teachers of Mathematics has prepared *Curriculum and Evaluation Standards*, generally called the NCTM Standards, for mathematics
instruction. Which of the statements below best describes your familiarity with the NCTM Standards? (CIRCLE ONE) (reversed)

Well aware of the NCTM Standards .......................................................... 1
Heard of the NCTM Standards but don’t know much about them............ 2
Not aware of the NCTM Standards .......................................................... 3
Not sure ..................................................................................................... 4

b. Please indicate the extent to which you agree with each of the following statements.
1. I am well informed about the NCTM Standard for the grades I teach
2. I am prepared to explain the NCTM Standards to my colleagues

7. a. The National Council of Teachers of Mathematics has prepared Professional Standards for Teaching Mathematics, generally called the NCTM Teaching Standards, for mathematics instruction. Which of the statements below best describes your familiarity with the NCTM Teaching Standards? (CIRCLE ONE) (reversed)

Well aware of the NCTM Teaching Standards ........................................ 1
Heard of the NCTM Teaching Standards but don’t know much about them 2
Not aware of the NCTM Teaching Standards ........................................ 3
Not sure ..................................................................................................... 4

b. Please indicate the extent to which you agree with each of the following statements.
3. I am well informed about the NCTM Teaching Standards for the grades I teach
4. I am prepared to explain the NCTM Teaching Standards to my colleagues

The preparation variable was found by summing the answers to the 3rd section of the survey instrument. The higher the sum, which could ranged from 8 to 32, the more prepared the teacher was to implement the standards. The questions included in the preparation sum were:

How well prepared are you to do each of the following?
   a. Present the applications of mathematics concepts.
   b. Use cooperative learning groups.
   c. Take into account students’ prior conceptions about mathematics when planning curriculum and instruction.
   d. Use computers as an integral part of mathematics instruction.
   e. Integrate mathematics with other subject areas.
   f. Manage a class of students who are using manipulatives.
   g. Use a variety of assessment strategies.
   h. Use the textbook as a resource rather than as the primary instructional tool.
i. Use calculators as an integral part of mathematics instruction.

j. Use performance-based assessment.

The independent variable of support was found by finding the sum of 6 questions in section 1 of the survey. The sum could range from 6 to 30 where a high score corresponds to more support. The questions included in the support sum were:

Please provide your opinion about each of the following statements.
1. I feel supported by colleagues to try out new ideas in teaching mathematics
2. I receive little support from the school administration for teaching mathematics (reversed)
3. Mathematics teachers in this school regularly share ideas and materials
4. Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies
5. I feel that I have many opportunities to learn new things in my present job.
6. I have time during the regular school week to work with my peers on mathematics curriculum and instruction.

In addition, to further test the significance of the implementation of block scheduling the t-tests were repeated for each research question using only the participants who reported a high preparation level for use of the NCTM Standards (section 3 of survey). The preparation rate was figured by averaging the scores on the preparation used in the regression analysis. These questions were scored using a 4-point Likert scale where 1 was not well prepared, 2 was somewhat prepared, 3 was fairly well prepared and 4 was very well prepared. The participant's were labeled as highly prepared if their average preparation score was greater than 2.5. An alpha level of 0.05 was used throughout the testing.

Summary

This chapter summarized the research procedures and methods used in this study. The survey consisted of 92 of the original 259 questions used in the 1993 National survey of
Science and Mathematics Education (Weiss, 1995). Survey packets were sent to 10 contact people, one at each high school with a total of 72 surveys sent. A return rate of 87% was achieved with the return of 63 surveys. The data collected were analyzed using descriptive statistics, regression analysis and t-tests.
CHAPTER 4. RESULTS AND DISCUSSION

In this chapter results and findings are presented. There are four sections in this chapter: (1) demographic characteristics, (2) findings related to research questions, (3) results of the regression analysis (4) findings related to the research question using participants with high preparation.

Demographic Characteristics

Six items of demographic information, including gender, age, years of teaching experience, type of schedule of school, and degrees held are reported in the first section of this chapter.

When examining the data concerning the respondents' gender and age as shown in Table 4, it was found that 35 of the respondents (55.5%) were male while the remaining 28 (44.4%) were female. The average age of the respondents was 44 years, while the maximum age was 61 years and the minimum age was 23 years. The largest group of respondents, 16 of 63 (25.4%), fell in the 45-49 year age group while the smallest group of respondents, 1 of 63 (1.6%), fell in the 20-24 year age group. Refer to Figure 2 for more details. Figure 3 shows the experience level of the respondents. The average amount of experience was 20 years, while the minimum was zero, and the maximum was 36 years of teaching.

Table 4. Gender of Respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>35</td>
<td>55.5</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>44.4</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>100</td>
</tr>
</tbody>
</table>
Figure 2. Age of Respondents

Figure 3. Teaching Experience
When the data were sorted for teachers on block or traditional scheduling, 32 (50.7%) respondents were currently on a block schedule while 31 (49.2%) were on a traditional schedule. Of the block respondents, 17 were male (53%) and 15 were female (47%). The traditional respondents had 18 (58%) males and 13 females (42%) (see Table 5).

Table 5. Gender of Respondents Block and Traditional

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>17</td>
<td>53.1</td>
<td>15</td>
<td>46.9</td>
<td>32</td>
<td>50.7</td>
</tr>
<tr>
<td>Traditional</td>
<td>18</td>
<td>58.1</td>
<td>13</td>
<td>41.9</td>
<td>31</td>
<td>49.2</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>55.6</td>
<td>28</td>
<td>44.4</td>
<td>63</td>
<td>100</td>
</tr>
</tbody>
</table>

The data showed that 58 of the respondents (92.1%) had earned a bachelor’s degree in mathematics. The other 5 respondents earned bachelor’s degrees in other areas. Seventeen of the respondents (27.0%) had earned a master’s degree in mathematics while 11 (17.5%) had earned master’s degrees in other areas. A total of 28 respondents (44.4%) had earned a master’s degree. When the data were broken down between block and traditional respondents, the block respondents had 91% with a bachelor’s degree in mathematics and 25% with a master’s degree in mathematics. A total 47% of block respondents had earned a master degree. The traditional respondents had 94% with a bachelor degree in mathematics and 29% with a master in mathematics. A total of 42% of traditional respondents had earned a master degree (see Table 6). The data showed that the block-scheduled teachers had on average been teaching with a block schedule for 1 year prior to the current teaching year.
Table 6. Distribution of degrees, Block and Traditional

<table>
<thead>
<tr>
<th></th>
<th>Block</th>
<th></th>
<th>Traditional</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Masters</td>
<td>15</td>
<td>47</td>
<td>13</td>
<td>42</td>
<td>28</td>
<td>44.4</td>
</tr>
<tr>
<td>BS Math</td>
<td>29</td>
<td>91</td>
<td>29</td>
<td>94</td>
<td>58</td>
<td>92.1</td>
</tr>
<tr>
<td>MA Math</td>
<td>8</td>
<td>25</td>
<td>9</td>
<td>29</td>
<td>17</td>
<td>27.0</td>
</tr>
</tbody>
</table>

Findings Related to Research Questions

The following are the findings concerning the research questions of this study. The implementation of the National Council of Teachers of Mathematics (NCTM) Standards was measured using the eighth and ninth sections of the survey. The items on the survey were classified to correspond to the appropriate variable and the data were reversed where appropriate. There were eight variables, which corresponded to the research questions, used to classify the survey items. These eight variables were 1) alternative teaching techniques, 2) calculator and computer use, 3) connections to mathematics, 4) communication of mathematical ideas 5) real life applications, 6) integration with other areas, 7) problem solving and 8) support. The mean and standard deviation for each survey item was found and was used for the calculation of the T-test.

Research question 1

Do teachers in block scheduled schools report a greater use of alternative teaching techniques such as small groups, individual explorations, peer instruction, whole-class
discussions, and project work than teachers in a traditional schedule? There were six items on the survey that addressed this question. The block and traditional means were 1.984 and 1.978 respectively on a scale where one was minimal, three was moderate emphasis and five was very heavy emphasis (see Table 7). The standard deviation of about 1 for both block and traditional shows that the majority of the teachers surveyed gave only moderate emphasis to alternative teaching techniques in the classroom. The t-test done on these items had a 2-tailed probability of 0.9845. This offers evidence that teachers in block scheduled schools and traditionally scheduled schools use about the same amount of alternative teaching techniques.

Table 7. Results for Research Question 1: Alternative Teaching Techniques

<table>
<thead>
<tr>
<th></th>
<th>( \bar{x} )</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>1.984</td>
<td>1.193</td>
<td>32</td>
<td>0.0195</td>
<td>0.9845</td>
</tr>
<tr>
<td>Traditional</td>
<td>1.978</td>
<td>1.250</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Research question 2

Do teachers in block scheduled schools report more calculator and computer use in instruction than teachers in a traditional schedule? There were three items on the survey that addressed this question. The block and traditional means were 3.801 and 4.462 and standard deviations of 0.809 and 0.433 respectively (see Table 8). In this section a 4 corresponds to once or twice a week, a 5 corresponds to almost daily. This shows that teachers at both types of schools are using calculators and computers on a regular basis. The t-test had a 2-tailed probability that was less than 0.001 this offers evidence that the traditional teachers use calculators and computers significantly more than block teachers do.
Table 8. Results for Research Question 2: Calculator and Computer Use

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.801</td>
<td>0.809</td>
<td>32</td>
<td>-4.0604</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Traditional</td>
<td>4.462</td>
<td>0.433</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Research question 3

Do teachers in block scheduled schools report more emphasis on establishing connections among mathematical concepts than teachers in a traditional schedule establish? There were two items on the survey that addressed this question. The block and traditional means are 4.047 and 3.855 with standard deviations of 0.110 and 0.433 respectively (see Table 9). This corresponds to moderate to heavy emphasis on establishing connections among mathematical concepts for both groups of teachers. The t-test done on these items had a 2-tailed probability of 0.0223. This offers evidence that teachers in block scheduled schools report a significantly higher emphasis on establishing connections among mathematical concepts than teachers in traditionally scheduled schools.

Table 9. Results for Research Question 3: Establishing Connections

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>4.047</td>
<td>0.110</td>
<td>32</td>
<td>2.3951</td>
<td>0.0223</td>
</tr>
<tr>
<td>Traditional</td>
<td>3.855</td>
<td>0.433</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Research question 4

Do teachers in block scheduled schools report more emphasis on student communication of mathematical ideas than teachers in a traditional schedule? There were three items on the survey that addressed this question. The block and traditional means were 3.177 and 3.656 the standard deviations were 0.370 and 0.274 respectively (see Table 10). This roughly corresponds to a moderate emphasis on the communication of mathematical ideas. The t-test done on these items had a 2-tailed probability that was less than 0.001. This offers evidence that teachers in traditionally scheduled schools report a significantly higher emphasis on student communication of mathematical ideas than teachers in block scheduled schools.

Table 10. Results for Research Question 4: Communication of Mathematical Ideas

<table>
<thead>
<tr>
<th></th>
<th>x</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.177</td>
<td>0.370</td>
<td>32</td>
<td>-5.8519</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Traditional</td>
<td>3.656</td>
<td>0.274</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Research question 5

Do teachers in block scheduled schools report more emphasis on students solving real life applications of problems than teachers in traditional schedules? There were four items on the survey that addressed this question. The block and traditional means for these items were 3.273 and 3.492 and the standard deviations were 0.359 and 0.382 (see Table 11). These
means correspond to moderate to heavy emphasis on real life applications. The t-test done
on these items had a 2-tailed probability of 0.0224. This offers evidence that teachers in
traditionally scheduled schools report a significantly higher emphasis on students solving real
life applications of problems than teachers in block scheduled schools.

Table 11. Results for Research Question 5: Real Life Applications

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.273</td>
<td>0.359</td>
<td>32</td>
<td>-2.3432</td>
<td>0.0224</td>
</tr>
<tr>
<td>Traditional</td>
<td>3.492</td>
<td>0.382</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Research question 6

Do teachers in block scheduled schools report more integration of mathematics with
other subject areas than teachers on traditional schedules? There were two items on the
survey that addressed this question. The block and traditional means were 3.031 and 3.161
(see Table 12). This means that both sets of teachers integrate mathematics with other
subject areas about once or twice a month. The t-test done on these items had a 2-tailed
probability of 0.0092. This offers evidence that teachers in traditionally scheduled schools
report a significantly higher amount of integration of mathematics with other subject areas
than teachers in block scheduled schools.

Research question 7

Do teachers in block scheduled schools report a greater emphasis on problem solving than
teachers on traditional schedules? There were four items on the survey that addressed this
question. The block and traditional means were 3.844 and 4.194 and the standard deviations were 0.558 and 0.612 respectively (see Table 13). This means that teachers in both block and traditional schools address problem solving about once or twice a week. The t-test done on these items had a 2-tailed probability of 0.0210. This offers evidence that teachers in traditionally scheduled schools report a significantly higher emphasis on problem solving than teachers in block scheduled schools.

Table 12. Results for Research Question 6: Integration with Other Areas

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.031</td>
<td>0.265</td>
<td>32</td>
<td>-2.7750</td>
<td>0.0092</td>
</tr>
<tr>
<td>Traditional</td>
<td>3.161</td>
<td>0.000</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 13. Results for Research Question 7: Problem Solving

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.844</td>
<td>0.558</td>
<td>32</td>
<td>-2.3698</td>
<td>0.0210</td>
</tr>
<tr>
<td>Traditional</td>
<td>4.194</td>
<td>0.612</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Research question 8**

Do teachers in block scheduled schools report greater support from colleagues and administration than teachers on traditional schedules? There were six items on the survey that addressed this question. The block and traditional means were 3.089 and 3.296 with standard
deviations of 0.927 and 1.111 respectively (see Table 14). A three on these items corresponded to "no opinion". The t-test done on these items had a 2-tailed probability of 0.4260. This offers evidence that differences between teachers in block scheduled schools and teachers in traditionally scheduled schools in the area of support from colleagues and administration is due to random differences.

Table 14. Results for Research Question 8: Support

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.089</td>
<td>0.927</td>
<td>32</td>
<td>-0.817</td>
<td>0.4260</td>
</tr>
<tr>
<td>Traditional</td>
<td>3.296</td>
<td>1.111</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To analyze the data further, the support questions were split into direct and indirect support where questions 1 and 2 are direct support and question 3-6 are indirect support (see Table 15). Direct support was defined as the personal support felt by teachers from peers and the administration. Indirect support was defined as the time and ability to share new ideas, work on curriculum and instruction, observe other teachers and grow as a professional. The mean for direct support for block and traditional were 3.845 and 4.080 the standard deviation was 0.403 and 0.156 (see Table 16). This shows that both block and traditional teachers generally agree with the statements related to direct support. The t-test done on these items had a 2-tailed probability of 0.0038. This offers evidence that traditionally scheduled teachers feel a significantly greater amount of support than their colleagues in block scheduled schools.
Table 15. Direct and Indirect Support

**Direct Support**

1. I feel supported by colleagues to try out new ideas in teaching mathematics
2. I receive little support from the school administration for teaching mathematics (reversed)

**Indirect Support**

3. Mathematics teachers in this school regularly share ideas and materials
4. Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies
5. I feel that I have many opportunities to learn new things in my present job.
6. I have time during the regular school week to work with my peers on mathematics curriculum and instruction.

<table>
<thead>
<tr>
<th></th>
<th>( \bar{x} )</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>3.845</td>
<td>0.403</td>
<td>32</td>
<td>-3.0698</td>
<td>0.0038</td>
</tr>
<tr>
<td>Traditional</td>
<td>4.080</td>
<td>0.156</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The indirect support questions had mean scores of 2.710 and 2.903 for block and traditional respectively (see Table 17). These means reveal that both block and traditional teachers do not feel that they receive indirect support from colleagues and administration. The strongest disagreement was with questions 4 and 6. Teachers on both block and traditional scheduled disagree with the statement that they regularly observe each other
teaching classes as part of sharing and improving instructional strategies. They also disagree with the statement that they have time during the regular week to work with peers on mathematics curriculum and instruction. The t-tests done on these items had a 2-tailed probability of 0.4734. This offers evidence that the differences between block and traditional teachers are random differences.

Summary of the results of the research questions

A list of the research questions and the related findings are summarized in Table 18.

Table 17. Results for Research Question 8: Indirect Support

<table>
<thead>
<tr>
<th></th>
<th>x</th>
<th>s.d.</th>
<th>n</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>2.710</td>
<td>0.901</td>
<td>32</td>
<td>-0.2570</td>
<td>0.5968</td>
</tr>
<tr>
<td>Traditional</td>
<td>2.903</td>
<td>1.196</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 18. Summary of the Results of the Research Questions

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Block</th>
<th>Traditional</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alternative Teaching techniques</td>
<td>x = 1.984</td>
<td>x = 1.978</td>
<td>0.9845</td>
</tr>
<tr>
<td></td>
<td>s.d. = 1.193</td>
<td>s.d. = 1.250</td>
<td></td>
</tr>
<tr>
<td>2. Calculator and Computer use</td>
<td>x = 3.801</td>
<td>x = 4.462</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.809</td>
<td>s.d. = 0.433</td>
<td></td>
</tr>
<tr>
<td>3. Establishing Connections</td>
<td>x = 4.047</td>
<td>x = 3.855</td>
<td>0.0223</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.110</td>
<td>s.d. = 0.433</td>
<td></td>
</tr>
</tbody>
</table>
Table 18. (continued)

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Block</th>
<th>Traditional</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Communication of Mathematical ideas</td>
<td>x = 3.177</td>
<td>x = 3.656</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.370</td>
<td>s.d. = 0.274</td>
<td></td>
</tr>
<tr>
<td>5. Real life applications</td>
<td>x = 3.273</td>
<td>x = 3.492</td>
<td>0.0224</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.359</td>
<td>s.d. = 0.382</td>
<td></td>
</tr>
<tr>
<td>6. Integration with other areas</td>
<td>x = 3.031</td>
<td>x = 3.161</td>
<td>0.0092</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.265</td>
<td>s.d. = 0.000</td>
<td></td>
</tr>
<tr>
<td>7. Problem solving</td>
<td>x = 3.844</td>
<td>x = 4.194</td>
<td>0.0210</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.558</td>
<td>s.d. = 0.612</td>
<td></td>
</tr>
<tr>
<td>8. Support</td>
<td>x = 3.089</td>
<td>x = 3.296</td>
<td>0.4260</td>
</tr>
<tr>
<td></td>
<td>s.d. = 0.927</td>
<td>s.d. = 1.111</td>
<td></td>
</tr>
</tbody>
</table>

Block n = 32  Traditional n = 31

Results of the Regression Analysis

The data were analyzed further by completing a regression analysis. The implementation of the National Council of Teachers of Mathematics (NCTM) standards was used as a dependent variable (see Figure 4) and awareness of NCTM Standards, preparation for use of the NCTM Standards, teaching experience, age, gender, type of schedule (block or traditional), and support were used as independent variables. The analysis of variance was significant at the 0.05 level. Which shows that at least one of the independent variables has a relationship to the implementation of the NCTM Standards.
Further analysis showed that the preparation variable had a P-value of $3.6082 \times 10^{-7}$ (see Table 19). The other variables were not significant factors. This shows that of the variables studied, preparation for using the NCTM Standards has a more important connection with the level of implementation than the type of schedule a teacher is on, the amount of experience a teacher has, the teacher’s awareness of the NCTM Standards, the teacher’s gender, age or support received.
Table 19. Results of Regression Analysis

<table>
<thead>
<tr>
<th>ANOVA</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>7</td>
<td>4217.74</td>
<td>602.53</td>
<td>12.01</td>
<td>3.505x10^-9</td>
</tr>
<tr>
<td>Residual</td>
<td>55</td>
<td>2759.98</td>
<td>50.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>6977.71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>32.6772</td>
<td>9.7829</td>
<td>3.3402</td>
</tr>
<tr>
<td>Awareness</td>
<td>0.2644</td>
<td>0.2036</td>
<td>1.2990</td>
</tr>
<tr>
<td>Preparation</td>
<td>1.2163</td>
<td>0.2130</td>
<td>5.7116</td>
</tr>
<tr>
<td>Experience</td>
<td>-0.0957</td>
<td>0.0930</td>
<td>-1.0282</td>
</tr>
<tr>
<td>Age</td>
<td>0.1109</td>
<td>0.0982</td>
<td>1.1297</td>
</tr>
<tr>
<td>Gender</td>
<td>0.2966</td>
<td>2.0316</td>
<td>0.1460</td>
</tr>
<tr>
<td>Schedule</td>
<td>2.2112</td>
<td>2.0050</td>
<td>1.1028</td>
</tr>
<tr>
<td>Support</td>
<td>0.0886</td>
<td>0.2772</td>
<td>0.3196</td>
</tr>
</tbody>
</table>

Analysis of Research Questions using High Preparation Participants

To further test the significance of the implementation of block scheduling the t-tests were repeated for each research question using only the participants who reported a high preparation level for use of the NCTM Standards. Since the regression analysis showed that preparation for use of the National Council of Teachers of Mathematics (NCTM) standards
was an important factor in the implementation of the NCTM Standards the results of only this part of the sample were analyzed. The preparation rate was figured by averaging the scores on the third section of the survey instrument, which is the section on preparation, and was the same section that was used in the regression analysis for the preparation variable. This section was scored using a 4-point Likert scale with 1 being not well prepared, 2 being somewhat prepared, 3 being fairly well prepared and 4 very well prepared. The participant’s data were used in this analysis if their average preparation score was greater than 2.5. In this analysis 17 teachers on block scheduling had high preparation scores (>2.5) and 23 teachers from traditionally scheduled schools had high scores (See Figure 5).

![Figure 5. Frequency Chart: High Preparation Variable](image-url)
The group t-tests were repeated as before for each research question, see Table 20 for specific results. The tests provided evidence that there were statistically significant differences in two areas, connections to mathematics and integration with other areas. The highly prepared teachers on a block schedule reported a significantly higher (p<0.01) emphasis on establishing the connections between mathematical concepts than teachers on a traditional schedule. In contrast the highly prepared traditional teachers had a significantly higher rate (p<0.001) of integrating mathematics with other content areas than teachers on block scheduling. The data for the other six areas showed that there were not significant differences in the answers given by highly prepared teachers in block and traditionally scheduled schools. These results offer evidence that when the variable of preparation is taken into account, there is still not a solid connection between the implementation of the NCTM Standards and the change to a block-scheduling format.

Table 20. Results of t-Test: High Preparation

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Block $\bar{x}$</th>
<th>Traditional $\bar{x}$</th>
<th>t</th>
<th>2-tailed probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alternative teaching techniques</td>
<td>2.03</td>
<td>2.07</td>
<td>-0.0914</td>
<td>0.9276</td>
</tr>
<tr>
<td>2. Calculator and computer use</td>
<td>4.22</td>
<td>4.54</td>
<td>-1.8488</td>
<td>0.0766</td>
</tr>
<tr>
<td>3. Connections to mathematics</td>
<td>4.35</td>
<td>4.07</td>
<td>2.7182</td>
<td>0.0099</td>
</tr>
<tr>
<td>4. Communication of mathematical ideas</td>
<td>3.69</td>
<td>3.84</td>
<td>-1.2669</td>
<td>0.2184</td>
</tr>
</tbody>
</table>
Table 20. (continued)

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Block $\bar{x}$</th>
<th>Traditional $\bar{x}$</th>
<th>t</th>
<th>2-tailed probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Real life applications</td>
<td>3.59</td>
<td>3.74</td>
<td>-1.9158</td>
<td>0.0635</td>
</tr>
<tr>
<td>6. Integration with other areas</td>
<td>3.44</td>
<td>3.52</td>
<td>-7.929</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>7. Problem solving</td>
<td>4.10</td>
<td>4.27</td>
<td>-0.96614</td>
<td>0.3402</td>
</tr>
<tr>
<td>8. Support</td>
<td>3.27</td>
<td>3.46</td>
<td>-0.5414</td>
<td>0.5915</td>
</tr>
</tbody>
</table>

Block n=17  Traditional n=23

Summary

In this chapter the results of the study were presented. First the demographic data of the respondents were analyzed. The research questions were analyzed using t-tests, a regression analysis was completed and the research questions were further analyzed using only participants with high preparation scores. The analysis of the data provided evidence that in two areas: alternative teaching techniques and support, there were not significant differences between block and traditional teachers. In only one area: establishing connections between mathematical ideas, the data provided evidence that block teachers had a significantly higher rate of implementation that traditional teachers did. In the other five areas: calculator and computer use, communication of mathematical ideas, real life applications, integration with other areas and problem solving, the data provided evidence that traditional teachers had a significantly higher implementation rate than teachers in block scheduling did.
The regression analysis on the data showed that of the seven dependent variables: awareness of NCTM Standards, preparation for use of the NCTM Standards, teaching experience, age, gender, type of schedule, and support, preparation for use of the NCTM Standards had a significant connection to the implementation of the standards. Those teachers who were better prepared to implement the recommendations of the NCTM Standards had higher implementation rates.

When only the data from teachers with high preparation rates were analyzed the means for block teachers were not significantly higher than the means for teachers in traditional schools in most areas. Traditional teachers had a significantly higher rate of integration with other subject areas, while block teachers had a significantly higher emphasis on the connections between mathematical concepts.

Therefore, based on this evidence, it appears that when all teachers are looked at, those who remain on a traditional schedule have a greater implementation rate of the NCTM Standards than teachers who are in the first 2 years of block scheduling. However, when teachers are highly prepared to implement the standards there are few differences between teachers in block scheduling and teachers in traditional scheduling.
CHAPTER 5. CONCLUSIONS

The first four chapters of this study examined the background, related literature, methodology and findings of the research. The purpose of this chapter is to summarize the research results from the preceding chapter, draw conclusions based on the findings, and provide some recommendations for further studies.

Summary of the Study

The purpose of this study was to attempt to identify if there is a connection between teachers' level of implementation of the NCTM Standards and the adoption of a block schedule. The NCTM Standards, specifically, the use of alternative teaching techniques, the amount of emphasis on establishing connections among mathematical ideas, the use of calculators and computers, the amount of emphasis on student communication of mathematical ideas, the use of real life applications, the integration of mathematics with other areas and the amount of emphasis on problem solving were used as indicators of change. Effects of other factors such as age, gender, awareness of the NCTM Standards, preparation for using the NCTM Standards, support and teaching experience were also measured. To accomplish this goal a 92-question survey was developed from a survey instrument originally used in the 1993 National survey of Science and Mathematics Education. This survey collected demographic information and information about high school math teachers beliefs, preparation, and practices regarding the NCTM Standards. Survey packets were sent to 10 contact people, one at each high school with a total of 72 surveys sent. A return rate of 87% was achieved with the return of 63 surveys. The data collected were analyzed using descriptive statistics to draw a profile of the respondents. The
eight research questions dealing with the implementation rates of block and traditionally scheduled teachers were evaluated by analyzing the data using t-tests where a significance level of 0.05 was used. A regression analysis was completed to determine which factors had significant impact on the implementation of the NCTM Standards in high school mathematics classrooms. The factors used were (1) awareness of the NCTM Standards, (2) preparation for use of the NCTM Standards, (3) teaching experience, (4) age, (5) gender, (6) type of schedule, and (7) support. The regression analysis suggested that preparation for using the NCTM Standards had the biggest impact on the implementation of the NCTM Standards. The effect of block scheduling was further analyzed using only the data from teachers that had a high preparation rating. This preparation rating was figured by finding the average of the 10 preparation questions in section 3 of the survey. A high preparation rating was defined as greater than 2.5 on a 4 point scale where a 1 means not well prepared, 2, somewhat prepared, 3 fairly well prepared, and 4 very well prepared.

Conclusions

In this section, a brief discussion of the findings along with conclusions will be presented.

Profile of respondents

The collected data showed that more than half (55.5%) of the respondents were male. The average age of the respondents was 44 years, while the minimum age was 23 years and the maximum age was 61 years. Average teaching experience among the respondents was 20 years. The range of teaching experience ranged from 0 to 36 years of teaching. Slightly
more than half (50.7%) the respondents taught in a block structured school. The traditionally scheduled teachers had slightly more teachers (94%) with bachelors degrees in mathematics while among block scheduled teachers 91% had earned a bachelors degree in mathematics. Traditionally scheduled teachers also earned (29%) more master's degrees in mathematics while among block scheduled teachers 25% had earned masters degrees in mathematics. Overall block-scheduled teachers had earned more masters degrees (47%) than traditionally scheduled teachers (42%). The data showed that the block-scheduled teachers had on average been teaching with a block schedule for 1 year prior to the current teaching year.

Findings related to research questions

The relationship between block scheduling and high school mathematics teachers' implementation of the NCTM Standards was investigated using a t-test to determine if block scheduled teachers have a greater implementation rate than traditionally scheduled teachers. The specific points of the NCTM Standards addressed were (1) use of alternative teaching techniques, (2) use of calculators and computers (3) establishment of connections among mathematical concepts (4) emphasis on student communication (5) use of real life applications, (6) integration of mathematics with other subject areas, (7) emphasis on problem solving, and (8) support from colleagues and administration.

The analysis showed that in five of the eight areas, calculator and computer use, communication of mathematical ideas, real life applications, integration with other areas and problem solving, traditionally scheduled teachers has significantly higher implementation rates that teachers in block scheduling. Block scheduled teachers had a significantly higher rate in only one area, establishing connections between mathematical ideas. In the other two
areas, alternative teaching techniques and support, the differences between block and traditionally scheduled teachers were not significant. This evidence suggests that teachers who remain on traditional schedules have a higher implementation rate of the NCTM Standards than teachers in the first 2 years of block scheduling. The teachers in block scheduling may still be in an adjustment period from changing from a traditional schedule to a block-scheduled format. The teachers surveyed were in the early stages, the first 2 years, of adopting the block schedule. Implementing the NCTM Standards may be on the back burner for these teachers who are still be adjusting to the change to block scheduling.

The actual levels of implementation in the different areas of the standards were interesting. Alternative teaching techniques, for both block and traditional teachers, had an average implementation rate of 2 on a 5-point scale where 1 is never and 5 is almost daily. This shows that teachers in this study use alternative teaching techniques on average once or twice a semester. This finding is parallel to the national study completed by Weiss (1997) which also found a low use alternative teaching techniques. Often teachers struggle with implementing alternative teaching techniques because the standards ask teachers to change the way they teach and to unlearn some of their professional training. They are asked to use activities that are very different from the practices they themselves experienced as students (Stepanek, 1997). Another area of low implementation was the integration of mathematics with other content areas. Teachers in this study had an average implementation rate of about 3 on a 5-point scale. This means that teachers integrate with other content areas on average once or twice a month. Block scheduling is claimed to be a promoter of classroom innovation (Edwards, 1995; O’Neil, 1995) and teaching methods that are varied and
interactive (Irmsher, 1996). This claim seems to have fallen short for the block teachers in this study.

On the positive side, several areas of the NCTM Standards also had high levels of implementation. These areas included calculator and computer use, connections to mathematics, and problem solving. Teachers in both block and traditional scheduling report having students use calculators and computers about once or twice a week. This is similar to the results found by Fagan (1995) and Weiss (1997) which show that teachers agreed that calculators and computers should be an integral part of mathematics instruction. They also report that students take part in problem solving activities once or twice a week. This is an increase from the 1993 study by Weiss which reported that only 40% of classes make conjectures and explore possible methods to solve problems once a week (1997). A heavy emphasis was also reported in the area of helping students learn how mathematical ideas connect to one another.

The area of support from colleagues and administration also had findings of interest. Teachers generally felt they had support from their peers and administration. However when indirect measures of support, such as time during the regular school day to work on curriculum and time to observe other teachers were measured, teachers felt they did not have time to do such activities. This finding was parallel to the findings of Weiss, “The picture that emerges is one where teachers feel supported by their colleagues, but have to “steal” moments to work with them” (1995, p. 15). The adoption of a block schedule could provide the opportunity for teachers to work collaboratively more, however, the results of this study show that that did not happen for the block scheduled teachers.
Results of the regression analysis

The evidence from the t-test shows that teachers in traditional schools do have a higher implementation rate of the NCTM Standards than teachers in the first 2 years of block scheduling do. A regression analysis was done to try and determine which factors studied have the most influence on the implementation rates of the NCTM Standards. The regression analysis used implementation of the NCTM Standards as the dependent variable and used 7 independent variables. The independent variables were: (1) awareness of the NCTM Standards, (2) preparation for use of the NCTM Standards, (3) teaching experience, (4) age, (5) gender, (6) type of schedule and (7) support. Of the seven factors considered the second factor, preparation for use of the NCTM Standards, had a p-value of less than 0.001 which shows that preparation has a stronger connection to implementation of the NCTM Standards than any of the other variables. Schools that adopt block-scheduling hoping to see dramatic changes in classroom teaching techniques may not see that result, especially in the first two years of implementation. High quality in-service training on the NCTM Standards needs to be offered to prepare mathematics teachers for the transition to the type of teaching and learning envisioned by the NCTM Standards.

Results of the research questions: high preparation

To further study the relationship between block scheduling and high school mathematics teachers' implementation of the NCTM Standards the t-tests were repeated using only the data from teachers who had high preparation rates. This analysis showed that highly prepared block scheduled teachers had a significantly greater emphasis on establishing the connections between mathematical concepts than highly prepared counterparts in
traditionally scheduled schools. Traditional teachers who were highly prepared had a significantly higher rate of integrating other content areas into their curriculums than teachers on block scheduling. In the other six areas there were no significant differences between teachers on block scheduling and teachers on traditional scheduling. When teachers are well prepared to implement the NCTM standards the evidence suggests that there are few differences between teachers who are in traditional schedules and teachers who adopt block schedules. Principals and school leaders considering the change to block scheduling should look at how well prepared their mathematics teachers are to implement the NCTM Standards. If teachers are well prepared to implement the standards, then the change to a block schedule does not appear to have much effect on their implementation rates of the standards.

Summary

Overall, when all teachers are considered, the evidence suggests that teachers in traditional scheduled schools implement the standards more than teachers in the first two years of block scheduling do. However, when preparation is accounted for, it appears from this research that the implementation of the NCTM Standards is not significantly different for teachers using a traditional schedule and teachers using a block schedule. The strong relationship between specific in-service training on the NCTM Standards and the implementation of the standards is very important. Schools that are considering adopting block scheduling should realize that although block scheduling may offer an opportunity for innovation and the use of varied and interactive teaching methods this is not a guaranteed outcome. Teachers need quality in-service and preparation to successfully implement the NCTM Standards in the classroom.
Summary of conclusions

This section is a summary of the conclusions of the study. Conclusions made were:

1. When all teachers are considered, those who remain on a traditional schedule have a greater implementation rate of the NCTM Standards than teachers who are in the first 2 years of block scheduling.

2. When teachers are highly prepared to implement the standards there are few differences in the implementation rate of the standards between teachers in block scheduling and teachers in traditional scheduling.

3. The regression analysis showed that of the variables studied, the most important factor in the implementation rate of the NCTM Standards is preparation for use of the standards. Other factors considered were awareness of standards, age, gender, type of schedule and support. Therefore quality in-service and preparation are important areas of consideration when moving to a block schedule.

Recommendations for Future Research

Based on the results of this study, the following recommendations are proposed:

1. The research study should be repeated with teachers that have had more experience on block scheduling so the adjustment variable is less of a factor.

2. The research study should be repeated with a larger sample of teachers from across Iowa or in other states.

3. Collect data on what type of textbook series is being used by each teacher. Some new series are written to complement the NCTM Standards, many older series are not.
4. Further research the connection between preparation for the NCTM Standards and the implementation of the standards.

5. More research needs to be completed on the effects of block scheduling on mathematics achievement.

6. Research on the effects of Block scheduling on mathematics when it is combined with quality in-service opportunities on the NCTM Standards.

Summary

This chapter summarized the results of previous chapters. In addition, a brief discussion of the findings, together with the conclusions was presented. Six recommendations for further studies were also suggested.
APPENDIX A. HUMAN SUBJECTS FORM
Checklist for Attachments and Time Schedule

The following are attached (please check):

12. X Letter or written statement to subjects indicating clearly:
    a) the purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see item 17)
    c) an estimate of time needed for participation in the research
    d) if applicable, the location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, when and how you will contact subjects later
    g) that participation is voluntary; nonparticipation will not affect evaluations of the subject

13. □ Signed consent form (if applicable)

14. □ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. X Data-gathering instruments

16. Anticipated dates for contact with subjects:
    First contact ________
    Last contact ________
    Month/Day/Year    Month/Day/Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:
    Month/Day/Year

18. Signature of Departmental Executive Officer
    Date
    Department or Administrative Unit

19. Decision of the University Human Subjects Review Committee:
    X Project approved  □ Project not approved  □ No action required

    Patricia M. Keith
    Name of Committee Chairperson
    Date 5-5-98
    Signature of Committee Chairperson
APPENDIX B. PERMISSION TO USE SURVEY
Angela,

You have our permission to use the questionnaire in your research. By copy of this message, I am asking my assistant to mail you a copy of the mathematics teacher questionnaire.

Iris Weiss

At 08:29 PM 12/15/97 -0800, you wrote:

Iris, My name is Angela Pierce. I am a high school math teacher working on my masters degree at Iowa State University. I am writing to request a copy of and permission to use your survey from the 1993 National Survey of Science and Mathematics Education. I have a copy of a paper presented at the Annual Meeting of the American Educational Research Association titled Mathematics teachers' response to the reform Agenda: Results of the 1993 National Survey of Science and Mathematics Education. This looks exactly like what I am looking for in a survey! Thanks so much for your time, work, and help. My address is: Angela Pierce 1306 Glenwood Trs. Marshalltown, IA 50158 My e-mail (home): pierceja@marshallnet.com size=2> work: piercea@po-1.marshalltown.k12.ia.us Happy Holidays! Angela
APPENDIX C. SURVEY INSTRUMENT
1. Please provide your opinion about each of the following statements. (CIRCLE ONE ON EACH LINE)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>No Opinion</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Students learn best when they study mathematics in the context of a personal or social application.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b.</td>
<td>Students learn mathematics best in classes with students of similar abilities.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c.</td>
<td>Students need to master arithmetic computation before going on to algebra.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d.</td>
<td>Students should be able to use calculators most of the time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e.</td>
<td>Virtually all students can learn to think mathematically.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f.</td>
<td>I enjoy teaching mathematics.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g.</td>
<td>I consider myself a “master” mathematics teacher.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h.</td>
<td>I feel supported by colleagues to try out new ideas in teaching mathematics.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i.</td>
<td>I receive little support from the school administration for teaching mathematics.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j.</td>
<td>Mathematics teachers in this school regularly share ideas and materials.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k.</td>
<td>Mathematics teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l.</td>
<td>Activity-based mathematics experiences aren’t worth the time and expense for what students learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>m.</td>
<td>I feel that I have many opportunities to learn new things in my present job.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>n.</td>
<td>I have time during the regular school week to work with my peers on mathematics curriculum and instruction.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
2. Please rate each of the following in terms of its importance for effective mathematics teaching at the grade levels you teach.

<table>
<thead>
<tr>
<th></th>
<th>Definitely should not be a part of math instruction</th>
<th>Makes no difference</th>
<th>Definitely should be a part of math instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Concrete experience before abstract treatments...</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b. Students working in cooperative learning groups..</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c. Emphasis on connections among concepts..........</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d. Deeper coverage of fewer mathematics ideas.......</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>e. Hand-on/manipulative activities..................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>f. Applications of mathematics in daily life........</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>g. Emphasis on arithmetic computation...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>h. Emphasis on solving real problems................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>i. Emphasis on mathematical reasoning...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>j. Emphasis on writing about mathematics.............</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>k. Integration of mathematics subjects (e.g., algebra, probability, geometry, etc.) all taught together each year...</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>l. Coordination of mathematics with science.........</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>m. Coordination of mathematics with vocational/technology education...............................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>n. Every student studying mathematics each year.....</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>o. Taking student preconceptions about a topic into account when planning curriculum and instruction........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>p. Inclusion of performance-based assessment.........</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>q. Use of computers..................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>r. Use of calculators................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

3. How well prepared are you to do each of the following?

<table>
<thead>
<tr>
<th></th>
<th>Not well prepared</th>
<th>Somewhat prepared</th>
<th>Fairly well prepared</th>
<th>Very well prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Present the applications of mathematics concepts...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. Use cooperative learning groups..........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
### How well prepared are you to do each of the following?

<table>
<thead>
<tr>
<th>Task</th>
<th>Not well prepared</th>
<th>Somewhat prepared</th>
<th>Fairly well prepared</th>
<th>Very well prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Take into account students' prior conceptions about mathematics when planning curriculum and instruction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d. Use computers as an integral part of mathematics instruction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e. Integrate mathematics with other subject areas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f. Manage a class of students who are using manipulatives</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g. Use a variety of assessment strategies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h. Use the textbook as a resource rather than as the primary instructional tool</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i. Use calculators as an integral part of mathematics instruction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j. Use performance-based assessment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

### 4. Please check the box(es) next to the degree(s) you hold also list your major and minor.

<table>
<thead>
<tr>
<th>Degree</th>
<th>MAJOR</th>
<th>MINOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor's Degree</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Master's Degree</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Doctorate Degree</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Other Degree(s)</td>
<td>□</td>
<td>Specify below:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2)</td>
</tr>
</tbody>
</table>

In what year did you last take a course for college credit in mathematics?

19__

In what year did you last take a course for college credit in the teaching of mathematics?

19__

### 5. What is the total amount of time you have spent on in-service education in mathematics or the teaching of mathematics in the last 3 years? (Include attendance at professional meetings, workshops, and conferences, but do not include formal courses for which you receive college credit.)

0 5 10 15 20 25 30 35 40 45 50 55

*Thanks for your assistance!*
6. a. The National Council of Teachers of Mathematics has prepared *Curriculum and Evaluation Standards*, generally called the NCTM Standards, for mathematics instruction. Which of the statements below best describes your familiarity with the NCTM Standards? (CIRCLE ONE)

Well aware of the NCTM Standards .................................................. 1
Heard of the NCTM Standards but don't know much about them .......... 2
Not aware of the NCTM Standards .................................................... 3
Not sure ............................................................................................. 4

(Continue with question 6.b.)

b. Please indicate the extent to which you agree with each of the following statements.

(CIRCLE ONE ON EACH LINE)

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>No Opinion</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am well informed about the NCTM Standard for the grades I teach</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I am prepared to explain the NCTM Standards to my colleagues</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

7. a. The National Council of Teachers of Mathematics has prepared *Professional Standards for Teaching Mathematics*, generally called the NCTM Teaching Standards, for mathematics instruction. Which of the statements below best describes your familiarity with the NCTM Teaching Standards? (CIRCLE ONE)

Well aware of the NCTM Teaching Standards ...................................... 1
Heard of the NCTM Teaching Standards but don't know much about them .... 2
Not aware of the NCTM Teaching Standards ........................................ 3
Not sure ............................................................................................. 4

(Continue with question 7.b.)

b. Please indicate the extent to which you agree with each of the following statements.

(CIRCLE ONE ON EACH LINE)

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>No Opinion</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am well informed about the NCTM Teaching Standard for the grades I teach</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I am prepared to explain the NCTM Teaching Standards to my colleagues</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
8. Think about the mathematics class you most often teach. How much emphasis will each of the following student objectives receive?

(CIRCLE ONE ON EACH LINE.)

<table>
<thead>
<tr>
<th></th>
<th>Minimal emphasis</th>
<th>Moderate emphasis</th>
<th>Very heavy emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>a. Increase interest in mathematics ........................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b. Learn mathematical concepts ................................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c. Learn mathematical algorithms ...............................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>d. Learn how to solve problems ..................................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>e. Learn to reason mathematically ...............................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>f. Learn how mathematical ideas connect with one another ...................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>g. Prepare for further study in mathematics ....................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>h. Understand the logical structure of mathematics ..........................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>i. Learn about the history of mathematics .....................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>j. Learn to explain mathematical ideas effectively ...........................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>k. Increase awareness of the importance of mathematics in daily life .......</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>l. Learn about the applications of mathematics in science ..................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>m. Learn about the application of mathematics in business and industry ....</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>n. Learn to perform computations with speed and accuracy ....................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>o. Prepare for standardized tests ................................................</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

9. Think about the math class you most frequently teach. About how often do students in this mathematics class take part in the following types of activities?

(CIRCLE ONE ON EACH LINE.)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Once</th>
<th>Or twice</th>
<th>Almost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Or twice</td>
<td>or twice</td>
<td>or twice</td>
<td>daily</td>
</tr>
<tr>
<td></td>
<td>a month</td>
<td>a week</td>
<td>daily</td>
<td></td>
</tr>
<tr>
<td>a. Listen and take notes during presentation by teacher ..................</td>
<td>Never 1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>b. Do mathematics problems from textbooks .................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>c. Do mathematics problems from worksheets ...............................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>d. Work in small groups ......................................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>e. Work in class on mathematics projects that take a week or more ....</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>f. Work at home on mathematics projects that take a week or more ......</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>g. Make conjectures and explore possible methods to solve a mathematical problem ................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>h. Learn about mathematics through real-life applications ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>i. Write their reasoning about how to solve a problem ....................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
<tr>
<td>j. Use manipulative materials or models ....................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 5</td>
</tr>
</tbody>
</table>
10. For the following equipment, please indicate the approximate number of times per semester each is used in your most frequently taught mathematics class. For those not used, circle either 1, not needed, or 2, needed but not available.

(CIRCLE ONE ON EACH LINE.)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Never</th>
<th>Once a month</th>
<th>Once a week</th>
<th>Almost daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Overhead projector</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. Videotape player</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. Graphing calculators</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d. Scientific calculators</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e. Computers</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f. Computer/lab interfacing devices</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

11. Please answer the following questions about yourself and your school.

a. Indicate your sex:
   - Male: ............................................ 1
   - Female: ........................................... 2

b. In what year were you born? 19______

c. How many years have you taught mathematics prior to this school year? ____ years

d. What type of schedule is your school on?
   - Alternate day block: ......................... 1
   - Intensive (4X4) Block: ...................... 2
   - Traditional: .................................. 3

e. If you are on some type of block schedule how many years prior to this one have you been on it? ____ years
Dear Principal Clark,

I am a graduate student working on my master’s degree in Curriculum and Instruction at Iowa State University in Ames, Iowa. Under the supervision of Dr. Ann Thompson, I am conducting research on the implementation of the National Council of Teachers of Mathematics (NCTM) Standards as part of my graduate work.

I am writing you to ask for your permission to survey the teachers in your mathematics department on their use of the NCTM Standards. I would like to ask the head of your mathematics department to act as a contact person. The surveys will be mailed to the contact person, and that person will be asked to distribute them and return them to me.

In addition to your permission to survey the teachers in the mathematics department, I also need the name, phone, and e-mail address of the head of your math department and the number of people in the mathematics department. You may mail me this information at the above address, leave a message on my answering machine or e-mail me at: piercej@marshallnet.com.

Thank you for your time. Your help is greatly appreciated.

Angela Pierce
Marshalltown High School
Marshalltown, Iowa

Ann Thompson
Iowa State University
Ames, Iowa
APPENDIX E. CONTACT'S LETTER
March 3, 1998

Rich Rozell
Marshalltown High School
1602 S. 2nd Ave.
Marshalltown, IA 50158

Dear Mr. Rozell:

I am a graduate student at Iowa State University working under the supervision of Dr. Ann Thompson. I am also a mathematics teacher at Marshalltown High School. I am writing you to ask for your help in distributing a survey to the mathematics teachers in your high school. I have made contact with Jerry Stephens, and have been granted permission to give the survey. In order to have the best and most timely response, I would like to have a contact person in each school that would distribute and collect the surveys and mail them back to me. Will you be the contact person for your school, Mr. Rozell?

If you do not wish to serve as the contact person for your school please call me at school during the day, 515-754-1130, or at home in the evening, 515-752-4874.

The surveys will be mailed to you on Friday, March 6, 1998, and will take approximately 15 minutes to complete. You will receive enough surveys for each person in your mathematics department. I will ask the participants to return the survey to you, sealed in the included envelope, by Monday, March 16, 1998. Then you would mail all the surveys back to me in the included envelope.

I greatly appreciate your time and effort in helping me collect this data. If you have any questions please feel free to call me.

Sincerely,

Angela Pierce
Mathematics Questionnaire

Dear participant,

Approximately 60 teachers from six Iowa high schools have been asked to complete this survey about mathematical instruction and beliefs. The information will help provide insight into changes being made in Iowa in the field of mathematical instruction.

Your principal has granted permission for me to approach you to participate in this survey; however, your participation is completely voluntary. If you do not wish to participate, simply return the survey to your contact person. The survey will take approximately 15 minutes to answer.

All survey data received will be kept strictly confidential and will be reported only in aggregate form. No information identifying individual schools or teachers will be released. No identifying information whatsoever will be included in the data set.

If you have any questions about this survey please phone me at (515) 752-4874 or e-mail me at pierceja@marshallnet.com.

How to complete the Questionnaire
Most of the questions instruct you to “circle one” answer or “circle all that apply”. For a few questions you are asked to write in your answer on the line provided. When you have completed the survey please return it in the enclosed envelope to your contact person.

Thank you for your time and effort.

Sincerely,
Angela Pierce
Dr. Ann Thompson
REFERENCES


Wiske, M. & Levinson, C. “How teachers are implementing the NCTM standards.” Educational Leadership 50, 8-12.