ATTITUDES AND BELIEFS OF PARENTS OF MIDDLE SCHOOL CHILDREN ABOUT CALCULATORS IN SCHOOL MATHEMATICS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Graduate School of The Ohio State University

By

Sharon Shriver Sweeney, MA, BS

The Ohio State University
2004

Dissertation Committee: Approved by

Professor Douglas T. Owens, Advisor
Professor Patricia A. Brosnan
Professor Nikki L. Conklin

Graduate Program in Education
Abstract

This was a qualitative study to learn the attitudes and beliefs of parents of middle school children about calculator use in school mathematics. A survey found that the parents were mostly neutral about the use of calculators in school mathematics, although there were some who were very positive and others who were quite negative. The survey was followed by focus group interviews to learn why they held these attitudes and beliefs. Focus group interviews revealed that among other concerns most parents thought children would not learn operational mathematics if they were using a calculator or that it would become a crutch and they thought there is benefit from doing mathematics by hand. Many of the parents saw advantages to using a calculator, such as calculator use can be quicker and more efficient and that children would learn real life experiences using a calculator in their mathematics classes.

An intervention was conducted, including a newsletter and a mathematics lesson. The newsletter informed the parents about the project and included information about research on the use of calculators as a pedagogical tool in mathematics. The lesson showed parents one way the calculator could be used as a learning and teaching tool by leading them through a discovery lesson. The parents used the calculator to learn or relearn how to multiply fractions by looking for patterns using a calculator. The intervention was followed by individual interviews with the parents to learn their
attitudes and beliefs and to learn if they became more positive about calculators in school mathematics. Most of the parents in this study were more positive about calculator use in school mathematics after the intervention. They had several reasons for becoming more positive, but most of the reasons could be categorized as the parents not realizing the calculator could be used as a discovery tool and not only for computation.

Most parents became positive after experiencing the calculator as a pedagogical tool. Teachers need to know how to teach with the calculator and need to keep communication lines with parents open. Similar studies should be done with parents of elementary students.
Dedicated to

My husband—Richard

My children—Jeff, Sharienne, and Mitchell

Their spouses—Loretta, Dennis, and Morissa

My grandchildren—Nicholas, Kamala, Caden, and Sergei

and

My mother—Millie Shriver
ACKNOWLEDGEMENTS

I would like to express my gratitude and appreciation to the following for their help and support:

My advisor, Douglas T. Owens, who gave his support, encouragement, and patience to the completion of this dissertation and degree,

My parents, George (Bill) and Millie Shriver, who were my first teachers and especially my father, who first got me interested in and excited about mathematics,

Chuck Conner, my high school mathematics teacher, who helped me maintain excitement of mathematics and helped me through college calculus,

Vickie and Janet, who studied with me to learn mathematics,

Uncle Ellis and Aunt Ethel who were inspirations during my educational experiences,

Jeff, Shari, and Mitch, my first research subjects,

Nick, Kamala, Caden, and Sergei who gave me joy during this study and gave me a chance to continue experimenting with the educational process,

Virginia and Loretta, who took notes during the focus group interviews and reviewed the transcripts of the interviews,

Jeff, Dennis, Mitch, and Morissa, who kept my computer up and running,
Shari, who allowed me to bounce ideas about this dissertation off of her and gave me advice as I was writing,

Mitch, who encouraged and prodded me to complete this dissertation and who kept a copy of my drafts safe,

Morrisa, who gave me the opportunity to discuss teaching and reminded me of what it is like to be a new teacher,

All of those who participated in this study and the pilot studies,

All of those who gave me encouragement and kept me in their prayers,

God, who granted me the strength and wisdom to finish this degree, and

Most of all, Richard, without whose support and encouragement none of this would have been possible.
VITA

1990        M.A. Mathematics, The Ohio State University
2001        Assistant Professor, Ohio University, Athens, Ohio.
1996 – 2000  Graduate Teaching Assistant, The Ohio State University
1990 – 1996, 2001-2002  Mathematics Adjunct Faculty—Columbus State Community College, Columbus, Ohio
1988 – 1990  Graduate Teaching Assistant—The Ohio State University, Columbus, Ohio
1970 – 1988  Substitute Teacher—Fairfield County, Ohio
1982        High School Mathematics and Science Teacher—Fairfield Union High School, Rushville, Ohio
1968 – 2002  Private Tutor
1966 – 1968  Middle School Mathematics Teacher—Medina Junior High School, Columbus, Ohio.

PUBLICATIONS
FIELDS OF STUDY

Ph. D. — Mathematics Education

Masters Degree— Mathematics

Undergraduate— Education with double major in Mathematics and Chemistry/Physics
# TABLE OF CONTENTS

ABSTRACT ........................................................................................................................................ ii

ACKNOWLEDGEMENTS ........................................................................................................... v

VITA ............................................................................................................................................... vii

LIST OF FIGURES ................................................................................................................ xii

LIST OF TABLES ................................................................................................................ xiii

CHAPTER 1 PROBLEM DEFINITION AND FRAMEWORK ..................................................... 1

  PROBLEM STATEMENT ................................................................................................................. 3
  RATIONALE FOR THE STUDY ........................................................................................................ 3
  RESEARCH QUESTIONS ............................................................................................................... 8
  IMPORTANCE OF THE STUDY ..................................................................................................... 9
  LIMITATIONS OF STUDY ......................................................................................................... 11
  DEFINITIONS OF TERMS ......................................................................................................... 12
  THEORETICAL FRAMEWORK .................................................................................................. 13
    Constructivism .......................................................................................................................... 14
    Sociocultural Theory ............................................................................................................... 18
    Discovery .................................................................................................................................. 19
  CONCEPTUAL FRAMEWORK .................................................................................................. 20
    Parental Beliefs ....................................................................................................................... 20
    Parent Education .................................................................................................................... 22
  SUMMARY .................................................................................................................................. 24

CHAPTER 2 LITERATURE REVIEW ..................................................................................... 26

  PARENTAL ATTITUDES TOWARD MATHEMATICS EDUCATION ............................................. 28
  PARENT INVOLVEMENT ............................................................................................................. 32
  CALCULATOR AND STANDARDS-BASED CURRICULUM IN MATHEMATICS CLASSROOMS ......................................................................................................................... 43
  CORRELATION BETWEEN ATTITUDES AND ACHIEVEMENT ............................................. 51

CHAPTER 3 METHODOLOGY ............................................................................................... 60

  SETTING AND POPULATION .................................................................................................... 60
  INSTRUMENTATION WITH RATIONALE .................................................................................... 62
    Surveys ..................................................................................................................................... 65
    Focus Groups .......................................................................................................................... 66
    Individual interviews .............................................................................................................. 70
  INTERVENTION .......................................................................................................................... 71
    Newsletters ............................................................................................................................. 72
    Workshop ................................................................................................................................. 72
  PROCEDURE ................................................................................................................................ 74
  TIMELINE ...................................................................................................................................... 76
  ETHICS .......................................................................................................................................... 77
  TRUSTWORTHINESS .................................................................................................................. 78
APPENDIX A CONSENT FORMS.................................................................................................... 218
APPENDIX B SURVEY ...................................................................................................................... 220
APPENDIX C URBAN SCHOOL SURVEY..................................................................................... 221
APPENDIX D FOCUS GROUP QUESTIONS ................................................................................. 222
APPENDIX E INDIVIDUAL INTERVIEW QUESTIONS ............................................................. 223
APPENDIX F LESSON PLANS .........................................................................................................224
USING A CALCULATOR TO LEARN HOW TO WORK WITH FRACTIONS........................................ 224
  MATERIALS .........................................................................................................................................224
  OBJECTIVES .......................................................................................................................................224
  PROCEDURE (2 HOURS) .......................................................................................................................224
  ASSESMENT .......................................................................................................................................224
  WORKING WITH FRACTIONS...........................................................................................................225
    Addition of fractions ..........................................................................................................................225
    Subtraction of fractions .....................................................................................................................226
    More Addition and Subtraction of fractions ......................................................................................227
    Multiplication of fractions .................................................................................................................228
APPENDIX G NEWSLETTER .......................................................................................................... 230
APPENDIX H COPY OF HUMAN SUBJECTS FORM.................................................................. 232
APPENDIX I....................................................................................................................................... 233
APPENDIX J ADDITIONAL QUOTES............................................................................................ 238
RESEARCH QUESTION TWO: WHAT ARE PARENTS’ BELIEFS ABOUT THE USE OF CALCULATORS IN
MATHEMATICS INSTRUCTION? WHY DO PARENTS HOLD THEIR BELIEFS OR ATTITUDES TOWARD
CALCULATOR USE IN MATHEMATICS CLASSES? .............................................................................238
  Negative beliefs.................................................................................................................................238
  Positive Beliefs.................................................................................................................................242
LIST OF FIGURES

FIGURE 1.1 CONCEPT MAP OF THEORY ................................................................................... 25
LIST OF TABLES

TABLE 3.1 TIMELINE OF STUDY .................................................................................................. 77
TABLE 4.1 SURVEY RESULTS OF RURAL PARENTS................................................................. 89
TABLE 4.2 RESEARCHER’S JUDGMENT OF ATTITUDES OF INDIVIDUAL RURAL POOR PARENTS ........................................................................................................ 96
TABLE 4.3 SURVEY RESULTS OF WEALTHY PARENTS .......................................................... 99
TABLE 4.4 RESEARCHER’S JUDGMENT OF ATTITUDES OF INDIVIDUAL WEALTHY PARENTS .................................................................................................................. 104
TABLE 4.5 SURVEY RESULTS OF RURAL POOR PARENTS .................................................... 105
TABLE 4.6 RESEARCHER’S JUDGMENT OF ATTITUDES OF INDIVIDUAL RURAL POOR PARENTS ........................................................................................................ 112
TABLE 4.7 SURVEY RESULTS OF URBAN PARENTS............................................................... 113
TABLE 4.8 RESEARCHER’S JUDGMENT OF ATTITUDES OF INDIVIDUAL URBAN PARENTS .................................................................................................................. 117
TABLE 4.9 AVERAGE OVERALL MEAN ...................................................................................... 117
TABLE 4.10 THEMES OF PARENT BELIEFS............................................................................... 158
TABLE 4.11 STATISTICS OF POSITIVE AND NEGATIVE SENTENCES BEFORE AND AFTER INTERVENTION ......................................................................................... 163
TABLE 4.12 NUMBER OF POSITIVE AND NEGATIVE SENTENCES MADE BY EACH PARTICIPANT BEFORE AND AFTER INTERVENTION .............................................. 164
TABLE 4.13 PERCENT OF POSITIVE SENTENCES BEFORE AND AFTER INTERVENTION BY TYPE OF SCHOOL ......................................................................................... 168
TABLE 4.14 NEGATIVE ATTITUDES OF PARENTS ................................................................. 191
TABLE 1.1 SURVEY COMPILATION TABLE ............................................................................ 233
CHAPTER 1

Problem Definition And Framework

Parents can be very influential about which programs are implemented in a school. In a paper presented as part of the symposium at the 1997 annual meeting of the American Educational Research Association, Jean Konzal stated, “When parents develop negative attitudes toward new practices—especially when these parents are influential—powerful resistance may develop and new instructional practices may disappear” (1997, p. 2).

“New Math” was the name given to the reform movement of the time from 1955-1975. This reform movement hoped to provide high school students with the mathematics content they needed to study mathematics in college. Originally designed for high school students, the reform gradually began to include elementary students where it faltered. When people began to feel that “New Math” was a failure, there was a call for back-to-basics (Secada, 1992).

I began teaching during the time that many schools were beginning to transition New Math into the lower grades. My younger sisters and brother were in elementary school at the time, trying to learn mathematics using New Math. My father and I often argued about what they were learning in their mathematics classes. I tried to convince him that the mathematics facts they were teaching
were not different from the mathematics facts he learned—2 + 2 was still 4, but nothing I could say would convince him. At the time, I felt New Math was more of a way to teach mathematics using new terms and ideas to help students discover the patterns in mathematics. When New Math failed to be implemented, I wondered how much of the failure was due to other parents, like my father, lacking the understanding of what the New Math program was and teachers not prepared to teach it. My father and many of my students’ parents seemed to understand only that their children were not being taught the same way they had been taught. Could this cycle be repeating itself now with the acceptance of calculators in mathematics education?

My own experiences as my children went through the school system seemed to reinforce the idea that a lack of information causes parents to resist change in education. One situation took place at a swim meet for my children. I was talking with several other mothers, when one mother expressed concern about her daughter, who was in the fourth grade, being required to use a calculator in her mathematics class. After I explained some of the advantages to using the calculator as a teaching and learning tool, these mothers decided that allowing their children to use calculators might not be such a bad idea. Another time, while I was talking with a friend in a grocery store, her child’s seventh grade teacher stopped to speak with her. During the conversation, the teacher mentioned that he had received a grant of graphing calculators for his classroom. He said that he might allow the students to use them on the last day of school to check their work. He, too, even as a teacher, did not realize the value of the calculator as a teaching
and learning tool. I have had similar conversations with parents and wondered if the parents would be so negative toward calculator use if they understood how calculators could be used to teach and learn mathematics. If the parents learned the value of the calculator as a teaching and learning tool, would they urge the teachers to learn how to use the calculator as a teaching and learning tool?

**Problem statement**

Many middle school parents and teachers express concern about children using calculators to "do their mathematics." They believe students must learn "the basics" before they use a calculator. They do not understand how the calculator can be used as an investigative tool. The purpose of this study was to investigate parents' attitudes and beliefs about calculators in middle school mathematics. Parents were then shown how the calculator could be used as a teaching and learning tool. Finally, interviews were conducted with the parents to determine if the educational process caused a change in parents' attitudes and beliefs about calculator use in mathematics education.

**Rationale for the Study**

Konzal (1997) indicated that parents can have an effect on whether new practices survive in the schools. If the parents believe that the new practices are good for their children, they will probably be more positive about the new practices. In a quantitative study involving rural Mississippi parents of third, fourth, fifth, and sixth grade students, Collums (1991) found that through an educational program, it was possible to positively influence attitudes of parents
toward the use of calculators in mathematics education. In another quantitative study Bitter & Hatfield (1993) found that the percentage of parents of middle school children that viewed the calculator positively increased after their children had been involved in a program that integrated calculators into the mathematics curriculum. Bitter & Hatfield also found that the percentage of parents who thought the calculator would hinder students’ understanding of basic computation skills increased.

In the *Professional Standards for Teaching Mathematics* (NCTM, 1991) and *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), the National Council of Teachers of Mathematics (NCTM) recommends the use of calculators in mathematics instruction as early as kindergarten. For K-4, they recommend the “use of calculators in appropriate computational situations” and “Calculators also can be used as an effective instructional tool for teaching computational skills” (NCTM, 1989, p. 44 & 46). In the *Standards* for grades 5 through 8 the recommendation is that calculators can be used in problem-solving situations and making mathematical connections among graphical, numerical, and other representations and recognizing relationships with tables, graphs and rules. “Technology can foster environments in which students’ growing curiosity can lead to rich mathematical invention. In these environments, the control of exploring mathematical ideas is turned over to students” (NCTM, 1989, p.81). There are frequent references to graphing utilities found throughout the standards for grades 9 through 12 (NCTM, 1989). In the updated version the *Principles and Standards*, NCTM (2000) states six principles to guide school mathematics
including the Technology Principle, which is “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning” (p. 11). NCTM additionally suggests that students should participate in guided work with calculators, which “can enable students to explore number and pattern, focus on problem-solving processes and investigate realistic applications” (NCTM, 2000, p. 77).

Research has found that there can be many positive effects by using calculators in mathematics education (Dunham & Dick, 1994; Eads, 1986; Quesada & Maxwell, 1994; Groves & Stacey, 1994). Students using calculators showed growth in mathematical achievement and mathematical concepts, while their attitudes toward mathematics improved (Eads, 1986). Students believed the calculators improved their ability to solve problems (Dunham & Dick, 1994). Use of a calculator improved student motivation and contributed to a depth of knowledge of mathematics (Quesada & Maxwell, 1994). Third grade students with more calculator experience showed a significant improvement of understanding of the number system and in the ability to choose an appropriate operation for word problems. They performed better than children without calculator experience on computation, estimation tasks, and on real-world problems. The students with calculator experience also exhibited better knowledge of number, place value, decimals and negative numbers (Groves & Stacey, 1994). Despite this research, many parents believe that calculators should not be used in elementary school (Graber, 1993).
Other research has shown parents can influence the attitudes of their children (Elmore and Others, 1985; Tocco, 1971; Wentworth and Monroe, 1996; Wilhelm, S. & Brooks, D. M., 1980). These same studies found a relationship between the students’ attitudes and their mathematical achievement. In light of this research it makes sense to determine parental attitudes toward calculator use in mathematics instruction and to try to positively influence their attitudes and beliefs.

Research that has been conducted on changing beliefs seems to indicate that beliefs are formed in one of two ways—through experiences and through information gathering. If the belief is formed by experiences those beliefs are resistant to change unless the learner has new experiences that are contrary to his/her belief. If the belief was formed by receiving information, the believer would need to be given information contrary to what he/she believes in order to change that belief (Bruning, Schraw, & Ronning, 1995).

In discussing the public attitudes about mathematics, The National Research Council (1989) indicates, “Adults who determine policy in mathematics education often measure the mathematical needs of today’s students by their own meager and outdated mathematical accomplishments” (pp. 9-10). McLeod (1992) states, “The improvement of mathematics education will require changes in the affective responses of both children and adults” (p. 575). Konzal (1995) found that parents developed mental images of what they thought were good schools from the education they received as children.
Parents’ attitudes and beliefs about how mathematics should be taught were formed over a long period of time. Attitudes and beliefs that have been formed in complex ways are generally resistant to change (Bruning, et al., 1995). McLeod (1992) distinguishes the difference between beliefs, which are “cognitive in nature, and are developed over a relatively long period of time,” (p. 579) with attitudes, which he refers to as “responses that involve positive or negative feelings of moderate intensity and reasonable stability” (p. 581). In this study, I am interested in both the parents’ beliefs and their attitudes. Since beliefs are formed over a longer period of time, they will be harder to change with the educational program. I think the parents’ attitudes about education are rooted in their beliefs; therefore, in order to have a lasting effect on the parents’ attitudes, their beliefs must be changed.

In a study I conducted, while teaching a beginning algebra course at a community college, I asked the following questions of my students: “Do you think the graphing calculator should be used to teach mathematics in elementary and middle schools? Why or why not? In what grades should calculators and graphing calculators be introduced into the mathematics classroom? Do you have school-age children? What are their ages and grades in school?”

The students had been using the Texas Instruments (TI) 82 graphing calculator for at least one year. About half of the students said the calculator should not be used in elementary grades and some of them thought it should not be used until junior high, high school, or even college. One student, a parent of a 15-year-old eighth grader said, “I feel the graphing calculator should be used
starting in middle school and not elementary because in elementary the basics are taught and should be learned prior to using this calculator. Calculators should be used starting around sixth grade and again the graphing calculator should start in seventh.”

Another student, who has no children, said,

I don’t think that calculators should be used to teach math in elementary schools. If they did, students would learn to rely on the calculators too much and wouldn’t know the fundamentals. I think calculators should be introduced in the last two years of high school. By then students would be solid with the fundamentals and would use them for large numbers that take a long time to figure.

Several students referred to the need for students “to work the problems out in their head” or with paper and pencil (student personal communications, May 28, 1996).

**Research questions**

This study will attempt to answer the following questions:

1. What are parents’ attitudes about the use of calculators in mathematics instruction?

2. What are parents’ beliefs about the use of calculators in mathematics instruction? Why do parents hold their beliefs and attitudes toward calculator use in mathematics classes?

3. Will parents change their beliefs and attitudes toward calculator use in mathematics classes through an intervention that shows the calculator being used as a teaching and learning tool?
4. What did parents, who originally held negative attitudes and beliefs about the use of calculators in mathematics instruction, think caused them to become more positive about the use of calculators in mathematics instruction?

5. What did parents with negative attitudes and beliefs think was the reason they continued to think negatively even after the intervention?

6. Were there parents who were originally positive about calculator use in mathematics intervention and are now negative about it? If so, why did they think there was this change?

Importance of the Study

If parents are not supportive of an innovative practice, they may create resistance to the implementation of that practice and the practice may not be employed or may not be fully employed. If the practice is implemented, the parents may not support it and eventually the practice will be dropped (Konzal, 1997). By finding out what parents’ attitudes and beliefs are, why they hold these attitudes and beliefs, and how these attitudes and beliefs may change, I hope to inform educators about ways they can solve problems that may already exist with the parents or how they can avoid future problems.

The National Council of Teachers of Mathematics Principles and Standards for School Mathematics recommends that for grades 6 through 8, technology, including scientific calculators, be used in problem-solving situations and making mathematical connections among graphical, numerical, and other representations. Use of technology allows students to work on problems that do
not have whole number solutions. Technology can aid students in examining and recognizing relationships in mathematics. “When technology tools are available, students can focus on decision making, reflection, reasoning, and problem solving” (NCTM, 2000, p.24). This study will show parents how calculators can be used to teach children the connection between computations and the rules for computations with fractions.

Because research (Elmore and Others, 1985; Mucha, 1987; Parson, 1979; Tocco, 1971; Yee, 1986) has shown parents can influence the attitudes of their children, determining parental attitudes toward calculator use in mathematics education is important. The findings of the few studies that have included attitudes of parents toward the use of calculator have been conflicting or inconclusive.

In a search of the Internet, I found several sites that express negative attitudes toward NCTM Standards and the calculator in mathematics education. One was an entry into the Congressional Record by Senator Robert Byrd from West Virginia (Byrd, 1997). Another was a reprint of a column in a national newsmagazine (Leo, 1997). Both of these articles, as well as several others, cited Marianne Jennings, a professor at Arizona State University. Ms. Jennings is a mother, who was upset with her daughter’s mathematics program and was vocal about letting people know. Educators need to inform parents about new programs in their children's schools and how those programs are helping the students.

This study will help educators learn what parents think about the use of calculators in mathematics education. More importantly, it may help educators
learn how to calm the fears parents have about new practices in their children’s education. By educating parents to the value of calculator use in mathematics education it is hoped there would be a ripple effect with parents educating others in the community about the calculator’s value.

Using a constructivist paradigm, this study examined parents’ attitudes and beliefs about calculators. To learn which parents are positive or negative about the use of calculators, a Likert-type survey was distributed to parents of students in four schools of various socioeconomic status groups. Then through focus groups, the attitudes and beliefs toward the use of calculators in mathematics instruction of these parents were examined. I then conducted an intervention so the parents could learn how a calculator can be used as a teaching and learning tool. After the intervention, I conducted individual interviews of the parents to determine if their attitudes have changed and what was the deciding factor that caused the change.

*Limitations of Study*

As in any study there are limitations of this study. The schools were not randomly chosen, but were chosen for their convenience and to give a wide variety of subjects with different socioeconomic status. Because I did not work in the schools and did not involve the teachers in my study, there were few parents involved with the study. The study only entailed one intervention that lasted about twenty minutes.

This study only involved parents of middle school children. Some of the participants also had children in high school and in elementary school.
Discussions in both focus group interviews and individual interviews included use of calculators in elementary and high schools as well as calculator use in middle school. A limitation of this study is that only parents of middle schools were involved.

Another limitation of the study is that my framework does not contain only theory. Some of what is included was obtained from papers presented at various conferences. I had difficulty finding theoretical information about parent beliefs and parent education in mathematics.

The timeframe and sequence of data collection could be a limitation of the study. The study was conducted for the rural school overlapped that of the wealthy school. The timeframes for the rural school and the wealthy school were the longest. From the time the surveys for the rural school were distributed until these individual interviews were all conducted was fourteen months. For the wealthy school it was sixteen months. The study for the rural poor school took six months from the time surveys were distributed until the individual interviews were all conducted, while it took five months for the study of the urban school. From the beginning of the distribution of the first surveys at the rural school to the final individual interviews at the urban school was 32 months.

**Definitions of Terms**

The following operational definitions are used for terms in this study.

**Attitude:** A person’s disposition—positive or negative—at a moment in time. In this study parents expressed a positive or negative disposition about calculators use in school mathematics.
Belief: What the parents accept as truth about a set of tenets. In this study belief is about the parents’ accepted truth about calculator use in school mathematics.

Calculator: A handheld electronic device that is used to do mathematical computations. In the intervention of this study the TI15 calculator was used. The TI15 is recommended for middle school use. It is a scientific calculator that employs the correct order of operations. Fractions are stacked similar to what is in middle school textbooks. The TI15 calculator can be programmed so fractions are not reduced automatically.

Parent: The person who is responsible for the care and upbringing of the child.

Theoretical Framework

The theoretical framework for this study includes weak constructivism (Ernest, 1996), social constructivism (Ernest, 1996), sociocultural theory (Forman, 1996), and discovery learning (Bruner, 1966; Shulman, 1970). Both types of constructivism, weak and social, actively involve the learner in participating in the learning process. Learners do not just sit passively while someone else imparts information to them. Learners construct new information by reconstructing the knowledge they already have. Both the sociocultural theory and social constructivism entail learning as a social experience. Learners learn from those around them. According to sociocultural theory (Forman, 1996), those who are learners learn from those more knowledgeable than they are. In social
constructivism, those involved in the teaching and learning may be on the same
level of expertise, but learn together through interactions during common
experiences. Discovery lessons were used for the intervention. Worksheets were
constructed with problems for the parents to solve and look for a pattern, to devise
a rule for multiplication of fractions. They were actively engaged with the
calculator as a teaching and learning tool.

Constructivism

Constructivism is a theory of learning that proposes, “that all individual
human knowledge is constructed by each individual” (Ernest, 1996, p. 339). “It
recognizes that knowing is active, that it is individual and personal, and that it is
based on previously constructed knowledge” (Ernest, 1996, p. 336). Von
Glasersfeld (1996) says, “Radical constructivism assumes that the cognizing
activity is instrumental and neither does nor can concern anything but the
experiential world of the knower” (p. 308). The other two types of constructivism
are the same as radical constructivism with one or two differing assumptions. In
constructivism, new knowledge is either rejected or accepted. If it is accepted, it
may add to the knowledge that the learner has already constructed or it may
require the learner to reconstruct his/her knowledge of what he/she thought was
true. This last case is what this study is trying to produce. Parents, who are
negative, see that the calculator can be used in different ways from what they
originally thought. They will need to tear down their old belief and reconstruct
their knowledge of how a calculator can be used in the mathematics classroom.
In considering constructivism when teaching abstract ideas in mathematics, the teacher must allow the students to have experiences that allow them to make their own abstractions. With manipulatives, the teacher can create experiences that will lead the student to the abstraction. In order for a new concept or abstraction to be learned it must be related to what the student already knows and “students must be shown that there are elements in their experience that can be related differently from the way they habitually relate them” (von Glasersfeld, 1996, p. 312). The student must also realize that there are advantages of the new way. Von Glasersfeld (1996) says, “Whatever one intends to teach must never be presented as the only possible knowledge” (p. 313).

In this study, constructivism applies to the ways in which the parents formed their attitudes and beliefs toward calculators in mathematics education. To change the parents’ attitude and beliefs will require them to reconstruct their ideas of what is good mathematics instruction. It may also involve changing their ideas of what mathematics is, because parents may think mathematics is just computations. The parents have many concerns about calculator use in mathematics education. In order to change their belief that calculators are not educational tools, they need to be shown how it can be used as such a tool.

Ernest (1996) distinguishes three types of constructivism: weak constructivism, radical constructivism, and social constructivism. In this study, weak and social constructivism play a part.

**Weak constructivism.** In weak constructivism, “constructed truths can only be known as such by means of information from the world” (Ernest, 1996, p.
So as not to be a contradiction of the theory of constructivism, weak constructivism “only tries to account for the knowledge representations of individuals” (Ernest, 1996, p. 340).

In weak constructivism, all knowledge is constructed by the individual him/herself. Weak constructivism is much like radical constructivism, except, as Ernest (1996) describes, it is knowledge that the learner constructs that is consistent with the realities of the world, in this case, the “truths” of mathematics. The individual must take in information from outside to construct his/her knowledge of truth. Ernest (1996) says that weak constructivism “only tries to account for the knowledge representations of individuals” (p. 340). When the learner constructs knowledge, it must be consistent with the outside world, such as in mathematics, the knowledge he/she constructs must agree with the premises of mathematics.

In the intervention of this study, the parents will be experiencing use of calculators as learning and teaching tools. If they have not thought of a calculator in this way, they will have to either accept or reject this way of thinking. If they accept it, they will need to “tear down” their pre-constructed idea of what a calculator is. They then will need to accommodate this new information by using it to construct new knowledge.

**Social Constructivism.** Like weak constructivism, social constructivism is similar to radical constructivism except that knowledge comes from conversations with others. In conversations with others, the individual examines his/her
constructs of knowledge and reconstructs new knowledge. For the social constructivist, "The world is that of a socially constructed world that creates (and is constrained by) the shared experiences of the underlying physical reality (Ernest, 1996, p. 343). Ernest (1996) says, "The humanly constructed reality is all the time being modified and interacting to fit ontological reality, although it can never give a ‘true picture of it’" (p. 343). Social constructivism concerns both an individual constructivism and a social interaction.

Ernest (1996) says, "Language is regarded as the shaper of, as well as being the summative product of, individual minds" (p. 343). In social constructivism, language helps the learner build his/her knowledge through conversations with others. He/she is constantly using language to examine his/her beliefs during the conversations and is accepting or rejecting knowledge that he/she is gaining through conversations or insights from the conversations. As he/she accepts new knowledge, he/she is rebuilding his/her knowledge.

In the focus group interviews, parents discussed the use of calculators in mathematics education. As the discussions continued some of the parents seemed to be more positive and came up with more advantages to using a calculator in mathematics classes. In the intervention, parents had conversations with the researcher as they worked with the calculator. Through these conversations the parents might have become more positive about calculator use in mathematics education.
**Sociocultural Theory**

According to Forman (1996), Sociocultural theory consists of three major components: peripheral participation, activity setting, and instructional conversation. Peripheral participation refers to a newcomer participating in activities in which there are more experienced participants. Activity setting consists of the following: those present during the activity, or in this case the discussion, the important cultural values, the operations and task demands of the activity, the scripts for conduct of the participants during activity, and the purposes or motives of the participants.

Through the intervention program of this study, the researcher is the old-timer and the parents are newcomers. In the focus group interviews, some of the parents, who are knowledgeable about calculators in education, assumed the role of old-timers, while others, who have not had such experiences, are the newcomers. The old-timer leads or directs the newcomers until they are no longer on the outside edge and can begin to participate fully in the discussion. The old-timer informs the newcomer of the norms, values, and the discussion practices of the classroom.

During the focus group interviews, activity setting consists of the parents present for the interview and the interviewer. The discussion about the use of calculators in mathematics instruction that develops is the activity. The important cultural values that exist will vary from school to school and even group to group. The operations and task demands of the activity are keeping the discussion on the subject while allowing the parents to feel relaxed and talk freely about use of
calculators in mathematics education. Getting everyone to participate in discussion and not allowing anyone to dominate the group is the scripts for conduct of the participants during the activity. The purposes or motives of the participants probably vary. For the researcher, the purpose is to learn parents’ attitudes and beliefs about the use of calculators in the mathematics classroom and to learn this information to present research on the subject. The parents’ purpose was to help the researcher. Hopefully their motives were to share their attitudes and beliefs about calculator use in mathematics education with the researcher.

The instructional conversation in the focus group interviews involved parents who thought the calculator was a good tool for teaching mathematics to explain to the other parents. There was also instructional conversation in the intervention when the researcher demonstrated to the parent how the calculator could be used as a tool to teach multiplication of fractions.

**Discovery**

Jerome S. Bruner is the name most associated with discovery learning. Shulman, (1970) proclaims, “Bruner is not the discoverer of discovery: he is its prophet” (p. 29) “Bruner’s version of learning by discovery involved a theoretical mélange of Piaget and Plato” (p. 25). Bruner (1966) hypothesized that students would notice patterns from answering provocative questions used to elicit discovery.

For the intervention, I designed worksheets for the parents to do using a calculator. The worksheet contained multiplication of fractions for the parents to do using a calculator. After doing several problems, the parents were asked to
look for patterns in the fraction problems that they solved. Through the patterns they discovered, they were asked if they could devise rules that would enable them to solve problems without the use of calculators. Most of the parents already knew the rules for multiplying fractions. A few commented they did not remember the rules and working with the calculator helped them remember.

Conceptual Framework

Parental beliefs and parent education are part of the framework of this study. Parents have a set of beliefs that determine their attitude toward calculators in the mathematics classroom. In order to change their attitude, their beliefs must be challenged. This study attempts to challenge their beliefs through an intervention.

Parental Beliefs

Dodd (1997) says,

1. “Educators should talk to parents to find out what they think, misunderstand, or need to know” (p. 22)

Information from surveys may not give the complete picture of what parents think. They may indicate they oppose a practice, when in fact, there may be something else behind this opposition. Some of the parents in this study, actually approved of methods being used in this class, but were critical of it for other reasons. Some of the parents were opposed to a practice because they thought their children would not learn from it. Others thought it was too rigorous and time consuming.
2. “Discussions with parents about outcomes may be positive, but dialogue about process(es) may be more productive in the long run” (Dodd, 1997, p. 22).

Most parents and teachers agree on the outcomes of the education process, but many may disagree on the process being used to achieve these outcomes. If the parents are not permitted to discuss the processes being used, the teacher may think that they are in agreement when there actually is an underlying current of dissatisfaction. In Dodd’s (1997) study, the parents that most favored a traditional teaching method talked mostly about outcomes, while those who were more likely to support a non-traditional approach wanted to discuss processes. Dodd (1997) says, “By keeping parents focused only on outcomes, educators may in fact prevent them from developing the new understandings about teaching and learning which might lead them to support the changes educators want to make” (p. 23).

3. Educators should provide more opportunities for parents to learn more about unfamiliar classroom practices” (p. 23).

Teachers may be able to help parents become more comfortable about new processes by teaching them how the process will help their children reach the desired outcomes. Dodd says, “Educators may be able to help these parents develop some new understandings about teaching and learning by engaging them in activities in which they will learn about practices different from those they have experienced” (p. 23). In this study, parents favored practices they thought would help their children learn and opposed those that they thought would deter
their children’s learning. Dodd added, “[To learn,] parents must be actively involved and engaged” (p. 23). She says that parents learn little about new ways of teaching from newsletters and other written school communication. She suggests that educators conduct focus groups or employ other ways of discussing new practices with parents before they implement new practices.

Dodd and Konzal (1999) said, “What parents say at first may not tell the whole story. When parents were asked to explain something they objected to, their reasons were personal and complex” (p. 144). Often their objections were because they did not understand new practices implemented in their children’s classes. They said, “Parents are more likely to support new practices when their children are successful with them” (p. 145). If teachers speak with parents in a two-way conversation they may learn what parents want and they may be able to allay the parents’ concerns. This study uses focus group interviews and individual interviews to learn parents’ concerns.

**Parent Education**

Civil, Guevara, and Allexaht-Snider (2002) conducted research that involved working with parents using “Math for Parents” courses. The eight weekly classes were used to develop an understanding of “concepts related to fractions, decimals, and percentages” (p. 2). Half of the classes dealt with fraction concepts—mostly, about what a fraction is. The material used in the classes were those developed over the years by the instructor. “[The] course was modeled after content taught to children in grades K-6” (p. 4). The parents used hands-on material in their group work. At the end, parents thought they had a
better understanding of mathematics concepts and thought it was important to learn with understanding. One college-educated parent commented, “It’s not about just doing the math but understanding why it is the way it is” (p. 2). Another parent said, “We start from the very beginning to see how [fraction concepts] developed . . . and then we have to develop our own formula . . . and [then] you understand. The findings of this study “suggest that giving parents opportunities to actively construct their own understanding of mathematics concepts provides a critical foundation for their work with their own children. Furthermore, as parents themselves learn mathematics with an emphasis on understanding rather than rote memorization, they become quite vocal about the importance of understanding for their children’s mathematics education” (p. 5).

In another paper, Civil (2001b) said that parents expressed a desire to learn “academic” mathematics. In this paper, she said, “One characteristic that most parents seemed to value in the pedagogical approach . . . [was] friendliness” (p. 3). One of the instructors said that in teaching parents it is important to involve them. The parents also said they enjoyed learning with other adults. In still another paper, Civil (2001a) said that their goal in the projects was to get parents “to see mathematics as something that makes sense to them, we emphasize meaning over remembering formulas” (p. 4). They have found that parents want to understand the mathematics that they are learning.

In this study, my goal was similar to that of Civil. I wanted the parents to understand how the calculator could be used as a teaching tool and to experience learning with a calculator much as their children might if they were using a
calculator in a discovery learning approach. My approach during the intervention was friendly. The parents that participated in the focus group interviews were all friendly and everyone seemed to enjoy him/herself.

**Summary**

This study first uses surveys to learn what parents’ attitudes are about the use of calculators in the mathematics classroom. Dodd (1997) and Dodd and Konzal (1999) report, surveys do not give an accurate interpretation of what the parents think; therefore, focus group interviews were used. The focus group interviews reflect sociocultural learning. Some of the parents learn from other parents that realize ways the calculator may help students learn mathematics. The sociocultural learning will help the parents construct their knowledge of ways calculators can be used to benefit their children’s learning. There is also social constructivism involved, because some of the parents will learn from each other just by discussing ways the calculator can be used in mathematics education. After the focus group interviews, an intervention involving discovery learning was conducted. The parents used the calculator to experience multiplication of fractions much as their children would in a Standards-based curriculum. Through discovery learning the parents had the opportunity to construct their knowledge of calculators as pedagogical tools; this is weak constructivism. Parents either accepted or rejected the use of calculators in mathematics education. If they accepted its use, through constructivism they built a greater understanding of calculator use.
Figure 1.1, on page 25, shows how the theory relates to a change in parents attitudes and beliefs about the use of calculators in school mathematics. There is an interaction between sociocultural theory and social constructivism in the focus group interviews and in the intervention. Discovery learning contributes to weak constructivism. If the parents accept the new knowledge, they will reconstruct their idea of calculators. Through this individual constructivism, whether it is weak, social, or a combination of both, the parent will then change his/her attitudes, beliefs, or both about calculator use in school mathematics.

**Figure 1.1**
CONCEPT MAP OF THEORY
CHAPTER 2

Literature Review

This review of the literature is divided into four sections: (1) parents’ attitudes about the use of calculators in a mathematics classroom, (2) parent involvement in education, (3) calculator and Standards-based curriculum in a mathematics classroom, and (4) the correlation between attitudes and students’ achievement.

According to Miller (1978) some media, such as The New York Times and the Washington Post have the ability to determine what their readers talk about and what other media run (Miller, 1994). Therefore, it is important to note an article in the New York Times, dated April 6, 2004, was entitled “In Math, Computers Don’t Lie. Or Do They?” This title appears to give a negative impression about computers in mathematics. The article mentioned computer-assisted proofs, but in one paragraph it stated, “The debate over computer-assisted proofs is the high-end version of arguments over using calculators in math classes—whether technology spurs greater achievements by speeding rote calculations or deprives people of fundamentals” The next paragraph continued, “‘I don’t like them, because you sort of don’t feel you understand what’s going on,’ said Dr. John H. Conway, a mathematics professor at Princeton. Although, I
believe that Dr. Conway was speaking of computer-assisted proofs, it is not clear that he is not speaking of calculators in mathematics class.

Another damaging headline appeared in the *Washington Post*—“Calculators, ‘Pretend’ Exam Add Up to Poor Math Skills.” The author expresses concern that the number of students that do arithmetic will decline because students are permitted to use their graphing calculators on the exam.

In the nationally circulated *USA Today* another negative title was “Erosion of basic math skills hinders students.” This editorial stated, “Calculators are handy substitutes, but not everyone will carry a calculator forever. Plus, calculators are only as accurate as the data entered into them.” (Erosion of basic math, 2002).

In 1998, *Readers’ Digest* printed an article entitled “Kick Calculators Out of Class.” The author began, “They should be banned from elementary schools.” He lamented that children will not learn their multiplication tables and therefore, will not be able to do arithmetic (Gelernter, 1998).

A letter to the editor in the *Tennessean* from a mathematics teacher of 42 years is entitled “Calculator is not a teaching tool for math.” He tells parents not to let their children use calculators when doing their homework. (Gorham, 2003)

An article found on the Internet written by a 23-year-old Teach for America corps member, who was teaching fourth-grade mathematics in inner city New York, was entitled “How not to Teach Math.” The author complained the program he was required to use encourages a “detrimental overreliance on calculators” to replace mental computation.
According to Cohen (1963), “[The press] may not be successful much of
the time in telling people what to think, but it is stunningly successful in telling its
readers what to think about.” So if you read any of these articles, you as much of
America are thinking about whether calculators are or are not a good thing in the
mathematics classroom. And what do you do if your child’s school list requires a
calculator? Do you enthusiastically send him/her off to school with his/her
calculator? Or do you do as some parents in Wisconsin or in San Diego California
did?

**Parental Attitudes Toward Mathematics Education**

Parents in a Wisconsin school district pulled their children out of the
Standards-based mathematics program and home schooled them until they were
told that they were in violation of the truancy laws (Vukmir, 2001). Parents in San
Diego reacted to the introduction of a reform mathematics program based on the
These parents united to change the curriculum of California. They have a website
with links to topics which appear to be mostly negative about the reform efforts in
mathematics (Vukmir, 2001).

Parents are uncomfortable when they perceive their children’s
mathematics classes as different from those that they experienced. Involvement to
help parents understand the reform mathematics program may bring their ideas of
mathematics education closer to what is being taught. Because much of a child’s
education occurs outside of the school, with information about how mathematics
is being taught in the school, parents will be in a better position to help their
children with mathematical experiences (Peressini, 1998).

According to a study by Wentworth and Monroe (1996), parents want
computers to be part of their children’s education, but other studies showed that
parents don’t want computers used in innovative ways to educate their children.
Parents preferred the standard methods of teaching. Wentworth and Monroe
discussed a survey that investigated the relationship of parents’ attitudes of the
roles of teachers and computers in the classroom. Five elementary schools from
one school district were used. Mathematics education in the schools ranged from
traditional to innovative constructivist approaches. Likewise, computer use ranged
from drill and practice to creative problem solving uses. Parents of children in the
schools that used a traditional approach expected the schools to prepare their
children with job skills. These parents thought the teacher’s role and the role of
the computer were the same. Their beliefs may be the reason the schools used the
kind of instruction they did or the beliefs may be a reflection of the type of
instruction used in the schools. Parents of children in schools in which
mathematical instruction was more innovative had a broader view of what they
expected of their children’s education and the role of both teachers and
computers. These parents looked at education as the building of understandings
and meanings. Again, did the type of education their children were receiving form
the parents’ attitudes or did the schools deliver the innovative instruction because
of the parents’ attitudes? The research that Wentworth and Monroe cited showed
that little has changed in instructional methods in public schools even though the
use of technology had dramatically increased over the two decades prior to this study.

The purpose of Collums’ (1991) study was to determine the effect of a parent education program on the attitudes of rural Mississippi parents of third-, fourth-, fifth-, and sixth-grade students toward the use of calculators in their children’s mathematics classroom. The researcher designed newsletters containing information on calculator usage, tips for purchasing a calculator, and calculator activities. In addition to the newsletter, the parents participated in workshops. Questionnaires were used to collect data on parental attitudes on the use of calculators in elementary mathematics classes before and after the parent education program. The only statements on the questionnaire that did not show significant change were those to which the parents responded positively in the beginning. From the results of the study the researcher recommended increased usage of calculator activities in elementary mathematics classes, parent and teacher training in using calculators with elementary-age children, and additional research on the possible negative effects of using calculators. She also recommended more research on the effects of a parent education program on parents with extremely negative attitudes about calculator usage.

Graber (1993) compared the attitudes of parents and teachers toward the use of calculators in the elementary classroom. He administered a survey to elementary teachers and parents. Teacher responses were 24% and parents were 10%. The teachers were more positive than parents about the use of calculators in
the elementary classrooms. The researcher concluded that parents were not enthusiastic about calculators in elementary school.

A two-year study by Bitter and Hatfield (1993), which involved the use of the Texas Instruments’ Math Explorer™ Calculator, included 580 seventh- and eighth-grade students and their teachers. The researchers investigated student use of the calculator in various activities and with multiple mathematics topics. They looked at the student perceptions about calculator use and compared before and after project beliefs of students, before and after project beliefs of parents, and before and after project beliefs of teachers about calculator use. An onsite research assistant developed classroom materials, interviewed students and teachers, and performed other duties necessary to keep communication between the school and the project team. To be certain that all of the students had access to a calculator, the school purchased the Texas Instruments’ Math Explorer™ Calculator, which was checked out to the students in the same manner as their textbooks. A comparison of the attitudes of the parents before and after the study showed the percentage of parents that viewed the calculator positively increased after the study on all but one question. On that question, there was an increase in the percentage of parents who thought the calculator would hinder students’ understanding of basic computation skills.

These studies found that parents prefer traditional methods of teaching to innovative teaching practices in mathematics. Some of these studies have shown that parents become more positive about innovative practices when they learn more about these practices.
Parent Involvement

Not only does NCTM (2000) emphasize the need to use calculators from prekindergarten through the twelfth grade, it also points out the need for family involvement. Families can convince their children to take more mathematics. They will push for a high quality mathematics program, but only if they realize how the program will benefit their children. “If families and other members of the public do not understand the intent of, and rationale for, improvements in mathematics education, they can halt even the most carefully planned initiatives (NCTM, 2000, p. 378).”

Students will achieve more in school if their parents are involved. In a study done by Lynn (1994), “students get better grades, have better attitudes toward school and have high aspirations if parents are aware of what’s happening in school and encourage their children” (p.1). In a paper presented as part of the symposium at the 1997 annual meeting of the American Educational Research Association, Jean Konzal (1997) stated, “When parents develop negative attitudes towards new practices—especially when these parents are influential—powerful resistance may develop and new instructional practices may disappear” (p. 2).

The Konzal (1995) study is qualitative study done in a New England town near a metropolitan area. There was tension in the town between the parent “from away” and the parents born and educated within the state and the local community. The study consisted of interviews conducted over a three-week period of mostly parents of twelfth-grade students of the school. Those who came “from away” were mostly professionals with progressive educational experiences,
those raised within the state were conservative in their opinions about new
dractices in the school, and those born in town were poor and experienced
difficulty in school. Many of the parents “from away” were well informed about
school practices and changes; therefore, they were able to influence the school for
the benefit of their children. The parents born within the state felt frustration at
the inability to effect change for their children. The knowledge of the town’s
people about the changes was limited and they felt they had little influence to
change the situation. As a result, the school listened to the influential parents and
changed the mathematics curriculum. In comparing the mathematics curriculum
change with the change in the social studies curriculum, the researcher found that
the social studies teachers learned from the mistakes of the mathematics teachers.
“These teachers designed their new course so that it pushed at the edges of [the
parents’ zones of tolerance] without going too far and creating a storm of
resistance from influential parents” (Konzal, 1997, p. 20). After three successful
years, the program was modified to include changes similar to those that had been
resisted in the mathematics program. These changes were met with little or no
resistance. Konzal (1997) suggested that parents should be involved in proposed
curricular changes before the new practice is developed or implemented.

These include parenting, communicating, volunteering, learning at home,
decision-making, and collaborating with community. The most controversial of
these appears to be decision making which Epstein refers to mean “a process of
partnership of shared views and actions toward shared goals, not just a power
struggle between conflicting ideas" (Epstein, 1995, p. 705). Parents and schools blame each other for the lack of partnerships in education. To improve this problem teachers and schools need training on ways of involving parents and the community in all six types of involvement (Epstein, 1993). An earlier study (Epstein & Dauber, 1991) found that contrary to what teachers thought, both teachers and parents thought parent involvement was important.

Even though the decision-making process in their children’s schools is a controversial area, more parents are getting involved in it. Many parents first get involved in the decision-making process when they learn of a practice that does not appear to be benefiting their child or that they think may be harmful to their child. Other community members may also get involved for similar reasons (Bradley, 1994; Diegmueller, 1994; Olson, 1994; Pitsch, 1994; Portner, 1994; Self, 1994). Other articles cited concern over educational reform or its slow pace as increasing the amount of parent and community involvement (Bradley, 1998; Dykstra & Fege, 1997). Anne Dodd (1996) said, in reference to the changes brought about by schools developing learning standards and implementing practices based on research, “We cannot expect parents to accept and support these changes if they don’t understand them and are left out of the planning process” (p.44).

Lambert (2003) said that parents often support programs that track and label students, create competition, and are more traditional in instruction and assessment. She identifies four stages, called quadrants, of parents in leadership roles. In Quadrant 1, “Most parents voices are either silent or heard only when the
parent is called to school because of a discipline problem or special-education placement” (p. 67). In the second Quadrant, “more parents are involved in some aspects of school life, often attached to a specific program—sports, for instance, or the performing arts” (p. 67). In schools of the third Quadrant, “Involved parents are more skillful and focused in their participation and have begun to exhibit shared responsibility for the school’s improvement” (p. 68). In the fourth Quadrant parents exhibit true leadership (p. 68). In order to fully develop parents as leaders, the author has several suggestions including “parent-to-parent leadership and advocacy” (p. 69) which could include parents conducting opinion polls of other parents, conducting focus group studies, and informing parents about “new learning practices” (Lambert, 2003, p. 69).

Peressini (1998) said that parents have “influence in education and school reform” (p. 577). He described several reform curricula that were put into schools. In these schools the parents disliked the new curricula and worked to establish more traditional curricula that they thought would emphasize the basics. Peressini summarized, “[Parents] are a group that must be seriously considered in any attempt to reform education. …There is a need not only to involve parents as a significant constituency group in current efforts to reform mathematics education but also to focus on understanding the various aspects of parental involvement in school mathematics (p. 577).

In an earlier study, Peressini (1996) explored the role of parents in three urban high schools by examining mathematics teachers’ perceptions of parents and parents’ perception of their children’s mathematics. The schools were in the
process of reforming the mathematics program. In two of the schools, parents desired to be more informed about the changes in the mathematics program. Another school informed parents about the changes by sending a letter home to the parents at the beginning of the year explaining the new program and inviting them to participate in a “Family Algebra Night” twice each semester. On those nights, the parents actually experienced the mathematics program by solving problems in the way the students do. Even though the parents mostly supported the reform movement in the mathematics curriculum they were unsure how the program would affect their children. “Lack of communication between schools and families seems to lead, in many instances, to misunderstandings about the mathematics program” (p. 21) Parents would have liked to be able to help their children with their mathematics homework, but none of the schools offered to help the parents do that. The only time parents in these schools were involved in any decision-making processes was when they demanded to be involved. Peressini stated, “The lack of attention give to parents in the reform of mathematics education has set both parents and teachers up for contention” (p. 25).

Barton, Drake, Perez, St. Louis, and George (2004) conducted a study of urban parents. Through traditional forms of parent involvement, one parent became more knowledgeable about the school and how she could advocate for her children. This knowledge gave her the confidence to question and vocalize various practices of the school. Another parent, who had a high school degree, was not comfortable with the English language. She worked in the home of a
principal of a private school. By questioning this principal, she was able to advocate for her child with his teacher. The researchers concluded, “[Parental] engagement is a set of relationships and actions that cut across individuals, circumstances and events that are produced and bounded by the context in which that engagement takes place” (p. 11).

Civil, Andrade, & Anhalt, (2000) did a qualitative study in which, among other methods, the parents did writing exercises and participated in discussions about mathematics. The researchers found that, as parents visited the mathematics classrooms, they became more aware of how and what was taught in the mathematics classrooms. They were then able to share activities with their families at home and by doing so some of these parents took “an active role in wanting to change their children’s experiences with math in school” (p. 425).

In a paper presentation, Civil (2001a) told of her research with minority and working-class parents in two ongoing projects. She spoke about the topics of parents as learners, parents as parents, and parents as leaders. In speaking of parents as learners, she said that the parents want to learn mathematics and the want to understand what they are learning. In both of the projects the instructors try to teach for understanding. In both projects, the parents said that their children were the major reason they were participating in the project. They wanted to be able to inspire and motivate their children. In one of the projects, the second year parents were involved they teamed up with teachers and became part of a leadership team to teach other parents. The researcher said that the parents seemed to gain confidence as they participated in leadership roles.

37
In another paper, Civil (2001b) said that most parents seemed to value friendliness in the pedagogical approach. They enjoyed the support they received in working in groups and “they also enjoyed listening to each other’s ideas about a problem” (p. 3). They liked learning with other adults. These parents wanted to learn school mathematics so they would be able to help their children. One of the instructors said that he thought it was important to involve the parents in the classes he was teaching. He also said that it was important to be certain that all attendees were taking part in the lesson.

Atkin & Bastiani (1988) identified four concerns of parents dealing with their children’s schools:

1) The development of practical arrangements for effective communication between parents, teachers and pupils lies at the heart of good home/school relationships.

2) Effective basic communication needs to be backed up by a range of appropriate opportunities for parents to participate in their children’s schooling.

3) Schools need to recognize, support, and strengthen the crucial role of parents as educators.

4) Parents represent a valuable, but often unacknowledged resource which could be tapped to great effect in the education of children and young people. (pp. 64-65)
The researchers said, “Detailed knowledge of curriculum content that teachers possess is not necessarily a barrier between home and school and does not seem to be a requisite if parents wish to be involved with their children’s learning. …The kind of knowledge that these parents find useful is their understanding of the educational system as a whole” (Atkin & Bastiani, 1988, p. 73). Atkin & Bastiani (1988) said that parents don’t see themselves as ‘educators’ and don’t realize how much they can help educate their children. The authors went on to point out, “Listening to parents can be the beginning of creating different but complementary roles for the professional teacher and the lay parent” (p. 42).

Parents may be knowledgeable about school practices, but may not fully understand them. They receive few, if any, “explanations of what the school is doing, and more particularly how and why it is doing it” (p. 54). The authors said that communication and involvement can change parents’ views and that the more contact parents have with the schools the more they identify with the goals and activities of the school. They found that often, once parents felt part of the education community, they were more supportive of teachers, policies, or practices. They found that communication between the schools and the parents could be a problem when the school failed to communicate in terms that the parents understood. When parents were more familiar with the schools, they were less willing to accept the school’s definition of a problem, the course of action the school proposed, the ways of doing things, and the consequences of such action (Atkin & Bastiani, 1988).
Brand (1996) conducted Project Interconnecting Teachers, Children, and Homes (PITCH) for Literacy involving 16 teachers from various schools who participated in workshops to help them improve home and school relationships. The workshops were comprised of speakers, readings, small-group discussions and other various activities. They sent surveys or questionnaires home to find out what they could about parent involvement in their schools. “Many teachers were surprised to learn from their parent surveys that parents felt uninformed about the daily experiences in the classroom” (p. 77). One teacher commented, “The PITCH workshops opened my eyes to how parental involvement can help me in the classroom and how important I can be in helping parents educate children” (p. 77). Teachers in the workshop realized not only the difficulty getting parents involved, but also the rewards when parents were involved. By sharing with each other, the teachers were able to exchange ideas and give each other encouragement to try new and innovative ways to get parents involved. The authors said, “Teachers must be given support so they can create strong partnerships that let parents know the profound effect they have on their children’s future” (Brand, 1996, p.80).

A study by Dodd (1997) involved 25 parents of eleventh-grade students, who studied English in a heterogeneously grouped American Studies course. These parents thought that the best way for students to learn was in a class that would actively involve the students in what they were learning and would help them see the connection to their own lives and their future. In interviews, the researcher found that in discussing parents’ opinions of innovative teaching
practices, the parents appeared to contradict themselves. Often, what they said they wanted for their children, was taking place in the innovative classes, but they said that they opposed these classes. It would have been difficult to assess this from a survey alone. One parent was opposed to a practice because her child had received a low grade in the classroom that used that practice. When the discussion continued, she indicated that she thought that same practice was a good way to learn. Some parents opposed the innovative class because “they were confused about how the course was taught or critical of its demanding requirements” (p. 21). Other parents could not understand how their children could learn with this type of instruction. “This study indicates that conversation with parents in a non-threatening environment is not only valuable as a means of discovering what parents actually think about certain practices, but such conversations may also encourage some parents to develop new understandings about teaching and learning” (Dodd, 1997, p. 21).

Another study by Dodd (1995), which investigated parents’ beliefs about teaching and learning English, found that parents held misconceptions about innovative practices or the way these practices were implemented. This study found that parents that were more knowledgeable about different practices were “more likely to express a preference for a greater variety of practices” (p. 5). The study suggests that information from surveys “may be misleading or incomplete” (p. 9). Educators need to speak with parents to learn what they believe and what misconceptions they may have.
A survey of 50 parents in an inner city elementary school (Holloway, 1997) was conducted to learn about school involvement, personal involvement, and parent involvement. In this school, the researcher had heard comments from teachers that parents did not care and from parents that teachers did not listen to them or respect them as parents. Through a survey of the parents, the researcher learned that parents did not get involved if they did not feel that they were part of the school community. Parents thought that parent workshops were important, especially if the workshops helped them learn how to tutor their children at home. Most parents thought that involvement in curriculum planning was important, while some were concerned that the parents involved in choosing curriculum, might choose curriculum that would favor their own children.

Cochran and Dean’s study (1991) was a three-year study that followed 225 urban families with three-year old children until these children began first grade. As they visited the homes of these families, they asked the parents what they were doing to help their children develop. After receiving permission from the parent, they share these activities with the other parents of the study. The researchers said, “This approach gave parents a feeling of their own value” (p. 263). They worked “to build confidence and skills specific to active involvement with the child’s school and teacher” (p. 263). The researchers said that the empowerment process enabled parents to make changes in their neighborhoods, as well as improving their children’s school achievement. Through this program and one that involved the school, the parents developed more positive attitudes toward becoming involved with the school. Cochran & Dean (1991) said, “If
…efforts [to promote interactions with families] are confined to either personal interactions or policy changes, much of the potential of the empowerment process is lost, and actual harm may result” (p. 268). In order to avoid this problem parents’ communication skills and expectations for parent involvement would need to be reflected by the school’s policies. By emphasizing interpersonal communication and policy-shaping skills for all involved will avoid the uneasiness felt by those who are usually in charge sharing that responsibility.

These studies point to the importance of involving parents in their children’s education. When parents have become involved they have generally become more positive toward schooling practices than they were before their involvement. The types of involvement recommended vary from parent-teacher conferences to parents being involved in decision making. Educational workshops that help parents be able to help their children seem to most helpful to create positive attitudes for parents. Education to prepare parents to participate in decision-making would help them when choosing curriculum.

**Calculator and Standards-based curriculum in mathematics classrooms**

This section concerns the literature about the use of calculators in mathematics classrooms and Standards-based curriculum in mathematics classrooms. Some of the literature did not state whether calculators were used in the instruction, but because Standards-based curriculum should incorporate calculators in the instruction, I have included Standards-based curriculum here (NCTM, 2000).
In a review of research on teaching and learning, Hiebert (1999) found that “Students learn what they have an opportunity to learn” (p. 12). Most students are being taught simple calculation procedures, terms and definitions, so that is generally all they are learning. The research data indicate that this traditional teaching is deficient even though this method is often referred to as the “proven” method when compared with experimental approaches.

Ellington (2003), who performed a meta-analysis on 54 research studies, found that operational and problem-solving skills of students in kindergarten through twelfth grade improved when a calculator was used as an integral part of the instructional and testing program. The most improvement occurred when the calculator was used as a pedagogical tool. When the calculator was used as a pedagogical tool but was not used in testing, the students maintained their paper-and-pencil skills and the skills necessary to understand mathematical concepts. The study found that the instruction with a calculator should be for at least nine weeks. In those studies when the calculator instruction lasted for more than nine weeks, students appeared to have improved attitudes toward mathematics. The use of a calculator during instruction did not hinder the development of computational skills of elementary students in the studies when the calculator was available or not available during testing. The researcher recommended, “Calculators should especially be emphasized during the instruction of problem-solving skills in middle and high school” (p. 457).

Fuson, Carroll, and Drueck (2000) used two studies to test the achievement of second and third graders using a Standards-based curriculum.
Beginning in kindergarten these students have used calculators and other mathematical tools extensively throughout their mathematics instruction. The two studies focused on students who had been taught using the same curriculum in the first and second grades for one study and in the first through the third grades for the other. These studies found that the students in these classes were on the same level as other U.S. students on multidigit addition and subtraction computations. They scored higher on a test of number sense than other U.S. students and matched the scores of Japanese students in this area. They also scored higher than other U.S. students in traditional curriculum on place value and numeration, reasoning, geometry, data, and solving number stories. The third graders even outsored seventh-graders on a few questions in these areas.

A study performed by Huntley, Rasmussen, Villarubi, Sangtong, and Fey (2000) to test the effects of a Standards-based curriculum in Algebra found mixed results. It found that the students did better in areas of algebra that were emphasized in their classroom. In other words, the students in the Standards-based curriculum did better on problems using functions and graphing technology than did the students in the traditional curriculum because the curriculum emphasized those skills. Likewise, they found that the students in the traditional curriculum did better on algebraic symbol manipulation than did the students in the Standards-based curriculum, because that curriculum emphasized those skills. This study found that both the traditional and the Standards-based curricula could be improved (Huntley et al., 2000).
The purpose of the Eads’ study (1986) was to evaluate the development of materials for an updated mathematics and computer usage curriculum for kindergarten through grade six. The study also attempted to describe the preparation of inservice training and materials for elementary teachers to use to carry out the new curriculum with the use of computer technology in the classroom. Increased presence of computers, calculators and other technologies in the classroom affected curriculum. The need for curriculum reform was immediate and critical in view of future career and personal needs of students. Teacher participants in the study were confident in the revised mathematics curriculum and indicated that they could include the computer literacy curriculum in the subject matter areas. Teacher’s attitudes toward using computers in the classroom changed from frustration to a feeling of confidence. They thought the computer enhanced mathematics learning. The teachers thought all teachers should participate in extensive training in the use and implementation of new and revised curricula that take advantage of the new technology. Students achieved significant growth in mathematics achievement, mechanics, and concepts. After the study, students had more positive attitudes toward mathematics than before the study.

A Dunham and Dick (1994) article from *The Mathematics Teacher* presented an overview and discussion of some of the results of research of graphing calculator use in the classroom. Some of the studies found students taught using the graphing calculators performed better than students without the use of graphing calculator instruction. Other research found no difference in the
performance of students that were instructed with or without the graphing calculator. The article points out that researchers, who were concerned the students would rely on the calculator as a crutch, did not think the student should use the calculator on exams. Whereas, other researchers argued not allowing the graphing calculator to be used on exams, when the students had been taught to use the calculator as a basis of instruction, handicapped the students. Some of the studies indicated that students, who were given instruction based on the graphing calculator, understood more concepts of graphing than did students taught in the traditional way. Other studies indicated the opposite. Students in some of the studies believed calculators improved their ability to solve problems. The article said the combination of technology and changes in curriculum and instruction should be investigated.

Wilson and Krapfl (1994) analyzed literature related to graphics calculators by looking at the assumptions of what mathematics should be learned, how it should be learned, and how graphing calculators influence teaching and learning of mathematics. The authors mentioned to the ease of the user to adjust the scale of the axes by zooming in or out on graphs and to trace points to analyze the graphs; features which allowed students to experiment with, visualize, and explore properties of functions. Because of the ease with which students could switch between algebraic, graphical and tabular representations of functions, it was claimed that students could select the representation that most effectively gave them the information they were seeking. They cited research that claims students could be given more interesting problems involving real-life situations.
because of the ease of use and the ability of the graphics calculator to draw accurate graphs. Students could use the graphics calculator to easily look at a number of graphs of a family of functions and explore relationships of the functions through the graphs. Reports that the authors reviewed claimed that through graphics calculator use, students could better conceptualize alternative representations of functional ideas. One study showed students with graphing calculators were able to make stronger links between graphic and algebraic representations of functions. Students were impressed by the power of the graphics calculator and found that it made mathematics more enjoyable. Through the use of the graphics calculator, teachers tended to lecture less and encouraged students to explore and experiment more with mathematics. The authors found several potential problems of using the graphing calculators. Students did not appear to be able to interpret graphs of functions and they did not seem to understand the scaling of the window. There were problems of the graph not showing the discontinuities of some graphs. Students could think that graphical methods of solving problems were equivalent to the algebraic methods and could think that all solutions were rational numbers. The authors concluded that in order for students to get the maximum benefits from the technology, the problems associated with the technology must be examined.

Quesada and Maxwell (1994) conducted a study involving 710 students in a precalculus course at a large university over three semesters. Students in the control group were taught in the traditional manner while students in the experimental group used the graphing calculator with more interactive
presentation of topics. Students were informed at the beginning of the course that every test would include word problems. The students in the experimental sections were required to buy the specified graphing calculator; there were no complaints registered about buying the calculator. All students took the same final exam. Each semester, the mean score on the final exam of the experimental groups was significantly higher than that of the control groups. With the graphical approach students gained more depth, maintained interest, and improved their motivation. The researchers did not investigate the reasons for the improved scores of the experimental group.

Groves and Stacey (1994) followed children from kindergarten and first grade through third and fourth grades for a four-year investigation. The study investigated the effects of calculators on the learning and teaching of mathematics. At the beginning of the study, the researchers observed the calculator being used as a recording device, a counting device, a computational tool, and an object to explore. Teachers and students developed activities around these uses. During each year from 1991 through 1993 all third and fourth grade children were given a written tests, including a test of calculator use. Each year ten percent of the children took part in interviews. The written test, done without the use of calculators, showed a significant improvement of understanding of the number system and in the ability to choose an appropriate operation for word problems in grade three. There was no significant change in numeracy not related to number, in knowledge of number facts, or in computational ability. Students with longer calculator experience did better on the calculator-use problems
involving decimals and negative numbers and more difficult problems. There was no significant difference in the ability to use the calculator for simple one- or two-step operation problems. The interviews showed that on computation and estimation tasks and on some real world problems children with long-term calculator experience performed better than did children without such experience. They exhibited better knowledge of number, place value, decimals and negative numbers.

Pesek and Kirshner (2000) conducted a study in which students in the experimental group received only a discovery-type instruction while those in the control group received the traditional type of instruction followed by the same discovery-type of instruction. The researchers found that students in the experimental group learned as much and in most cases more than those in the control group. The fifth-grade students in this study were studying area and perimeter. The control group had five days of traditional instruction followed by three days of discovery. The experimental group had only the three days of discovery. The researchers found that many students in the control group clung to misconceptions they obtained in the traditional instruction despite finding contradictory evidence during discovery. In the interview part of the study, students in the control group thought they had learned more during the traditional instruction than during the discovery.

These studies found that calculator and Standards-based curriculum improved students’ mathematical achievement and knowledge of mathematical concepts. The use of calculators also improved students’ attitudes toward
Some studies reported that students believed the calculators improved their ability to solve problems. Other studies reported the calculator seemed to improve student motivation.

**Correlation between attitudes and achievement**

Tocco (1971) tested the correlation of the students’ attitudes toward mathematics and the attitudes toward mathematics that they perceived their parents had with the students’ achievement in mathematics. The researcher thought students’ attitudes toward mathematics, their perception of their parents’ attitudes toward mathematics, and the socio-economic status of their families would be positively correlated with their achievements in mathematics. Questionnaires to measured students’ attitudes toward mathematics and students’ perception of their parents’ attitudes toward mathematics of 150 randomly chosen mathematics students in Miami, Florida junior high school. The study concluded there was a direct relationship between student attitudes toward mathematics and the student reports of their parents’ attitudes toward mathematics. The researcher found a direct relationship between student attitudes toward mathematics and student achievement in mathematics. There were no substantial findings dealing with the direct relationship between achievement in mathematics and socio-economic status, attitudes toward mathematics and socio-economic status, student reports of their parents’ attitudes toward mathematics and socio-economic status, student reports of their parents’ attitudes toward mathematics and achievement in mathematics.
Parson (1979) investigated what determines one’s decision to take or not to take mathematics. Approximately 250 children in the fifth through the eleventh grades and their parents completed questionnaires regarding their beliefs and attitudes about mathematics and English. Parson (1979) found children were not as accurate about their fathers’ beliefs as they were their mothers’ beliefs, which could explain the lack of correlation between fathers’ beliefs and those of their children. Children’s expectancies and their plans were most directly related to their mathematical self-concept and to their perceptions of their parents’ beliefs about their (the children’s) mathematical aptitude and potential. Parents’ and teachers’ estimates of the children’s ability were only partially determined by the children’s actual past performances. The children’s future expectancies were related most directly to the children’s gender and to their perceptions of their parents’ expectations for them. Parents had gender-differentiated perceptions of their children’s mathematics aptitude. They felt advanced mathematics was more important for their sons than for their daughters. Parents’ perceptions of and expectations for their children were related to the children’s perception of their parents’ beliefs and to the children’s self-concept, future expectations, and plans. Parents felt their daughters had to try harder to do well in mathematics.

Wilhelm and Brooks (1980) conducted a study to investigate the influence of parental attitudes toward mathematics on their children’s attitudes and achievements in mathematics, to determine if there were differences in attitudes toward mathematics based on gender or grade level, and to update past research. Two survey forms were given to each of 241 seventh-, eighth-, and ninth-grade
students from a middle class socioeconomic group to give to their parents. The anxiety levels of students in the low and medium ability groups corresponded to that of their parents. There was no significant correlation between the anxiety levels of the high-ability group and their parents’ anxiety levels. There was a high positive correlation for self-concept between mother and son and between mother and daughter in the low-ability group. There was no correlation between either of the parents and child in the medium-ability group. Ninth-graders perceived mathematics more valuable than the seventh- or eighth-graders. The study also found that fathers of low ability sons had a poorer attitude toward mathematics than did their sons. Within the medium- and high-ability groups fathers and sons put a similar value on mathematics while fathers and daughters had opposite views. Mothers’ influence on her children lessened in the medium and higher group levels.

Lyons’ (1980) research was to determine if parental modeling, parental reinforcement or academic and career interest could identify whether high school females would elect an accelerated mathematics program or a regular mathematics program. Earlier research indicated that the amount of participation of females in advanced mathematics courses might explain the gender differences in school mathematics achievement. The study found the three variables that correlated most highly with the students’ course selection were paternal occupation and maternal hours and period of employment. The most important correlation found in the study was that fathers of the females in the accelerated mathematics group were considerably more often engaged in mathematics-related
occupations than are those of the regular mathematics group. The specific occupations of the fathers of the accelerated group were engineers, business executives, and systems analysts, while the occupations of the fathers of the regular mathematics group were lawyers, publishers or writers, and real estate agents. The father’s educational level was only moderately correlated to the choice of the mathematics program chosen by the females. The amount of post secondary schooling of the subjects’ fathers in both groups was varied. Mothers with daughters in the accelerated group were most likely not to be employed, or if they were, began employment after their daughters entered high school. Neither the mothers’ type of employment nor their educational level had any substantial correlation to their daughter’s choice of mathematical programs. The parental reinforcement did not appear to correlate with the students’ choice of mathematics program. Lyons thought this might reflect that all the students were in a high school for the gifted and all of the students probably received substantial parental reinforcement for achievement. The group in the accelerated program expressed more definitive interests in obtaining graduate degrees and in electing mathematics courses in high school and college than did the regular group. The career goals of the students were not yet well defined.

Zimmermann’s (1982) study attempted to examine the characteristics of parents of mathematics anxious eighth-grade girls. It explored parental variables that could be related to math anxiety and was designed to contribute to understanding some of the variables that impact the development of math anxiety in women. The students, who had average or above average intelligence scores,
were chosen by mathematics achievement levels which were one or more years behind their reading achievement levels and by their own self-reported anxiety levels. The parents of the chosen students were given questionnaires about their attitude toward mathematics and about demographics. The study found there was a significant relationship between the math anxiety of mothers and that of their daughters. A significantly larger number of fathers than mothers of mathematics anxious daughters graduated from college and graduate school. It was thought that the lower education level of the mothers might have an impact on their daughter’s future participation in mathematics programs. There was a significant difference between mothers and fathers in higher-level college mathematics courses taken. General mathematics was taken by 83% of the women in this study. Testing showed the parents of the mathematics anxious girls were not more mathematics anxious than the normative sample.

Elmore, and Others (1985) investigated the relationship between attitudes toward mathematics, career interests, and parent variables measured at the eighth grade and attitudes toward mathematics and career interests measured at the twelfth grade. Students participated in the study during the school year as eighth graders and again four years later as twelfth graders. Data were collected on the students’ attitudes toward mathematics and career interests during both the eighth and twelfth grades. Additional data were collected on the parents’ attitudes toward their children’s mathematical abilities. The positive attitude of the parents toward their children’s mathematical ability correlated with the interests expressed by the students in mathematically related occupations.
Cain-Caston (1986) investigated the extent of the relationship between both parents’ and students’ attitudes toward mathematics and student achievement. In addition, the researcher compared these relationships by gender and performance levels. At the beginning of the third grade, students were randomly assigned to classes based on their gender and their performance ratings. The students and their parents were each given an attitude survey. At the end of the 15-week study the students were administered an achievement test. The study found no significant relationship between students’ attitudes toward mathematics and students’ achievement in mathematics. There was a significant negative relationship between students’ attitudes toward mathematics and fathers’ attitudes toward mathematics. There was no significant relationship between mothers’ attitudes toward mathematics and students’ attitudes toward mathematics. There was a significant relationship between mothers’ attitudes toward mathematics and fathers’ attitudes toward mathematics. There was no significant relationship between students’ attitudes toward mathematics and their gender, race or performance levels. The researcher concluded that parental attitudes were not the only determining factor of students’ attitudes and their performance.

Yee (1986) presented three studies that show parents beliefs differ with respect to their sons’ and daughters’ mathematics competencies. The first study found that even though parents did not rate their daughters’ mathematical ability lower than that of their sons, they thought their daughters had more difficulty and had to work harder to do well in mathematics than did their sons. Parents thought mathematics was more important to their sons than other subjects. The parents’
mathematics-related conception of themselves was unrelated to their children’s perceptions of their own mathematical ability. The parents’ conceptions and expectations of their children were strongly related to their children’s self-concepts, expectancies, and course plans even more so than the children’s past mathematical performances. The findings of the second study were nearly identical to those of the first. Parents of sons in this study reported more positive perceptions of their children’s mathematical achievement, even though the daughters were performing better than the sons in both standardized mathematical tests and grades. The third study found children’s views of their own mathematical ability and the value they placed on mathematics were more strongly related to their parents’ perceptions of their mathematical ability than to their teachers’ perceptions. Parents of sons were more likely to use strategies to motivate their children than parents of daughters. They perceived their sons’ strengths to be in mathematics and their daughters’ to be in English. The parents generally used their children’s grades and placement in an ability group, their children’s comments about mathematics, and their own observations about the difficulty level to assess their children’s mathematical abilities. The paper concludes by stating, “Parents need to be informed that they can play an important role in promoting sex equity in mathematics participation.”

Mucha (1987) examined the academic and attitudinal effects of a mathematics homework program on second grade children. The homework program was designed around mathematical games. Homework that used a game format required parent-partners who played interactive roles with their children,
unlike the typical homework assignments. In order to prevent possible resentment of more schoolwork, the homework was chosen to be less like work and more like play and relaxation. An attitudinal survey was administered to 25 second-grade students at the beginning of the study. Mathematics skill tests were also given at the beginning of the study. The parents were sent a letter explaining the mathematics games homework. The children checked out the games and registered which games they took and the amount of time they spent playing the games. Although there was a gain in both attitude and achievement scores no significant correlation was found between the two. The general attitudes of both the students and the parents for the homework format were overwhelmingly positive. Parental involvement and student achievement showed some correlation. The game format for homework was a positive experience for all students, parents, and teacher.

All of these studies found a direct relationship between student attitudes toward mathematics and either the attitudes of at least one parent toward mathematics or the student reports of at least one of their parents’ attitudes toward mathematics. Some of the studies found a direct relationship to the students’ perception of their mathematical ability and their mathematical achievement. Others found parents’ positive attitudes correlated with students’ interests in mathematics related occupations. Most of the studies found a significant correlation between students’ attitudes in mathematics and that of their parents. It seems that, if parents convey their attitudes to their children, they can and do influence their children’s self-concepts. Some studies found that parent
involvement could improve students’ attitudes toward mathematics and students’ mathematical achievement. Teachers can influence parents to have a more positive attitude toward their children’s mathematical performance if they encourage nonthreatening activities for them to participate in with their children.

Parents’ attitudes toward mathematics can influence their children in several ways. By conveying positive attitudes to their children, their children can become more positive about mathematics. Students, who are positive about mathematics, tend to do better in mathematics than other students. Through parent involvement, many parents became more positive about the practices in the schools. The use of calculators as a pedagogical tool did not hinder students’ basic arithmetic skills and improved a variety of their mathematics skills. This study examined parents’ attitudes before and after intervention to determine if intervention helped the parents to become more positive toward calculators in school mathematics.
CHAPTER 3

Methodology

This study explored attitudes and beliefs of parents toward the use of calculators in mathematics instruction. I utilized a grounded survey, focus group interviews, and individual interviews. As the researcher for this study, I was both the moderator for the focus group interviews and the interviewer for the individual interviews. I also served as analyst for the data. Before the individual interviews, I conducted an intervention to educate the parent on a way the calculator can be used as a teaching/learning tool. This chapter includes sections on the setting and population for the study, the intervention, a procedures section, and sections on trustworthiness and ethics.

Setting and Population

This study was conducted with a purposeful sample, which according to Patton is selected for information-rich cases for in-depth study (Patton, 1990, p. 182). The population included parents of middle school students in fifth through eighth grades in four types of schools. The schools were chosen because of the schools’ accessibility (convenience sampling), and also because they exhibited a wide range of variation of socioeconomic groups of parents (maximum variation sampling) (Patton, 1990, p. 182). The schools fit into four of the eight groups used
by the Ohio Department of Education (Cohen, 1980). The four groups included in this study are:

1. Big 8 Districts defined as "major city school districts that typically make comparisons among themselves."

2. Rural Districts defined as "districts without any city of over 5,000 population in 1970."

3. Rural Poor /High Aid to Dependent Children (ADC) Districts defined as "rural districts that have high incidence of poverty impact (approximately 10% ADC or greater) and do not qualify as Wealthy."

4. Wealthy Districts defined as "districts which have either very high average family income or high general tangible (or public utility tangible) valuation per pupil, or some high combination of these factors relative to the state average" (Cohen, 1980).

The populations of the parents of these schools represented a range of occupations consisting of professionals, blue-collar workers, and farmers.

The urban middle school is part of a large city school that has average social economic status and high poverty. This middle school has an enrollment of 532 students. There is 71.3% African American and 26.3% white. Eighty-four percent of the students are from homes that are economically disadvantaged and 17.6% of the students have disabilities (Ohio Department of Education, 2004).

The rural school district contains two small towns. The people of this district are of average socioeconomic status and average poverty. The district contains both some agricultural and some small town economic characteristics.
The middle school has a student enrollment of 368. It is 99.1% white. Only 6.2% of the student come from homes that are economically disadvantaged and 13.5% of the students have disabilities (Ohio Department of Education, 2004).

The rural poor school is in a disadvantaged area. The people are of low socioeconomic status as measured by average income levels and percent of the population with some college experience. The middle school has a student enrollment of 454. It is 99.6% white. Fifty-two and five-tenths percent of the students come from homes that are economically disadvantaged and 20.3% of the students have disabilities (Ohio Department of Education, 2004).

The wealthy school district is near a major urban center. Residents have very high-income level, almost no poverty and a large percent of professional or administrative occupations. The middle school has a student enrollment of 401. There are 3.9% African American students and 93.1% of the students are white. Only 5.2% of the students come from homes that are economically disadvantaged and 10% of the students have disabilities (Ohio Department of Education, 2004).

**Instrumentation with Rationale**

A consent form (Appendix A on page 218) was sent with a grounded survey (Appendix B on page 220 and Appendix C on page 221) to get an initial idea about parents’ attitudes and beliefs. The survey reflects what I have learned through the literature review, from pilot study focus groups, and through conversations with parents and other lay people. The survey incorporates theories gained from these three sources. As Strauss and Corbin (1994) state, theoretical sensitivity “consists of disciplinary or professional knowledge, as well as both
research and personal experiences, that the researcher brings to his or her inquiry” (p. 280).

A survey can give limited information. The survey that I used gave me an initial idea of parents' attitudes and beliefs. But I wanted to learn more about their attitudes and beliefs. I not only wanted to know if a parent is positive or negative about calculators, but why did they have these attitudes or beliefs. I wanted to know if the parent has always held these same attitudes or beliefs. If their attitudes or beliefs changed, I wanted to know why. When I decided to study attitudes and beliefs, I thought of the surveys I have completed. I usually didn’t feel that it was possible to respond accurately. In many cases I may have had ambivalent feelings about the statement and had no way to indicate that. Many times I would just quickly go through the survey. It was difficult to indicate how intensely I felt about the statement to which I was replying even with a "strongly agree or strongly disagree."

Using the survey followed by focus groups helped me have a better understanding of the attitudes and beliefs held by the parents than a survey alone could have. Krueger (1994) states that the focus group interview is a socially oriented research procedure that allows people to be influenced “by the comments of others and make decisions after listening to the advice and counsel of people around them” (p.34). “Group discussions provide direct evidence about similarities and differences in the participants’ opinions and experiences as opposed to reaching such conclusions from post hoc analyses of separate statements from each interviewee” (Morgan, 1997, p.10). Krueger lists five other
advantages to using focus groups: allows moderator to probe, has high face validity, has relatively low cost, provides speedy results, and enables the researcher to increase the sample size. As limitations he lists: less control in the group interview as compared to the individual interview, data are more difficult to analyze, requires carefully trained interviewer, the variation in groups, groups are difficult to assemble, and the discussion must be conducted in an environment conducive to conversation (Krueger, 1994).

Often when I am first asked my opinion about something, I really can’t seem to find the words to express myself. Then, when talking to someone else, he/she will say something that triggers my thoughts and enables me put into words what I wanted to say. With a focus group, parents were able to respond to other parents’ comments. One parent might have mentioned something that another parent had not thought about, thereby, educating the other parents.

For the focus group interviews, I used a semi-structured interviews, somewhere between what Patton calls the standardized open-ended interview and the interview guide approach (Patton, 1990, pp. 288-289). The questions in Appendix D on page 222 guided the focus group interviews. By using focus group interviews, I gave up some control of the interview and this in turn helped me conceal my bias. During the focus group interviews many of the respondents revealed how strongly they felt about the questions asked. I expected some of the parents to change their opinions during the focus group interviews. I was alert to this possibility and probed further when it appeared that someone changed his/her
attitudes. All of the participants of the focus group interviews were invited to participate in individual interviews and most of them did.

I also used semi-structured questioning for individual interviews. The questions that guided the individual interviews can be found in Appendix E on page 223. I got to know individuals during the focus group interviews and learned a little about each of them, which helped me when I conducted the individual interviews.

**Surveys**

The surveys were used to determine whether the parents’ attitudes were positive or negative about the use of calculators in mathematics classrooms. See Appendix B on page 220 for a copy of the survey. The survey used with the rural school, the wealthy school, and the rural poor school begins with three questions about which type of calculator parents thought should be used at various grade levels. These three questions are followed by nine five-scale Likert-type survey questions about the respondent's attitudes on mathematics education and calculators in mathematics education. At the end there are seven demographic questions. After interviewing parents from the rural school, the rural poor school, and the wealthy school, I changed the survey for the parents of students in the urban school hoping to get a better feel for their attitudes. See Appendix C on page 221 for a copy of this survey. Huberman and Miles (1994) said that in qualitative research “instrumentation can be adjusted or added to” (p. 431) to give a better reflection of what is found in the field. I realized that, even though I gave them a definition of each of the calculators, most of the parents did not understand
the difference between a simple calculator and a scientific calculator. So for the urban school, I changed the first three questions to five-scale Likert-type survey questions about using calculators in high school, middle school, and elementary school. I also eliminated three questions that really didn’t tell me anything related to my study. These questions were “My child should be taught mathematics like I was taught.” “To learn mathematics, you only need to learn rules and how to apply them.” “Mathematics is computations only.” The remainder of the survey was unchanged. There were 109 surveys returned—22 from the rural school, 11 from the wealthy school, 32 from the rural poor school, and 44 from the urban school.

**Focus Groups**

A focus group is a group interview that relies on the interaction of the group members rather than each member providing his/her answer to questions presented by the moderator. Focus group participants are chosen because they have certain common characteristics that relate to the topic to be discussed. Focus groups are repeated until the groups are adding nothing new to what the previous groups have provided. When the researcher permits a permissive atmosphere, group members are able to influence each other with their responses and comments to ideas presented by other group members and the moderator (Krueger, 1994; Morgan, 1997).

The focus groups in this study were used to examine what individual parents think about calculators in mathematics instruction and why they hold these beliefs and attitudes. The focus group questions are included in Appendix D
on page 222. Each group consisted of two to eight parents who have children in
the same middle school. The participants were chosen because they were willing
to participate in the group interviews. The group interviews were set to
accommodate the most parents and consisted of parents who were available at the
time of the interview. Each focus group interview lasted between one and two
hours. I conducted focus groups in each school with all parents who were willing
to participate in the group interviews. I held a total of eleven focus group
interviews with a total of 34 participants—three groups with a total of eleven
participants at the rural school, two groups with a total of eight participants at the
wealthy school, four groups with a total of ten participants at the rural poor
school, and two groups with a total of five participants at the urban school.

In order to get participants for the focus group interviews Krueger (1994)
suggests a series of four sequential steps. He suggests planning meeting times that
don't conflict with community activities, contacting potential participants by
phone or in person about 10-14 days before the focus group interview, sending a
personalized invitation, and phoning each person the day before the interview to
remind him/her of the session and ask about his/her intent to attend. Information
about the focus groups and the surveys for the first two schools was sent to the
parents with the principals' newsletters. The principals suggested this as a way to
be certain that the letters and surveys reached the homes. The parents were asked
to return the surveys to their child’s teacher. There was not a good return of these
surveys and volunteers for the focus group interviews. For the last two schools the
teachers recommended sending the letter and survey home with materials that
regularly went home with the students and was returned. At one school these went home in a folder with material that parents read and needed to return the following week. At the other school these went home in the students’ grade cards, which were to be returned. For both of these last two groups, students were given coupons to a fast food restaurant when they returned the surveys and information. There was a much better return for these two schools. The letter, which can be found in Appendix A, informed them about my study and that I was very interested in each of their opinions. I let them know that I planned to share my findings with the school officials. The letter was also a consent form, if the parent wished to participate. I chose several dates for the focus group sessions, and contacted the parents by telephone to ask their choice of dates. I explained the focus group interview process and their purpose to the prospective participants. I phoned all prospective participants the day before to remind them of the focus group interview and to ask if they were planning to attend. Even though the last two schools returned more surveys, I was unable to get any more participants for the focus group interviews than in the previous two schools.

As motivation to encourage participation in focus groups, an incentive was appropriate. "Incentives are needed because participation in a focus group requires time and effort" (Krueger, 1994, p. 91). Although the incentive used for participants of focus groups is usually monetary, Krueger states that food or gifts may also be used. I conducted the interviews at a time that would coincide with a meal and had food available for the participants. In most cases, I conducted the focus group interviews at a restaurant and paid for the participants' food.
The focus group questions were pilot-tested twice with small groups of parents. In these focus group pilot studies, I learned that the questions elicited a lot of response. The parents in both of these groups were very willing to share their views with the others in the group and with me. The first pilot study was made up of three people from academia. There were two people working on their Masters’ Degree in mathematics education and a professor of agricultural engineering. All were parents of middle school students. I held this focus group interview in the evening at the college where everyone was attending, working, or both. As an incentive, I served pizza and pop to the participants. The major points that came out of this pilot study were:

- They thought the calculator was an effective tool. These parents thought that the calculator was a great equalizer allowing students who may not be the best arithmetic students to participate more fully in learning mathematics. They thought that the calculator allowed more time to be devoted to problem solving skills. They thought that the calculator could be an authoritative insight into understanding concepts.

- They questioned when to allow the use of calculators. These parents thought students should know how to do a process before using the calculator.

The members of the second pilot study of the focus group consisted of a homemaker, an electrical engineer, and a construction worker. All were parents of middle school students in a rural school. I held this focus group interview in a separate room at a pizza parlor. I allowed them to order from the menu before we
started. The interview was conducted as they ate their supper. Their thoughts were
different from those of the first group. These parents expressed the following:

- Fundamentals in mathematics must be taught before students use calculators.
- Their children should be taught the same way they were taught.
- The calculator should be used only for checking.

In the main study, I was both the researcher and the moderator of the focus
group interviews. I listened and observed during the focus group interviews. I
took some notes of things that I wanted to go into more detail as the discussion
develops. A typist accompanied me to take field notes during the focus group
interviews. I audiotaped and videotaped the focus groups. The typist acted as an
assistant moderator who helped greet participants and helped distribute the food.
In addition to taking notes, she gave an oral summary at the end of the interview.
On occasion there was a third person to help videotape the session and to monitor
the audiotaping and other equipment, refreshments, and room arrangements.

**Individual interviews**

After the intervention, I conducted interviews of all parents willing to
participate in the individual interviews to determine if their attitudes had changed
and what was the deciding factor to account for the change. I pilot-tested the first
draft of interview questions with a mother who I knew had changed her attitude
toward the use of the calculator in the classroom. She revealed that she changed
her mind about her children using the calculator in their mathematics classrooms
because her children were very successful in mathematics. A teacher had told her
that her children had a high aptitude for mathematics when they started school.
Her fears that her children would not learn their basic mathematics facts using the calculator were unfounded and her children enjoyed learning mathematics using a calculator. This pilot study revealed that the subject became more positive when she learned more about how the teachers were using the calculator in her child’s school and when she learned more ways the calculator could be used. The questions elicited much response but I revised the questions to probe deeper, especially if the individual that I was interviewing is not as open as this individual.

The open-ended interview questions, found in Appendix E on page 223, are the ones used to guide the interview process. The questions first probe the parent's views of his/her child's mathematics classes and what he/she thinks about using calculators in mathematics classes. Questions toward the end of the interview were to elicit the parent's concerns about calculators in mathematics classes and when he/she thinks calculators can be used. Twenty-five parents participated in the individual interviews—nine from the rural school, six from the wealthy school, six from the rural poor school, and four from the urban school.

**Intervention**

An intervention was presented to the parents for the purpose of positively affecting their attitudes and to change some of their beliefs about the use of calculators in mathematics education. The intervention in this study had two components—a newsletter and a workshop.
Newsletters

For the first two schools, a newsletter was sent home with the students before the workshop. In it, I introduced the study and myself. I included information on one way the calculator can be used as a teaching and learning tool. I also explained why their school was chosen and I included some facts from research about the use of calculators in the mathematics classroom. Finally, I included a section so parents could use a calculator to reinforce multiplication facts with their child. A sample copy of this newsletter can be found in Appendix G on beginning on page **Error! Bookmark not defined.**

The newsletter also served as an invitation to the workshop. I told the reader that there would be refreshments at the workshop and that I would be giving away a TI15 calculator and some coupons for fast food restaurants. I did not send newsletters to the last two schools, but had the parents read the information in the newsletter before I began the workshop.

Workshop

If parents experience a topic of learning in much the same way that their children would, I think the parents will have a better understanding of the process of using the calculators as a teaching and learning tool. Therefore, the teaching in the workshop was conducted in similar fashion to that of a discovery lesson in teaching a class of middle school children, although, in most cases lessons were conducted one-on-one.

I chose multiplication of fractions as the topic to use to instruct the parents, because fractions seem to be a difficult topic for middle school students
and probably for most adults. I devised a worksheet to lead the parents through a
guided discovery lesson. The worksheet consists of groups of problems for the
parents to work with a calculator. Participants are then asked to look for a pattern
in the problems they have just done and they are asked if they can come up with a
rule that they could use to do the problems. The answers to the first set of
problems do not reduce. The parents were instructed to try their rule on another
set of problems to see if the answer is the best answer for these problems. The
answers to this set of problems are reducible. They were asked what the reason
might be that there answers were not the best answer and asked to revise their rule
so it will work on all of the problems. The parent(s) were then shown how the
calculator could be used to teach reducing of fractions. A copy of the lesson plan
can be found in Appendix F on page 224 and copies of the worksheets, also in
Appendix F, begin on page 225.

I chose the TI15 calculator for the parents to use during the workshop. As
mentioned earlier, this calculator is a scientific calculator that employs the correct
order of operations. It performs operations of fractions with the numerator over
the denominator, much as children see in their textbooks. The TI15 calculator can
be programmed so fractions are not automatically reduced. It also has a game
built in for the children to practice their basic arithmetical functions.

Even though I offered incentives to the parents for attending the
workshop, I had low attendance at the first two schools—two participants at the
rural school and one at the wealthy school, so I modified the workshop by holding
an individual intervention before each interview. For all parents, who did not
attend the workshop and who were willing to participate in the individual interviews, I allowed enough time for the intervention before each interview. I conducted the same intervention with individual parents, as I did in the workshop, immediately preceding the individual interview.

Procedure

I contacted the principal of each school to learn of that school's procedure for permission to gain access to that school and the parents. I explained what I planned to do and asked the principals how they thought would be the best way to distribute the surveys to the parents. Two of the principals sent newsletters home to the parents at regular intervals. These principals thought the best way to get the surveys and letters to the parents was to include them with their newsletter. The third principal suggested that I speak with the middle school mathematics teachers who suggested that the letter and survey go home in the child’s folder that contained information for the parents and was sent home each Friday. The folders contained material for the parents to sign and return following the weekend. The fourth principal had me speak with the lead mathematics teacher. She suggested the letter and survey be sent home in each child’s report card, which was going out soon and was to be returned the following week.

The focus groups were conducted at a site off school grounds. The sites were chosen by their locale and their availability. A community center, a room at a library, a room at a local college, and restaurants were some of the places used for the focus group interviews. By using a site not on school grounds, I felt the parents might be more open to expressing their opinions, because I might not be
perceived as being linked with the school thought of as a representative of the school and the school's philosophy and program. In all cases food was provided to the participants. Most of the focus group interviews were held during mealtimes.

After the focus group interviews, I conducted the workshop part of the intervention to affect the parents’ attitudes and beliefs toward calculator use in mathematics instruction. This part of the intervention originally consisted of a separate parent workshop, which was conducted at the school. For the workshop, I requested a site in the school where I could conduct the workshop. In one school the workshop was in a classroom. In another it was in the school library. Before the workshop, newsletters were sent to the students’ homes. The newsletter, in addition to containing information about calculator use in schools, was an invitation to the workshop. After only a total of three parents attended the first two workshops I restructured the individual interviews and conducted the workshop for each individual parent prior to conducting the individual interview.

I held the combined interventions and individual interviews at a place that was convenient for the participants. Sometimes it was in the parents’ homes, but quite often it was for lunch at a convenient restaurant. We met at a time that was most convenient for the parent. Because I was not certain the parents had read or even seen the newsletter, I began all of the interventions by asking them to read the research section on calculators in the classroom from the newsletter. While the parent was reading, if at a restaurant, got food for both of us, then prepared for teaching and audiotaping. I began by explaining to the parent that we would use a calculator to do some problems with fractions. Before we began working, I gave
an explanation of how to use the calculator. I had the parent work on the
“Multiplication of fractions” worksheet. (See Appendix F on page 228.) After
several minutes, when I thought the parent understood the first section, I
discussed the questions with him/her. I then instructed the parent to do the second
part of the worksheet and we again discussed the questions. I gave the remainder
of the worksheets to the parent to take home to allow his/her child to work on
them. Before I began the individual interview, I showed the parent the game
function of the calculator.

All parents who participated in the focus group interviews and the one
parent, who had not participated in the focus group interview but had attended the
workshop, were invited to participate in the individual in-depth interviews.
Twenty-five parents participated in the intervention—nine from the rural school,
six from the wealthy school, six from the rural poor school, and four from the
urban school.

**Timeline**

The timeframe of data collection of the study covered a three-year period.
(See Table 3.1.) The surveys for the rural school were distributed in September
2000. The rural school focus group interviews were conducted from December
2000 through February 2001. The rural school individual interviews were
conducted from August 2001 through November 2001. The surveys for the
wealthy school were distributed in October 2000. The wealthy school focus group
interviews were conducted during March and May of 2001. The wealthy school
individual interviews were conducted from October 2001 through February 2002.
The surveys for the rural poor school were distributed in May 2002. The rural poor school focus group interviews were conducted during June and July of 2002. The rural poor school individual interviews were conducted during September and October of 2002. The surveys for the urban school were distributed in early December 2002. The urban school focus group interviews were conducted during January and February of 2003. The urban school individual interviews were conducted during April 2003.

<table>
<thead>
<tr>
<th>School</th>
<th>Surveys Distributed</th>
<th>Focus Group Interviews</th>
<th>Intervention &amp; Individual Interviews</th>
<th>Length of Time</th>
</tr>
</thead>
</table>

Table 3.1
Timeline of Study

Ethics

I used informed consent with the participants of the study. The consent form is included in Appendix A on page 218 (Punch, 1994). At the first meeting I had with each participant, I asked him/her to choose a pseudonym by which he/she would like to be known in the study; I used these pseudonyms to refer to the participants throughout the study. In all recordings and written materials I have used the pseudonym chosen by the parent. I typed the transcripts using these pseudonyms. I will also use these pseudonyms in any future written or oral presentations in which I might use materials from interviews. I have not used the
names of their children. I informed each participant that he/she could withdraw
his/her consent to have specific excerpts used if he/she notified me at the end of
the interviews. The Human Subjects IRB approved procedures under ethical
review (Protocol No. 00E0209). See Appendix H on page 232.

Trustworthiness

Lincoln and Guba (1985) list credibility, transferability, dependability, and
confirmability as criteria for trustworthiness. Triangulation of methods and data
were used to show credibility of the study. The methods used in this study were
surveys, focus group interviews, and individual interviews. Four different schools
were used to triangulate the data. The reader must determine transferability of the
study. To help the reader determine transferability, I have used thick description
in the data analysis. The typists, who assisted in the focus group interviews, have
read random transcripts to check for accuracy and bias of the transcripts. An audit
trail was used to show dependability and confirmability.

The survey data were compiled for all surveys that were returned. Those
individuals, who were willing to participate in the focus group interviews, put
their names on the information they returned with the surveys. The survey
information for each of these individuals was used to determine that individual’s
original attitude about calculators in the mathematics classroom.

Focus groups were used to learn the participants’ beliefs about the use of
calculators in the mathematics classroom. “If we are interested in opinions about a
given product, a focus group interview will provide us with the most efficient
results” (Fontana & Frey, 1994, p. 373). Each focus group interview was
audiotaped and videotaped. To assure accuracy of the transcriptions, the transcriber at times found it necessary to listen to both audiotapes. If necessary, the videotapes were used to determine who was speaking on the tapes and clarify data on the audiotapes. Surveys, audiotapes and videotapes have been kept as part of the audit trail (Janesick, 1994). At the end of each focus group, the assistant moderator asked the participants if they would like her to read the notes taken during the group discussion. Most of the groups preferred to skip this part. They thought that since the interviews were both audiotaped and videotaped, this was unnecessary.

The individual interviews were transcribed completely with respect to the interviewees. Some stories told by the interviewer and participant that were not significant to the study were omitted as suggested by Bogdan and Biklen, (1998). After the interviews were transcribed, they were analyzed using QSR N5. The rationale chosen the themes of the reasons the participants gave for using or not using a calculator came from what they said, they were not chosen prior to the analysis. The decision to label a statement made by the interviewee as positive or negative was made by the researcher. For most of the statements, it was obvious whether they were positive or negative. The other statements were determined to be positive or negative by an impression that the researcher had from the context or the participant’s general demeanor.

To allow the interviewee to feel as comfortable as possible during the individual interview, these interviews were conducted in a place chosen by the participant. To give the participant the greatest opportunity to share all the
information he/she was willing to share and to give credibility to the interview, there was no time limit on the length of the interviews. The interviewees were given a chance at the end of the interview to add anything else they wished that they might not have already said. To allow the reader to assess transferability I wrote thick descriptive data of the schools and of each interview and interviewing process (Guba, 1981).

**The Researcher**

Janesick (1994) says one characteristic of qualitative study is that “qualitative design requires the researcher to become the research instrument” (p. 212). As an instrument in this study there are biases that I bring with me. To get the most from an interview, the researcher’s biases may be exposed in the process of the interview (Fontana & Frey, 1994). To help the reader understand the bias of this researcher, a discussion of the researcher follows.

My transformation to accept the use of calculators came over a period of several years. I, like most of the parents in my study, originally thought that a calculator should not be used until students understood what they were doing. I thought of the calculator as a computational machine only.

For many years I was a substitute teacher. On one particular assignment, I taught mathematics for a teacher of learning disabled students. She and I had many discussions about her students using calculators. She pointed out that her students were not good at memorizing and therefore, would probably not be able to do problems using basic facts. She was able to teach them to do mathematics using a calculator and they could do much more difficult problems than I would
have expected from students who were so challenged. Many of her students, upon
graduation, were able to hold meaningful jobs. One young man became a manager
of a clothing store. This started me on the way to accepting calculators as a
teaching and learning tool.

I later decided to pursue a Masters’ Degree. While working on my
Masters’ Degree, one of my professors had the class use a graphing calculator.
This was the first time I had been exposed to the calculator from a learning
standpoint. I was amazed at what I saw. By using a graphing calculator, calculus
came alive for me in a way I had never before experienced. I realized that using
the calculator did not hinder my learning and that I actually learned more, faster,
and into greater depth than I would have had I not been using a calculator.

I worked as a tutor for several students. One young man felt he needed a
better background in mathematics before he began college. During that summer, I
had him use a graphing calculator to investigate functions. He commented several
times that this was the first time he actually understood functions. He said that
before, when he had to graph functions by hand, he would forget what he was
doing by the time he got the graph drawn. This way, with the graphing calculator,
he could see how each coefficient was related to the function.

After receiving my Masters’ Degree, I taught at a community college that
was very progressive about using calculators in teaching mathematics. I was
teaching mathematics to entering college students using the graphing calculator.
Most of the students were able to learn using the calculator. I developed discovery
worksheets for the students similar to those I used in the intervention part of this
Many students commented that this was the first time that they understood mathematics and several thanked me for the way I taught. This college hosted several calculator workshops and I attended many of them. At each, I learned more about how to use the calculator to teach mathematics.

I began to think that the calculator could be used to teach much of what most teachers taught through drill and practice when I was in school. For a semester, I taught a mathematics methods course to preservice elementary teachers. I had a kindergarten teacher come in to show the students how she had used a graphing calculator with her class. The students were very impressed.

Through all of these experiences I have become more positively inclined to using calculators to teach mathematics even at a young age. I gave my oldest grandson a TI15 for his fifth birthday. Using that calculator and with help from Mommy, Daddy, and Grandma, he knew all of his basic addition and subtraction facts when he started first grade. He continued playing with the calculator and, after an explanation of multiplication and division, at the end of second grade he knew all of the basic multiplication and division facts. I have seen that the calculator does not impede learning as some parents worried that it would.
CHAPTER 4

Data Analysis

In this chapter, I explore the data of the study. The data came from surveys that were sent to parents, focus group interviews, and individual interviews. I used the data to answer the research questions of this study; therefore this chapter is arranged by the research questions. The first question is answered mostly from the survey data. The focus group interviews also provided some information about parents’ attitudes about calculators in mathematics instruction. The second question is answered using data from the focus group interviews. These data are presented according to themes generated as I read through the transcripts. The themes are presented as negative beliefs and positive beliefs. They are ordered within those categories by the number of parents who mentioned the theme starting with the one mentioned by the most parents. The parents answered Research Question Three during the individual interviews. Their responses to this question are given in alphabetical order of their pseudonyms. Research Questions Four and Five are again answered with data from the individual interviews. Similar to Research Questions Two, themes were developed as I read through the transcripts of the individual interviews. The number of parents who mentioned that theme likewise orders the answers to these questions; beginning with the theme mentioned most. The last Research Question was also answered by the data from the individual interviews.
Research Questions

1. What are parents’ attitudes about the use of calculators in mathematics instruction?

2. What are parents’ beliefs about the use of calculators in mathematics instruction? Why do parents hold their beliefs and attitudes toward calculator use in mathematics classes?

3. Will parents change their beliefs and attitudes toward calculator use in mathematics classes through an intervention that shows the calculator being used as a teaching and learning tool?

4. What did parents, who originally held negative attitudes and beliefs about the use of calculators in mathematics instruction, think caused them to become more positive about the use of calculators in mathematics instruction?

5. What did parents with negative attitudes and beliefs think was the reason they continued to think negatively even after the intervention?

6. Were there parents who were originally positive about calculator use in mathematics intervention and are now negative about it? If so, why did they think there was this change?

I used surveys to answer the first question, focus group interviews to answer the next two questions, and individual interviews to answer the last four questions. To answer each question I have included excerpts from the interviews to indicate the parents’ attitudes and beliefs and changes in their attitudes and beliefs. I used pseudonyms for all individuals throughout the study.
Research Question One: What are parents’ attitudes about the use of calculators in mathematics instruction?

To answer this first research question I turned first to the information that I gleaned from the surveys and then to focus groups. I collected the information from the surveys at the beginning of my study, before either interview and before the intervention. What follows next is information from the surveys that will answer Question one of my research questions. It is followed by information uncovered in the focus groups that answers this question.

Survey Results

Survey Compilation Table in Appendix I beginning on page 233 contains the information obtained from all of the surveys returned by the parents of the schools. I have given each question a number rating from 1 through 5, where 1 indicates the most negative answer for the question and 5 is the most positive answer. If the statement was a positive statement, “strongly agree” was 5 and “strongly disagree” was 1. If the statement was negatively stated, “strongly agree” was 1 and “strongly disagree” was 5. For each question I found the mean and then found the mean for all of the questions. Notice that I did not ask questions four through six on the survey given to the urban parents, and questions one through three was asked as a Likert-style question. The averages at the end of Appendix I show that the parents of all of the schools had an overall average near 3, which was neutral. The overall average of parents of the wealthy school was slightly higher at 3.6, that of the urban parents was 3.2, the rural poor parents was 3.1, and the mean of the rural school was 2.8. Appendix I shows that the parents of the rural school, the wealthy school, and the rural poor school favor high school students using a
calculator in their mathematics classes, but do not think children in elementary school should use a calculator. They were neutral about children in middle school using a calculator in their mathematics classes. The parents of children in the urban school were a little more positive than the parents of children in the other schools about children in middle school and in elementary school using calculators, and less positive about high school students using calculators in their mathematics classes. This difference may be due to the difference in the wording of those two questions. The parents of the students in the rural, rural poor, and urban schools were most negative about the statement “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). The mean for the answers of these parents was between strongly agree and agree. This was also the most negative answer for the parents of students in the wealthy school, but their answer was between agree and neutral. All parents were mostly positive about “I think no students should use calculators in their mathematics class” (statement 9). The rural parents’ mean was between neutral and disagree, but slightly closer to disagree. The other parents’ mean for this statement was between disagree and strongly disagree. The parents of the rural school children were not very positive about any of the statements. They were the most positive about the previous statement (statement 9) and “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). Their answers to statement 10 were between neutral and agree, slightly closer to agree. The parents from the wealthy school were very positive about “Calculators are effective teaching tools in mathematics classes” (statement 12) and mostly positive about “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). Their responses for the
first of these statements were between agree and strongly agree and for the second statement were very nearly agree. The parents of the rural poor were mostly positive about “Calculators are effective teaching tools in mathematics classes” (statement 12). The mean to their responses to this statement was 3.9, which would be “agree”.

I have also included in the table in Appendix I information about those who participated in the focus group interview (FG). This does not include surveys from Pat and Howard, who did not fill out surveys. The survey information from the parents, who participated in the focus groups, was also included in the surveys of all parents. The FG mean of each school for each question is close to that of school mean for each question for each school. For each question, the FG mean of the rural school is consistently higher than the school survey mean, which appears to indicate that the parents who participated in the focus group interviews were somewhat more positive than all the parents from that school who completed surveys. The FG rural parents had 0.8-point higher mean on “To learn mathematics, you only need to learn rules and how to apply them” (statement 5), “I think no students should use calculators in their mathematics class” (statement 9), and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). All other answers of the FG parents are little different from all the parents of their corresponding school.

The surveys gave me an idea of the attitudes of the participants of the study before I conducted the interviews. Parents, who were willing to participate in the focus group interviews, gave permission to use information from their surveys. I was able to identify each participant’s survey and determine how each responded to the survey questions. The subsequent pages contain information about my judgments of parents’
attitudes toward calculator use in school mathematics. I based each judgment on the way the participant responded to various statements of the survey. Their responses are organized by the type of school that the participant’s middle school child attends. Pat and Howard participated in the focus group interviews, but did not complete surveys. Their spouses completed the surveys and also participated in the focus group interviews. During the focus group interviews Pat and Howard appeared to have about the same attitudes and beliefs as their spouses. They often said, “I agree with [spouse’s name].” or “I have nothing to add to what [spouse’s name] said.”

**Rural School.** As mentioned in Chapter 3, this rural school district contains two small towns. The people of this district are of average socioeconomic status and average poverty. The district contains both some agricultural and some small town economic characteristics. The middle school has a student enrollment of 368. It is 99.1% white. Only 6.2% of the students come from homes that are economically disadvantaged and 13.5% of the students have disabilities (Ohio Department of Education, 2004).

In this group of parents, who all participated in focus group interviews, there are five men and six women. The occupations of these parents are a civil engineer, two housewives, a middle school teacher, a farmer, a fire chief, an executive director, a clergywoman, an engineer, a high school mathematics teacher, and a deputy recorder. There is a high school graduate, two have some college, five are college graduates, two have Masters’ Degrees, and one has a Professional Degree.

These parents of students in a rural school had varied attitudes about calculators in the mathematics classroom (see Table 4. 1 on page 89). They only seemed to agree on
two statements. All of these parents either disagreed or strongly disagreed with the statement “To learn mathematics, you only need to learn rules and how to apply them” (statement 5). They also all either disagreed or strongly disagreed with “No students should use calculators in their mathematics class” (statement 9).

| Note: Si-simple, Sc-scientific, Gr-graphing, SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree, NA-no answer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. High school students should use (no, simple, scientific, graphing) calculators. | Brad | Bruce | Cheryl | Greg | Hank | Jordan | Lee | Pam | Sherry | Val |
| | Sc | Sc | Gr | Gr | Sc | Sc | Sc | Sc | Si | Sc |
| 2. Middle school students should use (no, simple, scientific, graphing) calculators | Si | Si | Sc | Sc | No | Sc | Si | NA | Si | Sc |
| 3. Elementary school students should use (no, simple, scientific, graphing) calculators | No | Si | Sc | No | No | No | Si | No | Si | Sc |
| 4. My child should be taught mathematics like I was taught. | N | D | A | A | A | A | D | D | N | N |
| 5. To learn mathematics, you only need to learn rules and how to apply them. | D | D | SD | D | D | SD | NA | SD | SD |
| 6. Mathematics is computations only. | SD | D | SD | D | SD | D | SD | D | SD |
| 7. All students need to be able to do their mathematics by hand before they use a calculator to do it. | SA | D | SA | SA | SA | A | A | SA | N | N |
| 8. There is some mathematics that students can learn better if they first do it using a calculator. | A | A | N | D | D | D | N | D | A |
| 9. No students should use calculators in their mathematics class. | D | SD | SD | SD | D | D | D | D | SD |
| 10. Students will enjoy mathematics more if they can use calculators in their mathematics class. | SD | A | A | N | N | A | A | N | SA | N |
| 11. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class. | A | SD | D | SD | A | D | D | A | SD | SD |
| 12. Calculators are effective teaching tools in mathematics classes. | A | SA | A | SA | D | N | SA | A | A | SA |
| Overall mean | 2.9 | 4.4 | 3.7 | 3.4 | 2.6 | 3.2 | 3.6 | 3.1 | 4.0 | 4.3 |

Table 4.1
Survey Results of Rural Parents
I would describe Brad’s attitude about the use of calculators in the mathematics classroom as somewhat negative. The mean of his responses was 2.9. He thought high school students should use scientific calculators, middle school students should use simple calculators, and elementary students should use no calculators in their mathematics class (statements 1-3). Brad strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). He agreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). He strongly disagreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). But Brad agreed with the statement “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8).

Bruce seemed to me to be the most positive participant of the group about calculator use in school mathematics, which was not surprising because he is a high school mathematics teacher and uses the calculator extensively in his teachings. The mean of his responses was 4.4. He does not, however, teach at any of the schools that participated in the study. He thought high school students should use scientific or graphing calculators, middle school students should use simple, scientific, or graphing calculators, and elementary school students should use simple or scientific calculators in their mathematics classes (statements 1-3). Bruce disagreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). Bruce agreed with “There is some
mathematics that students can learn better if they first do it using a calculator” (statement 8) and “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). And he strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12).

Cheryl seemed to me to be mixed about calculators in mathematics classes and her overall mean was slightly positive. The mean of her responses was 3.7. She thought high school students should use scientific or graphing calculators, middle school students should use scientific calculators, and elementary school students should use simple calculators in their mathematics classes (statements 1-3). Cheryl strongly disagreed with “No students should use calculators in their mathematics class” (statement 9) and disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). And she agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). But she strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and was neutral about “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8).

I would describe Greg’s attitude about calculator use in school mathematics as somewhat mixed. The overall mean of his responses on the survey was 3.4—slightly positive. He thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary school students should use no calculators in their mathematics classes” (statements 1-3). He strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to
do it” (statement 7) and disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). But he strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). He also strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12).

I would describe Hank’s attitude about calculators in the mathematics classroom as mostly negative. The mean of his responses was 2.6 which was the most negative of this group of parents. He thought high school students should use scientific or graphing calculators, but he thought middle school students and elementary school students should use no calculators in their mathematics classes (statements 1-3). Hank strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and agreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). Hank disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and “Calculators are effective teaching tools in mathematics classes” (statement 12). He was neutral about “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10) and disagreed with “No students should use calculators in their mathematics class” (statement 9).

I thought Jonda seemed to have a mixed attitude about the use of calculators in the mathematics classroom. Her overall mean of 3.2 was neutral. She thought high school students should use scientific calculators, middle school students should use scientific calculators, and elementary school students should use no calculators in their mathematics classes.
calculators, and elementary school students should use no calculators in their mathematics classes (statements 1-3). She agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). But she disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). Jonda was neutral about the statement “Calculators are effective teaching tools in mathematics classes” (statement 12).

Lee’s attitude seemed to me to be somewhat positive about calculator use in school mathematics. The mean of his responses was 3.6. Lee thought high school students should use a scientific or graphing calculator, but he thought middle school students and elementary school students should use simple calculators” (statements 1-3). He disagreed with the statement “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). and agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). He strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12). But he agreed with the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8).

Pam’s attitude seemed to me to be somewhat negative about the use of calculators in the mathematics classroom, but the overall mean of her responses was neutral, 3.1. She thought high school students should use scientific or graphing calculators (statement 1),
she did not answer the question about what calculator middle school students should use (statement 2), and she thought that elementary students should use no calculator (statement 3). Pam strongly agreed with the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). And she agreed with the statement “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11).

I would describe Sherry’s attitude about calculators in the mathematics classroom as positive, which agrees with the overall mean of 4.0 of her survey responses. She thought high school students should use any calculator, middle school students should use simple or scientific calculators, and elementary students should use simple calculators” (statements 1-3). Sherry strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). She was neutral about the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), but Sherry disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). She strongly agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).

I would describe Val’s answers as positive about calculators in the mathematics classroom. The mean of her responses of 4.3 was also positive. Her overall mean was the second most positive of this group of parents. She thought high school students should use graphing calculators and middle school students and elementary school students should use scientific calculators in their mathematics classes. She was neutral about the
following statements: “All students need to be able to do their mathematics by hand before they use a calculator to do it.” “Students will enjoy mathematics more if they can use calculators in their mathematics class.” “My child should be taught mathematics like I was taught.” Val strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.” and “No students should use calculators in their mathematics class.” She agreed with “There is some mathematics that students can learn better if they first do it using a calculator.” and strongly agreed with “Calculators are effective teaching tools in mathematics classes.”

Table 4.2 on page 96 summarizes my judgment of the attitude about calculators in school mathematics of each parent from the rural school. For Bruce with a mean of 4.4, Cheryl with a mean of 3.7, Lee with a mean of 3.6, and Val with a mean of 4.3, my assessment of their positive attitudes correlates with the positive means of their survey responses. Likewise, my assessment of Hank’s negative attitude about calculators correlates with the negative mean of 2.6 of his responses to the survey statements and Jonda’s mixed attitude about calculators in mathematics classes is similar to the mean of 3.2 of her survey responses. Even though the mean of his survey responses was neutral (2.9), I assessed Brad as somewhat negative because he thought elementary students should use no calculators and responded strongly to statements that I considered to be the most negative statements on the survey. He strongly agreed with statement 7, “All students need to be able to do their mathematics by hand before they use a calculator to do it” and strongly disagreed with statement 10, “Students will enjoy mathematics more if they can use calculators in their mathematics class.” He also agreed with statement 11, “Students will not learn mathematics well if they are allowed to use calculators in their
mathematics class.” Similarly, I assessed Pam as somewhat negative despite the neutral mean (3.1) of her survey responses. Pam also thought elementary students should use no calculators and strongly agreed with statement 7, “All students need to be able to do their mathematics by hand before they use a calculator to do it” and she agreed with statement 11, “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.” I assessed Greg’s attitude about calculators in mathematics classes as mixed because he thought elementary students should not use calculators and strongly agreed with statement 7, “All students need to be able to do their mathematics by hand before they use a calculator to do it.” But he strongly disagreed with statement 11, “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.” and strongly agreed with statement 12, “Calculators are effective teaching tools in mathematics classes.”

<table>
<thead>
<tr>
<th>Parent</th>
<th>Positive</th>
<th>Negative</th>
<th>Neutral or Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brad</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruce</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheryl</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greg</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Hank</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jonda</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lee</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pam</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherry</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Val</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2
Researcher’s Judgment of Attitudes of Individual Rural Poor Parents

**Wealthy School.** As indicated previously, the wealthy school district is near a major urban center. Residents have very high-income level, almost no poverty and a large percent of professional or administrative occupations. The middle school has a student
enrollment of 401. There are 3.9% African American students and 93.1% of the students are white. Only 5.2% of the students come from homes that are economically disadvantaged and 10% of the students have disabilities (Ohio Department of Education, 2004).

There are six women and two men in this group of parents. There is an attorney and a middle school special and regular education teacher. Two are Certified Public Accountants and one is a risk manager. One is a teacher, one is a professor, and another one lists herself as a middle school educator. Three of them are college graduates, three have a Masters’ Degree, one has a Ph. D. and one has a Professional Degree.

The parents of students that attended a wealthy school seemed to be in somewhat more agreement than the parents of the rural school students (see Table 4.3 on page 99). All of these parents disagreed or strongly disagreed with the statements “Mathematics is computations only” (statement 6) and “No students should use calculators in their mathematics class” (statement 9). All but one of the parents thought students in high school should use graphing calculators and that parent did not answer the question (statement 1). All of these parents agreed or strongly agreed that “Calculators are effective teaching tools in mathematics classes” (statement 12) even though one parent added “for HS only” next to her answer.

My assessment of David’s attitude toward calculators in the middle school mathematics class is that he seemed to have a mixed attitude. The overall mean of his responses to the survey of 3.5 showed that he was slightly positive. He thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary students should use scientific calculators.
(statements 1-3). But he also strongly agreed with the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and disagreed with the statement “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). David strongly disagreed with “No students should use calculators in their mathematics class” (statement 9), was neutral on “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10), and disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11).

I would describe Ellen, who is a middle school educator and has helped with the middle school mathematics classes, as having mixed feelings about the use of calculators in mathematics classes. The overall mean of her responses to the survey of 3.6 was only slightly positive. She thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary students should use simple or no calculators” (statements 1-3). She agreed with the statement “To learn mathematics, you only need to learn rules and how to apply them” (statement 5), but disagreed with “Mathematics is computations only” (statement 6). She also agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). Ellen strongly disagreed with “No students should use calculators in their mathematics class” (statement 9), but disagreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). She disagreed with “Students will not learn
mathematics well if they are allowed to use calculators in their mathematics class”

(statement 11).

<table>
<thead>
<tr>
<th>Note: Si-simple, Sc-scientific, Gr-graphing, SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree, NA-no answer</th>
<th>David</th>
<th>Ellen</th>
<th>Kate</th>
<th>Lucy</th>
<th>Melanie</th>
<th>Sara</th>
<th>Sue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High school students should use (no, simple, scientific, graphing) calculators.</td>
<td>Gr</td>
<td>Gr</td>
<td>Si</td>
<td>Sc</td>
<td>Gr</td>
<td>NA</td>
<td>Gr</td>
</tr>
<tr>
<td>2. Middle school students should use (no, simple, scientific, graphing) calculators</td>
<td>Sc</td>
<td>Sc</td>
<td>Si</td>
<td>No</td>
<td>Gr</td>
<td>Si</td>
<td>Sc</td>
</tr>
<tr>
<td>3. Elementary school students should use (no, simple, scientific, graphing) calculators.</td>
<td>Sc</td>
<td>No</td>
<td>Sc</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>Si</td>
</tr>
<tr>
<td>4. My child should be taught mathematics like I was taught.</td>
<td>A</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>SD</td>
<td>N</td>
<td>SD</td>
</tr>
<tr>
<td>5. To learn mathematics, you only need to learn rules and how to apply them.</td>
<td>N</td>
<td>A</td>
<td>SD</td>
<td>A</td>
<td>D</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>6. Mathematics is computations only.</td>
<td>SD</td>
<td>D</td>
<td>SD</td>
<td>D</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>7. All students need to be able to do their mathematics by hand before they use a calculator to do it.</td>
<td>SA</td>
<td>A</td>
<td>SD</td>
<td>SA</td>
<td>D</td>
<td>SD</td>
<td>A</td>
</tr>
<tr>
<td>8. There is some mathematics that students can learn better if they first do it using a calculator.</td>
<td>D</td>
<td>A</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SA</td>
<td>SA</td>
</tr>
<tr>
<td>9. No students should use calculators in their mathematics class.</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>D</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>10. Students will enjoy mathematics more if they can use calculators in their mathematics class.</td>
<td>N</td>
<td>D</td>
<td>A</td>
<td>A</td>
<td>N</td>
<td>SA</td>
<td>SA</td>
</tr>
<tr>
<td>11. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.</td>
<td>D</td>
<td>D</td>
<td>SD</td>
<td>A</td>
<td>D</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>12. Calculators are effective teaching tools in mathematics classes.</td>
<td>A</td>
<td>SA</td>
<td>SA</td>
<td>A</td>
<td>SA</td>
<td>SA</td>
<td>SA</td>
</tr>
<tr>
<td>Overall mean</td>
<td>3.5</td>
<td>3.6</td>
<td>4.4</td>
<td>3.0</td>
<td>4.1</td>
<td>4.4</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Table 4.3
Survey Results of Wealthy Parents

I would describe Kate’s attitude about calculators in the mathematics classroom as very positive. The overall mean of her responses was 4.4 also very positive. She thought any calculator should be used in high school and middle school, but thought that no calculator should be used in elementary school (statements 1-3). Kate strongly disagreed with the statements “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), “Students will not learn
mathematics well if they are allowed to use calculators in their mathematics class” (statement 11), as well as “No students should use calculators in their mathematics class” (statement 9). She agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12).

I thought Lucy seemed to have the least positive attitude about the use of calculators in the middle school mathematics classroom of this group of parents. The overall mean of her responses was neutral—3.0, which was the lowest mean of this group of parents. She thought high school students should use graphing calculators, but thought that no calculators should be used in middle school or elementary school (statements 1-3). She strongly agreed with the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and the statement “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). But she was neutral about the statement “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). And agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). Lucy agreed with the statement, “To learn mathematics, you only need to learn rules and how to apply them” (statement 5), but disagreed with the statement, “Mathematics is computations only” (statement 6).

I would describe Melanie’s attitude about the use of the calculator in the mathematics to be very positive. The overall mean of her responses was 4.1. She thought that middle school students should use graphing calculators, but did not answer the
questions about use of calculators in high school or elementary school (statements 1-3). She disagreed with the statements “To learn mathematics, you only need to learn rules and how to apply them” (statement 5), “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). She strongly disagreed with “My child should be taught mathematics like I was taught” (statement 4) and “No students should use calculators in their mathematics class” (statement 9). She also strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12). She did show some signs of not being totally positive when she disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). And was neutral to “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).

I would describe Sara’s attitude as very positive about calculator use in school mathematics. The overall mean of her responses to the survey was 4.4, which is very positive. She thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary students should use simple calculators (statements 1-3). Sara strongly disagreed with the following statements: “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), “No students should use calculators in their mathematics class” (statement 9), and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). Sara strongly agreed with the statements: “There is some mathematics that students can learn better if they first do it
using a calculator” (statement 8), “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10), and “Calculators are effective teaching tools in mathematics classes” (statement 12).

I would also describe Sue as having a very positive attitude about calculator use in school mathematics. The overall mean of her responses was also 4.4. She thought high school students should use graphing calculators, middle school students should use scientific calculators and elementary students should use simple calculators (statements 1-3). She strongly agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8), “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10), and “Calculators are effective teaching tools in mathematics classes” (statement 12). Sue strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). But she agreed with the statement “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7).

Table 4.4 on page 104 summarizes my assessment of the attitude about calculators in school mathematics of each parent from the wealthy school. For Kate, Sara, and Sue all with a mean of 4.4 and Melanie with a mean of 4.1 my assessment of their positive attitudes correlates with the positive means of their survey responses. Even though the mean of his survey responses was slightly positive (3.5), I assessed David as having a mixed attitude about calculators in mathematics classes. He thought elementary students should use scientific calculators in their mathematics classes and disagreed with
statement 11, “Students will not learn mathematics well if they are allowed to use
calculators in their mathematics class.” But he disagreed with statement 8, “There is
some mathematics that students can learn better if they first do it using a calculator.” I
also assessed Ellen as having a mixed attitude, even though the mean of her survey
responses was 3.6, which would be slightly positive. She thought elementary students
should use simple calculators or no calculator at all and she agreed with statement 7, “All
students need to be able to do their mathematics by hand before they use a calculator to
do it” But Ellen agreed with statement 8, “There is some mathematics that students can
learn better if they first do it using a calculator” and she disagreed with statement 11,
“Students will not learn mathematics well if they are allowed to use calculators in their
mathematics class” and strongly agreed with statement 12, “Calculators are effective
teaching tools in mathematics classes.” I assessed Lucy as slightly negative despite the
neutral mean (3.0) of her survey responses. She thought elementary students should use
no calculators and strongly agreed with statement 7, “All students need to be able to do
their mathematics by hand before they use a calculator to do it” and she agreed with
statement 11, “Students will not learn mathematics well if they are allowed to use
calculators in their mathematics class.”
In Chapter three, I described the rural poor school as being in a disadvantaged area. The people are of low socioeconomic status as measured by average income levels and percent of the population with some college experience. The middle school has a student enrollment of 454. It is 99.6% white. Fifty-two and five-tenths percent of the students come from homes that are economically disadvantaged and 20.3% of the students have disabilities (Ohio Department of Education, 2004).

In this group of parents there was one man and nine women. This group contains a massage therapist, a warehouse assistant, a veterinary technician, a factory worker, a homemaker and part time office manager, a grill cook, a homemaker, a student and gardener, an accountant, and a substitute Head Start teacher and babysitter. Three parents are high school graduates, two parents have some college, one has an Associate Degree, and three are college graduates.

The group of parents from the rural poor school had very diverse attitudes (see Table 4.5 on page 105). The only statement they all appeared to agree on was “No students should use calculators in their mathematics class” (statement 9). Five of the participants disagreed with this statement and the remaining four participants strongly disagreed with it. Most of the participants strongly agreed with the statement, “All

<table>
<thead>
<tr>
<th>Parent</th>
<th>Positive</th>
<th>Negative</th>
<th>Neutral or Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>David</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Ellen</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Kate</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucy</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Melanie</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sara</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sue</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4
Researcher’s Judgment of Attitudes of Individual Wealthy Parents

*Rural Poor School.* In Chapter three, I described the rural poor school as being in a disadvantaged area. The people are of low socioeconomic status as measured by average income levels and percent of the population with some college experience. The middle school has a student enrollment of 454. It is 99.6% white. Fifty-two and five-tenths percent of the students come from homes that are economically disadvantaged and 20.3% of the students have disabilities (Ohio Department of Education, 2004).
students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), while one person agreed with it, and two were neutral about it.

| Note: Si-simple, Sc-scientific, Gr-graphing, SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree, NA-no answer |
|---|---|---|---|---|---|---|---|---|---|---|
| Brenda | Carol | Dala | Gina | Jackie | Joyce | Leanne | Paula | Peggy | Todd |
| 1. High school students should use (no, simple, scientific, graphing) calculators. | Gr | Gr | Sc | Sc | NA | SA | Gr | Gr | Sc | Fr | Si |
| 2. Middle school students should use (no, simple, scientific, graphing) calculators | Sc | Si | Si | Si | N | A | NA | N | A | NA | Si |
| 3. Elementary school students should use (no, simple, scientific, graphing) calculators | Si | No | No | No | N | A | No | Sc | No | No | No |
| 4. My child should be taught mathematics like I was taught. | SA | SD | D | SA | SA | D | SD | D | D | D | D |
| 5. To learn mathematics, you only need to learn rules and how to apply them. | SA | D | D | A | SA | SD | SD | A | D | D | D |
| 6. Mathematics is computations only. | D | D | N | A | N | N | A | SD | D | D | D |
| 7. All students need to be able to do their mathematics by hand before they use a calculator to do it. | SA | SA | N | SA | SA | SA | N | SA | SA | A |
| 8. There is some mathematics that students can learn better if they first do it using a calculator. | SD | A | A | N | SD | SD | N | A | A | A |
| 9. No students should use calculators in their mathematics class. | D | SD | SD | D | SD | D | SD | D | SD | D |
| 10. Students will enjoy mathematics more if they can use calculators in their mathematics class. | N | N | A | SA | SD | N | SA | N | N | A |
| 11. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class. | SD | SD | A | A | SA | SA | SD | SA | N | D |
| 12. Calculators are effective teaching tools in mathematics classes. | SA | A | A | SA | SD | A | SA | N | A | A |
| Overall mean | 3.0 | 3.6 | 3.1 | 2.8 | 1.3 | 2.8 | 4.7 | 2.8 | 3.5 | 3.3 |

Table 4.5
Survey Results of Rural Poor Parents

I would describe Brenda’s attitude toward the use of calculators in the mathematics classroom as mixed. The overall mean of her survey responses was 3.0, which is neutral. She thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary school students should use simple calculators (statements 1-3). She strongly agreed with “All students
need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and strongly disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). But Brenda strongly disagreed “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12). She also disagreed with “No students should use calculators in their mathematics class” (statement 9) and was neutral about “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).

I would describe Carol’s attitude about calculators in the mathematics classroom as slightly positive. The overall mean of her responses was 3.6, which is also slightly positive. She thought high school students should use graphing calculators, middle school students should use simple calculators, and elementary school students should use no calculators (statements 1-3). She strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). And she agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12). But Carol strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and was neutral on “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).
I would describe Dala’s attitude about the use of calculators in the mathematics classroom as mixed. The overall mean of her responses was 3.1, which is neutral. She thought high school students should use scientific calculators, middle school students should use simple calculators, and elementary school students should use no calculators (statements 1-3). She agreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). She was neutral about “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). Dala agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10) and “Calculators are effective teaching tools in mathematics classes” (statement 12). She agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and strongly disagreed with “No students should use calculators in their mathematics class” (statement 9).

I would describe Gina’s attitude about calculator use in school mathematics to be slightly negative. The overall mean of her response was 2.8, which is nearly neutral. She thought high school students should use scientific calculators, middle school students should use simple calculators, and elementary school students should use no calculators (statements 1-3). She strongly agreed with the following: “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7), “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10), and “My child should be taught mathematics like I was taught” (statement 4). Gina agreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11), but strongly agreed
with “Calculators are effective teaching tools in mathematics classes” (statement 12).

Gina remained neutral with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8).

I would describe Jackie’s attitude about calculator use in school mathematics as very negative. She had the most negative score, 1.3, of all of the parents who participated in the focus group interviews. She did not answer the questions 1-3 about which calculator high school, middle school, or elementary school students should use. She strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). Jackie strongly disagreed with the following: “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8), “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10), and “Calculators are effective teaching tools in mathematics classes” (statement 12). But she strongly disagreed with “No students should use calculators in their mathematics class” (statement 9). Because she was so strongly negative about every other question, I wonder if she misread the question.

I would describe Joyce’s attitude about calculator use in school mathematics as slightly negative. The overall mean of her responses was nearly neutral, 2.8. She thought high school students should use scientific or graphing calculators, middle school students should use simple calculators, and elementary school students should use no calculators (statements 1-3). She strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and “Students
will **not** learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). Joyce strongly disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8). But she disagreed with “No students should use calculators in their mathematics class” (statement 9) and agreed “Calculators are effective teaching tools in mathematics classes” (statement 12). Joyce was neutral about the statement “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).

Of the parents in the rural poor school, I found Leanne’s attitude toward the use of calculators in the mathematics classroom to be most positive. In fact, she had the most positive overall mean, 4.7, of all of the focus group parents. She thought high school students should use graphing calculators, middle school students should use graphing calculators, and elementary school students should use scientific calculators (statements 1-3). She strongly disagreed with “Students will **not** learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and “No students should use calculators in their mathematics class” (statement 9). Leanne strongly agreed with “Calculators are effective teaching tools in mathematics classes” (statement 12) and “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10). She was neutral about “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8).

My assessment was that Paula’s attitude about calculators in the mathematics classroom was that it was slightly negative. The overall mean of her responses was nearly
neutral, 2.8. She thought high school students should use scientific calculators, middle school students should use simple calculators, and elementary school students should use no calculators (statements 1-3). She strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11). Paula was neutral on “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10) and “Calculators are effective teaching tools in mathematics classes” (statement 12). But she agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and disagreed with “No students should use calculators in their mathematics class” (statement 9).

I would also describe Peggy’s attitude about the use of calculators in the mathematics classroom as slightly positive. The overall mean of her responses was slightly positive, 3.5. She thought high school students should use graphing calculators, middle school students should use scientific calculators, and elementary school students should use no calculators (statements 1-3). She strongly agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7) and agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) and “Calculators are effective teaching tools in mathematics classes” (statement 12). Peggy strongly disagreed with “No students should use calculators in their mathematics class” (statement 9). But she was neutral on “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10).
class” (statement 10) and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11).

I would describe Todd’s attitude about the use of calculators in the mathematics classroom to be slightly positive. The overall mean of his survey responses was also slightly positive, 3.3. He thought high school and middle school students should use simple calculators and elementary students should use no calculators (statements 1-3). He agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 8) but also agreed with “All students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 7). Todd disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 11) and with “No students should use calculators in their mathematics class” (statement 9). He agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 10) and “Calculators are effective teaching tools in mathematics classes” (statement 12).

Table 4.6 on page 112 summarizes my assessment of the attitude about calculators in school mathematics of each parent from the rural poor school. For Carol with a mean of 3.6, Peggy with a mean of 3.5, and Todd with a mean of 3.3, my assessment of their slightly positive attitudes correlates with the slightly positive means of their survey responses. Likewise, my assessment of Leanne’s very positive attitude about calculators correlates with the very positive mean of 4.7 of her responses to the survey statements. My assessment of mixed attitudes about calculators in mathematics classes of Brenda and Dala also correlates with the respective means of 3.0 and 3.1 to their survey responses. I assessed Jackie’s attitude about calculators in school
mathematics to be negative, which also corresponded with the negative mean (1.3) of her responses. Even though the means of their survey responses was neutral (2.8), I assessed Gina, Joyce, and Paula to have a slightly negative attitude. All three women thought elementary students should use no calculators and strongly agreed with statement 7, “All students need to be able to do their mathematics by hand before they use a calculator to do it.” Joyce and Paula strongly agreed with statement 11, “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” while Gina agreed with that statement.

<table>
<thead>
<tr>
<th>Parent</th>
<th>Positive</th>
<th>Negative</th>
<th>Neutral or Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Carol</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dala</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Gina</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jackie</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joyce</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leanne</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paula</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Peggy</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Todd</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.6
Researcher’s Judgment of Attitudes of Individual Rural Poor Parents

_Urban School._ As mentioned above, the urban middle school is part of a large city school that has average social economic status and high poverty. This middle school has an enrollment of 532 students. There is 71.3% African American and 26.3% white. Eighty-four percent of the students are from homes that are economically disadvantaged and 17.6% of the students have disabilities (Ohio Department of Education, 2004).
The five women of this group of parents are a childcare provider, a system and programming project leader, a licensed practical nurse, a school bus driver and one is retired. One finished 11th grade, one is a high school graduate, and three have some college.

The parents of students attending an urban school appeared to agree with the statement “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4). They also disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8) (see Table 4.7 on page 113).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Ann</th>
<th>Deb</th>
<th>Lu</th>
<th>Teresa</th>
<th>Tora</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High school students should use calculators in their mathematics class.</td>
<td>SD</td>
<td>N</td>
<td>SA</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>2. Middle school students should use calculators in their mathematics class.</td>
<td>SD</td>
<td>N</td>
<td>SA</td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>3. Elementary school students should use calculators in their mathematics class.</td>
<td>SD</td>
<td>D</td>
<td>A</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>4. I think all students need to be able to do their mathematics by hand before they use a calculator to do it.</td>
<td>SA</td>
<td>SA</td>
<td>A</td>
<td>SA</td>
<td>A</td>
</tr>
<tr>
<td>5. There is some mathematics that students can learn better if they first do it using a calculator.</td>
<td>N</td>
<td>D</td>
<td>SA</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>6. No students should use calculators in their mathematics class.</td>
<td>D</td>
<td>D</td>
<td>SD</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>7. Students will enjoy mathematics more if they can use calculators in their mathematics class.</td>
<td>A</td>
<td>D</td>
<td>A</td>
<td>D</td>
<td>N</td>
</tr>
<tr>
<td>8. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.</td>
<td>D</td>
<td>D</td>
<td>SD</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>9. Calculators are effective teaching tools in mathematics classes.</td>
<td>A</td>
<td>N</td>
<td>SA</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Overall mean</td>
<td>2.6</td>
<td>2.7</td>
<td>4.4</td>
<td>2.9</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Table 4.7**

Survey Results of Urban Parents

Of the parents of students in the urban school, I would describe Ann’s attitude toward calculators in the mathematics classroom as the most negative. Her overall mean
of 2.6 was somewhat negative. She strongly disagreed with the use of calculators by high school, middle school, and elementary school students (statements 1-3). Ann strongly agreed with “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4). She was neutral about “There is some mathematics that students can learn better if they first do it using a calculator” (statement 5). Ann agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 7) and “Calculators are effective teaching tools in mathematics classes” (statement 9). She disagreed with both “I think no students should use calculators in their mathematics class” (statement 6) and “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8).

I would classify Deb’s attitude about the use of calculators in the mathematics classroom as slightly negative. The overall mean of her responses was 2.7, which is slightly negative. She was neutral about the use of calculators by high school and middle school students and disagreed with elementary students using calculators in their mathematics class (statements 1-3). She strongly agreed with “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4). She disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 5) and “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 7). But Deb disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8) and “I think no students should use calculators in
their mathematics class” (statement 6). And she was neutral about “Calculators are effective teaching tools in mathematics classes” (statement 9).

Of the parents of students in the urban school, I would describe Lu’s attitude toward calculators in the mathematics classroom as the most positive. The overall mean of her survey responses was the most positive, 4.4, of this group of parents. She strongly agreed that high school and middle school students should use calculators and agreed that elementary students should use calculators (statements 1-3). Lu strongly disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8). She strongly agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 5) and “Calculators are effective teaching tools in mathematics classes” (statement 9). Lu agreed with “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 7) and strongly disagreed with “I think no students should use calculators in their mathematics class” (statement 6). But she agreed with “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4).

Teresa’s attitude about calculators in the mathematics classroom, I would describe as mixed. The overall mean of her survey responses was neutral, 2.9. She agreed that calculators should be used in high school, but disagreed that middle school students should use calculators and strongly disagreed that elementary students should use calculators (statements 1-3). She strongly agreed with “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4) and disagreed with “Students will enjoy mathematics more if they can use calculators in their
mathematics class” (statement 7). But Teresa agreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 5) and “Calculators are effective teaching tools in mathematics classes” (statement 9). She also disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8).

I would classify Tora’s attitude about calculator use in school mathematics as mixed, which matches her overall neutral mean of 3.1. She agreed that students in high school and middle school should use calculators, but strongly disagreed that elementary students should use calculators (statements 1-3). Tora disagreed with “There is some mathematics that students can learn better if they first do it using a calculator” (statement 5) and she agreed with “I think all students need to be able to do their mathematics by hand before they use a calculator to do it” (statement 4). But she disagreed with “Students will not learn mathematics well if they are allowed to use calculators in their mathematics class” (statement 8). Tora was neutral about “Students will enjoy mathematics more if they can use calculators in their mathematics class” (statement 7) and agreed with “Calculators are effective teaching tools in mathematics classes” (statement 9).

Table 4.8 on page 117 summarizes my assessment of the attitude about calculators in school mathematics of each parent from the urban school. My assessment for all five of these parents corresponds to the mean of their survey responses. I thought Ann and Deb were slightly negative which matches the mean of 2.6 and 2.7 respectively of their survey responses. I described Lu as positive, which corresponds to the mean of 4.4 of her survey responses. I assessed Teresa and Tora to be mixed which corresponds to the respective means of 2.9 and 3.1 of their survey responses.
<table>
<thead>
<tr>
<th>Parent</th>
<th>Positive</th>
<th>Negative</th>
<th>Neutral or Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Deb</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lu</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Teresa</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Tora</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 4.8
Researcher’s Judgment of Attitudes of Individual Urban Parents

In order to summarize results from the surveys overall average means from Appendix I are reproduced here as Table 4.9 on page 117. Overall, based on their answers to individual survey questions and the means from Table 4.9, which clusters around 3—a neutral attitude, I would describe the attitudes of the parents who participated in the survey as fairly neutral about calculator use in school mathematics. From the surveys, I would describe the attitudes of the focus group parents from the wealthy school to be mostly positive about the calculator in the mathematics classroom because their collective mean was nearly 4—a positive attitude.

| Rural      | 2.8  |
| FG Rural   | 3.5  |
| Rural Poor | 3.1  |
| FG Rural Poor | 3.1 |
| Wealthy    | 3.6  |
| FG Wealthy | 3.9  |
| Urban      | 3.2  |
| FG Urban   | 3.2  |

Table 4.9
Average Overall Mean of Surveys

Focus Group Interviews
The surveys helped me answer Question one of my research question, but the focus group interview also helped to answer, “What are parents’ attitudes about the use of
calculators in mathematics instruction?” The following is what I learned from the focus group interviews about parents’ attitudes about calculators in mathematics instruction.

Even though all of the parents that I interviewed in the focus group interviews held some negative attitudes about the use of calculators in the mathematics classroom, there were some who had positive attitudes at that time. Of the 24 parents that interviewed both before and after the intervention 22 parents, Carol, Gina, Brad, Cheryl, David, Greg, Hank, Jackie, Jonda, Kate, Leanne, Lee, Lu, Lucy, Melanie, Pam, Sara, Sherry, Teresa, Todd, Tora, and Val, all held some positive beliefs before the intervention. Only Ann and Paula had attitudes that I would describe as completely negative at the group interviews. They had nothing positive to say about the use of calculators in the mathematics classroom. I would describe the attitudes of Cheryl, Kate, Lu, and Sherry as positive about the use of calculators in the mathematics classroom before I met with them. I would describe the attitudes of Brad, Deb, Greg, Hank, Jackie, Joyce, Pam, Todd, and Tora as mostly negative about the use of calculators in the mathematics classrooms before students know the basics. I would classify the attitudes of Carol, Gina, Jonda, Leanne, Lee, Lucy, Peggy, Teresa, and Val as positive about the calculators in mathematics classrooms if they were used under certain conditions. David’s daughter and Melanie’s son were in a more advanced mathematics class and said they had no problem with the use of calculators at that level. Brenda, Bruce, Dala, Ellen, Howard, Pat, and Sue did not participate in the individual interviews. I would describe the attitudes of Brenda, Dala, Ellen, and Pat as negative about the use of calculators in the mathematics classroom, while I would describe the attitudes of Bruce, Howard and Sue as mostly positive.
Now that I have answered, “What are parents’ beliefs about the use of calculators in mathematics instruction?” I will go on to the next two research questions. These two questions were both answered by the focus group interviews.

Research Question Two: What are parents’ beliefs about the use of calculators in mathematics instruction? Why do parents hold their beliefs or attitudes toward calculator use in mathematics classes?

From the focus group interviews, I identified themes of the beliefs the parents held about the use of calculators in the mathematics classroom. These themes are both the beliefs of the parents and why they hold these beliefs and attitudes. I have used dialogue of the parents to let them tell about their beliefs and attitudes. In addition to the dialogue presented here, additional quotes appear in Appendix J on page 238. I divided these beliefs into two groups—positive and negative, depending on how I thought these beliefs affected that parent’s attitude. The negative beliefs are discussed first followed by the positive beliefs. I have ordered these beliefs by the number of parents that held each belief. The next section begins with the negative belief held by the most parents.

Negative beliefs
The parents revealed the following negative beliefs about the use of calculators in mathematics instruction to me during the group interviews. I identified fourteen reasons for their negative beliefs and I have put these in order of the reason given by most of the parents to that given by the fewest parents.

Won't learn basics. By far the reason that greatest number of parents gave for not wanting the calculator in the mathematics classroom was that they feared that the students would not learn the basics if they were allowed to use a calculator in the
mathematics classroom. Of the 34 parents that participated in the group interviews, 32 said that the students needed to learn the basics before they used a calculator.

Ann said, “If they don't have the basics when they go for a job interview, they are not going to have a calculator to teach them to do that. They need to know those facts first, and then go to the calculator.”

Greg said, “The basics and fundamentals at each level are taught by hand computations—let’s work this out by hand to see how everything goes together. . . . I think if an algebra student in 9th grade doesn't know in her head how to add 2+(-7) then there is a problem there. There is a problem with the fundamentals. Maybe that person is not ready for algebra. That is something that a student shouldn't have to rely on calculator to get right.” When asked if he felt that a child should not advance until he learns a particular fundamental skill, Greg answered, “The child hasn't advanced to that level yet. It's obvious. Someone needs to spend more time with them [sic], whether it's that teacher or a tutor outside of school. Somehow they should know something that simple.”

In an interview with Pat, Hank, Cheryl, Val, and Lee, all were concerned that students would not learn their basics if they were permitted to use a calculator in mathematics class. Cheryl said, “They need to know the basics.” Val said, “I think there is no replacement for learning the basics of division, multiplication, subtraction, addition. There is no replacement for that. You have to know that and it's a repetition kind of thing. I think there is a place for them if there can be a plan or method whereby you can't replace the children having to know all the basics.”
In an interview with Jonda, Brad, Sherry, and Pam, all were concerned about learning the basics if calculators were used in the mathematics classroom. Jonda said, “Until they understand the basic things, how can they learn more.” Brad said, “They need to know the basics. They need to do it a couple of times the long way to get the idea.”

In an interview with David, Sara and Melanie, all were concerned about the students not learning the basics if they used a calculator in the mathematics classroom. David said, “I think that as long as the kids know how to do the arithmetic there is no reason not to use the calculator just to make things easier.”

In an interview with five parents, Lucy, Sue, Ellen, Howard, and Kate also expressed concern that with the use of calculators in the mathematics classroom students would not learn the basics. Howard said, “It would seem logical that children would have a rock-solid foundation in the fundamentals before the calculator would be introduced into their education. There must be an age where a kid is expected to have all of the fundamentals where if a calculator were introduced it wouldn't interfere with what they already have learned.” Kate said, “Make sure they know the basics. Even if they come into middle school with the foundations if they are not using it they will lose it.”

In an interview with Gina, Peggy, Carol, and Paula all were concerned that children would not learn basic arithmetic if they used a calculator. Gina said, “I think it is a good thing once they know the basics and they are able to use calculators in high school, we know that if they further their education in college, they need to know how to use a calculator.”

Both Jackie and Joyce expressed concern that students would not learn the basics if they had access to a calculator in the mathematics classroom. Joyce said, “I think until
about 7th grade they shouldn't be in the classroom. They should be able to add, subtract, multiply, and divide in their head or on paper first. I think that once they start using a calculator they should be tested on the basics without a calculator now and then.

Thirty-two parents were concerned that children would not learn basic arithmetic skills if they use a calculator during mathematics instruction. Only Bruce and Teresa did not express this as a concern. This was the concern of the most parents who participated in the focus group interview.

_**Crutch.**_ Most parents were also worried that the calculator would become a crutch for the children. Twenty parents were concerned that their children or other children would depend on the calculator.

In an interview with three parents, Ann said, “They will depend on the calculator without using their own brain.”

Lu, a parent who was very positive about the use of calculators in the mathematics classroom said, “It can be a stumbling block when someone becomes too dependent on a calculator.”

Greg said, “As long as the calculator doesn’t become a crutch for the student or the teacher.” Later he again stated, “As long as the calculator is not used as a crutch to do some of the more fundamental aspects of mathematics.”

Hank and Pat, a husband and wife, were both concerned about the calculator becoming a crutch. Pat said, “I believe that it becomes a crutch.” Hank said, “Because they just can't count, they can't add, they can't subtract and I think a lot of that is because they have these kinds of crutches that allow them to not have to think about it.”
Cheryl, a very positive parent said, “I think there is probably abuse of the calculators and kids are taking it easy right now and they are not learning it.” She was concerned that, “They need to know basics and not use [calculators] as crutches.”

In an interview with Teresa and Tora, when asked what her concerns were, Teresa said, “Just that they would be used solely and not in addition to the teacher's study plan, that they would be relied solely upon and take away from a child's learning.” Tora agreed with Teresa’s last statement.

In another interview, Brad, said, “I think they depend too much on it. I don't think they should depend on the calculator.” Pam simply said, “It's a crutch.” Jonda was concerned that, “Kids will cheat with it. We won't notice it, because they're getting good grades and teachers won't notice it either.” Brad agreed with Jonda saying, “I think the same thing. They shouldn't have to totally depend on a calculator.”

At one of the interviews, Sara said, “My daughter is a little dependent on [the calculator].” David added, “I was concerned earlier about my daughter being lazy about learning basics things like the times tables with a calculator. She would be too lazy to learn, she would just do it on a calculator. It would be a crutch.” When asked what their concerns were, Sara said, “My only concern is a privileged kid who could learn it being lazy and relying solely on the calculator.”

In another interview, Ellen said, “I think we rely too much on the calculator. . . . I just think they use them too much.” Kate was also concerned, “They will get dependant on the calculator.”

At an interview with four parents, Carol said that she worried, “That [the students would] become calculator stupid—they couldn't live without them. I don't want them to
be so dependent that my child can't function without the technology. That is my fear. . . .

When they are in college, I don't want them to be tied to something that much.”

Joyce and Jackie had similar views. Jackie said, “They want to do their homework
with the calculator and then they can't do it on paper without the calculator. They are
depending on the calculator too much.” Joyce added, “Kids should be aware of the
calculators but not rely on them.”

Dala had similar thoughts. She said, “They use the calculator for everything.”
When asked about her concerns Dala reiterated, “Mine is the kids don't think anymore.
They know they can use the calculator so they get it and use it and that's it. They don't
think it out anymore. They just take advantage of the calculators.” Later she added, “I
think [my son] uses the calculator too much.”

These parents, along with Pam and Melanie were worried that the calculator
would become a crutch for the children, if they used it in their mathematics instruction.
They thought that the children would depend a calculator to do even the simplest
mathematics calculation.

**Benefit by hand.** Fourteen parents thought there was a benefit by doing
mathematics by using paper and pencil. They thought that children would miss something
useful if calculators were used in the mathematics classroom.

Deb said, “I want them to think and work it out on paper and understand how to
do it step by step. It messes with the thought process. . . .You need to know how to do the
math. You need to be able to show me that you know how to do the math and do the
problem. Later if you want to use a calculator, just to speed up the process, but you already know how to do the math then, that's fine.”

In an interview with Bruce and Greg, Greg, expressed, “Well, I’ll start with elementary school first. I think there’s a benefit to the drudgery of working through mathematics by hand. That’s where a student gets a real understanding of where the numbers come from and how they go together. In the prealgebra, . . . I think that there is a benefit to taking graph paper and plotting points on a line and drawing that and seeing what that equation looks like on graph paper as opposed to plugging it into the calculator and letting a calculator draw it for you.” Bruce who is a mathematics teacher was also concerned that students would miss something, “I think sometimes some of the algorithms are lost—the problems. But I think sometimes some of the algorithms are lost, the rules of how things work. So I think that happens.” When asked if he felt that students learn how to do square root by hand, Greg answered, “Yeah, I don't see why not. . . . I think that it may be beneficial to expose them how to do things by hand.

Carol said, “It's possible with the calculators now. They take you through it. The scientific calculators show you everything. I don't think they are getting it. It doesn't show you why you have to multiply this one by $x$ and divide that one by $y.$”

Jackie, in an interview with Joyce, said, “I was taught with pencil and paper instead of calculators. Now, they want to put calculators in schools. When they get out on their own they won't have a calculator to figure their math. They will need to use a pen and paper if they can't do it in their head. That was my strong subject and I don't believe in a calculator. . . . I want my kids to do it on paper not with calculators.”
Brenda said, “They need to be able to do the long hand way before they do it with a calculator. If you have word problem it's just a bunch of words and numbers. If you don't know how to put those numbers together then you can't use a calculator to begin with. You have to understand what you are doing before you can add the calculator to it. They have to be able to set it up by hand before they can use a calculator. . . . I personally think you have to be able to do it on paper. I don't have a calculator with me. How could I do a division problem if I don't know how to do it?”

These parents, as well as Ann, Pat, Teresa, Tora, Jonda, Melanie, Ellen, and Joyce, thought there was a benefit for students to do their mathematics by hand. They thought the students would learn more mathematics if they used paper and pencil. They were also concerned that the students could miss something important if they were using a calculator in mathematics instruction.

Don't always have calculator. Nine parents were worried that if the children used a calculator in their mathematics classes, they would have problems because, the students would not always have a calculator with them when they needed to do mathematics.

Deb said, “They may have to take a test to get the job. They may have to take a test on entry-level reading and math to get the job. I've never seen a calculator present.”

Greg said, “How many carry our calculators with us everywhere?”

Tora said, “When you get to the SATs, you're on a time frame, and your calculator breaks, what are you going to do, raise your hand?”

Sherry said, “Give that kid basics so in case battery goes dead, I can do this. You really don't want your kids to give up because they don't have the calculator.”
Ellen said, “It is frustrating when kids forget their calculator and the solar powered calculators can be frustrating when the teacher wants to dim the lights and they won't work.”

Peggy said, “What happens when in electric goes out and all you have is a calculator that plugs in and something has to be done.” In the same interview, Carol said, “If the battery goes out and it's midnight, you can't go out and get the batteries. When they are in college, I don't want them to be tied to something that much.

Brenda and Dala expressed similar concerns. Brenda said, “One of these days they won't have a calculator in their hand and they will be in trouble.” Dala said, “You can give a kid a computer and it will do anything for them, but they still need to learn their math so they could get by if they didn't have a calculator.” Brenda added, “I don't have a calculator with me. . . . As long as they have a calculator in their pocket all the time, it probably won't be a problem. I wouldn't call that an advantage.”

These nine parents were concerned that the children would not always have a calculator with them when they would need it. They mentioned tests to get a job. They were concerned that the batteries would die and they wouldn’t have extra with them. If they are using a solar calculator, the light may not be bright enough. And they said that everyone doesn’t carry a calculator with them all of the time.

Only see computational tool. Eight parents saw the calculator as a computational tool only. They could only think of a calculator as performing arithmetic operations to solve problems. They did not realize ways a calculator could be used to actually teach mathematics. They saw the calculator only as a hindrance in learning the arithmetic operations.
When asked what she thought about using a calculator to teach students math, Ann answered, “No. I don't like that idea. I taught school for three years and we never used a calculator.”

Brad and Pam, in an interview, also did not see a calculator as anything other than a computational tool. Brad said, “If they have a different calculator, it might have a key in a different place. . . . I have to hit this key and that key to get the answer. That's how I have to do it. I don't have to know why. I just have to know what buttons to hit to get the right answer.” And Pam said, “They need life skills.”

Ellen said, “When they have tests and quizzes, I think maybe half of it should be done without a calculator. It could be simple computational things to show they know how to do it. . . . But I think that most kids can compute without a calculator.”

Jackie and Joyce could not see value of the calculator other than as a computational tool, Jackie said, “My 13 year old is being taught negative numbers on the calculator. From my experience you can't get the right answer working with negative numbers on a calculator. . . . I can figure it out on paper. I want my kids to do it on paper not with calculators.” Joyce said, “My oldest wants to be a carpenter. That uses a lot of numbers but I think most of that you can deal with without a calculator. . . . I still think they need to be able to do it with pencil and paper, too. . . . A calculator will not figure out word problems for them. They really need to be able to do it on paper before they should use a calculator.” When asked under what conditions should the calculator be used, Joyce answered, “When they are working with really large numbers. . . . I use one to do my checkbook, because I may make a mistake if I don't.”
Brenda and Dala seemed to have the same viewpoint. Dala said, “Sometimes they use them and they don't even think any more. That's a problem. You give them a calculator and that's the end of it.” Brenda said, “You can't use calculator until you understand the problem. You need to be able to know what you are doing first before you can use a calculator. Once you visualize it, then you have it on paper and you can use the calculator to resolve your problem.” When asked if meant they should use paper and pencil with a calculator, Brenda replied, “If it's necessary. If you have word problem it's just a bunch of words and numbers. If you don't know how to put those numbers together then you can't use a calculator to begin with . . . . I know my individual child and what her needs are. If she can do something long hand she needs to learn how to do that first, then she can use a substitute.”

These nine parents talked about the computational aspects of a calculator. They wanted their children to have computational skills before they began to use a calculator.

Not necessary. Six parents from two of the schools thought the calculator was not necessary in mathematics. Some of the parents thought that what the students were learning in middle school was too basic to use a calculator. Other parents thought the calculator was not necessary because mathematics never changes.

Lu, Ann, and Deb were all participants of the same interview. Lu said, They need to understand the problem they are trying to solve, and then use the calculator as a tool.” Ann said, “Yeah, I'm kind of like her. I don't really think they are necessary.” Deb said, “Yes, that's where I am . . . . I don't see a need for them.” In another interview Tora said, “I think it's just like when you are learning the a, b, cs or your 1, 2, 3s, it's not necessary.”
Val said, “Maybe math never changes.” Hank said, “I don't think math changes that much when they still teach principles of Pythagoras and Galileo. . . . I don't think the math changes.”

These six parents thought that calculators weren’t necessary in school mathematics. They thought mathematics doesn’t change.

**Memorize keystrokes.** Five parents were concerned that the students would learn only to memorize the keystrokes when using a calculator in the mathematics classroom. They were concerned that by memorizing the keystrokes the children would not understand how to do the problems and that they would have difficulty when they used a different type of calculator or were without their calculator.

Brad said, “That's why they want a specific calculator. They do it with rote memory of this key, that key. If they have a different calculator, it might have a key in a different place. I try to explain the background of problem to my child and she gets all upset. “I have to hit this key and that key to get the answer. That's how I have to do it. I don't have to know why. I just have to know what buttons to hit to get the right answer.””

In the same interview Jonda, also a parent from a rural school, said, “They're just punching keys and waiting for it to do the work.”

Jackie said, “My friend has some children who are mentally handicapped. They are teaching him to use a calculator, but all he is doing is pushing a button.”

In another interview, Dala said, “All they really need to do is learn how to push buttons.” And Brenda said, “[The answers are right] as long as they push right buttons.”
These five parents were concerned that the children would only memorize keystrokes. They were concerned that the children would not know what they were doing, but would learn what order in which to push the buttons on the calculator. They were concerned that the calculator would become a black box to the children—you put numbers in, push some buttons, and the answer comes out.

*We didn't have calculators.* Five parents didn’t like the students using calculators to learn mathematics because they themselves didn’t have calculators to learn mathematics. Before I began my study, I thought there would be more parents that thought, because they learned mathematics without calculators, their children should also learn mathematics without calculators.

Ann said, “I taught school for three years and we never used a calculator.”

Melanie, said, “I know when we were in school we didn't have calculators. My son cannot even fathom what it must have been like to do math without a calculator.”

In three different interviews, Carol, Jackie, and Dala, also thought if they didn’t use calculators in school their children didn’t shouldn’t either. Carol said, “I feel the way we were taught, we didn't have technology, and we didn't have all of this.” Jackie said, “I was taught with pencil and paper instead of calculators. . . . That was my strong subject and I don't believe in a calculator.” When asked what students needed to know how to do by hand, Dala said, “I would say everything—the same thing that I learned when I didn't have a calculator in school. They should be able to do what I did in school.”
These five parents thought that the way they learned mathematics was good enough for them, so their children should learn the same way. They didn’t use calculators when they learned mathematics.

*Need estimation skills.* Four parents were concerned that students would not learn estimation if they had calculators while learning mathematics. I think when teachers use calculators to teach mathematics they will or should stress answers that make sense. If they do that, they will also need to stress estimation skills.

Greg said, “I don’t know how many times I have gone to the store and the cashier rings it up and says that will be such and such. And you think to yourself, because it was drilled into you how to add and how to round off, that doesn’t sound right. Well, if you aren’t taught that, if you are only taught how to do that with a calculator . . . You are not going to stand there and add it up on calculator. How will you catch something like that? Maybe the cashier did make a mistake, maybe not. That’s just one example. There are probably a lot of examples like that.”

Ellen, Sue, and Lucy had similar thoughts. Ellen said, “I think they should be able to estimate when they put items in the cart that it looks like they have $20 worth of food instead of finding out when they get to the check out counter that they have $32 and don't have enough money for it.” Sue said, “One little mistake in your computation can screw up the whole problem I want them to be able to use a calculator, but I also want them to be able to go into a grocery store and estimate what they have.” Ellen added, “In the seventh and eighth grades they already know their fundamentals, but what I find is that if they punch into the calculator and find that 17 times 12 is 52, they go with that answer
and they put it down. . . . They need to be able to recognize when the calculator is giving them the wrong answers.” Lucy said, “I remember taking statistics in college. All of the things you do, the teacher said the last thing is ‘Does this answer make sense?’ Even when we did the problems step-by-step the last question was, ‘Does the answer make sense?’ He wanted you to think about whether it fit.” Ellen said, “The problem with middle school, they don't care if anything makes sense. As long as they can go from A to B and someone says you're done, they don't care whether it makes sense. There are probably only a handful of very conscientious kids who will actually check their answers on any test. That is unfortunate.”

These four parents thought that children need to be able to estimate when doing mathematics. They were concerned that by using a calculator they would not be able to use estimation techniques. When students are using a calculator, they are need estimation skills. They need to be able to tell if their answers make sense.

**Need drill.** Three parents thought that drill was important. Two of the parents thought that drill was good for the children and that it was more stimulating not to use a calculator. The third parent thought her son did better when she drilled him using flashcards.

Greg said, “I think it’s good that the fundamentals be drilled in old-fashioned hard way. You do 20 problems and it’s long and it’s tedious and boring, but the benefit is definitely there.”
David said, “You shouldn't give them a calculator and say here's one less thing they have to do. The kids still need to be stimulated and they still need to be engaged in thought.

Jackie said, “[My son] does well with the flash cards at home.”

These three parents thought the children needed to exercise their brain with drill. They thought that the children would learn mathematics better with drill than with a calculator.

**Need same calculators.** Three parents were concerned that all of the students would not have the same calculators. One of the parents was concerned that some kids might have an advantage or disadvantage by having a different calculator than the other children. The other two parents were concerned about the difficulty in instruction if students have different calculators.

Teresa said, “You were asking about a calculator as a teaching tool, if they are going to allow them to use them, I think it is only fair to put everyone on level playing field. We're going to use this and these are the different functions it has. One child might get a calculator from a dollar store and another might have all different functions. They need to have the same equipment, because it is more difficult if they are all using different ones.”

Ellen and Lucy had similar thoughts. Ellen said, “My daughter had the right calculator, but when the battery ran down I went to the store and they didn't have the right one. That was a catastrophe. I will never do that again. I didn't realize what a bad thing it was until I went into a math class. The teacher has to explain that this is what you
do if you have this calculator and this is what you do if you have this calculator. At least 15 minutes is wasted when not everyone has the same calculator. If they borrow a calculator from the teacher it most likely will not be the one they use at home. I think if they are going to use calculators, it has to be mandatory that they all have the same one.”

Lucy said, “I think there needs to be a classroom set, so that if any child forgets theirs then they have it.” Ellen said, “If you are going to use a calculator then it has to be the same one for everyone with no exceptions. Some kids are still bringing in those little calculators that cost $2.99; they don't even have half of the functions on them.”

These three parents thought all the students should use the same calculator when using it in mathematics instruction. They were concerned that, if some students would buy expensive calculators when their classmates were using simple calculators, they would have an unfair advantage over their classmate. They were also concerned that too much instruction time would be used if the students had different calculators.

**Complicates mathematics.** Three parents were concerned that the use of a calculator would complicate the mathematics that the students are trying to learn. They were concerned about students pressing incorrect keys and not knowing what they had done wrong. I think this could happen with simple four-function calculators, but with a calculator that displays the problem, students can see what they keyed in and what problem the calculator performed.

Lu said, “I think it makes things more complicated. They accidentally hit a function key and then they are taking square roots.” Gina said, “Sometimes I'll have to really think about the calculator. I'll know if I've done something wrong.”
Jackie said, “My 13 year old is being taught negative numbers on the calculator. From my experience you can't get the right answer working with negative numbers on a calculator. It's just too confusing. She wasn't doing well with the calculator. I taught her the way I was taught on paper and she did much better. I could never learn on a calculator the way they are trying to teach her. It didn't make sense the way they were teaching her on a calculator because you always get the wrong answer. I told her she was pushing the wrong numbers, but she said that was the way the teacher told her to do it. I told her to just forget the calculator. It's not teaching them anything. . . . My 10 year old was using a calculator in class until I told the teacher he wasn't using it, because it is just confusing him. . . . It is just confusing them. In the long run, it's not helping them.”

**Teacher not involved.** Two parents were concerned that teachers would not be involved with the students. They were concerned that some teachers are lazy and would not be earning their salaries.

Jackie said, “I noticed that some kids may need [the calculator], but there are teachers that want them to learn everything on the calculator. It's the easy way out for them to let the kids do it with a calculator. That way the kids can figure their own problems. Some of the teachers are lazy and that is why they are using the calculator. . . . It is just like [the teachers] are not teaching them. The calculator is just making them lazy.” In another interview, Dala said, “I think calculators became teacher and the teachers quit teaching.”

**Cost.** Only Gina, a parent from a rural poor school, was concerned about the cost of calculators for students using the calculator in the mathematics classroom. She said,
“When you talk about calculators in mathematics classes, there is the issue of money. Are students going to provide them, or will teachers, school board, or will there be state funding? Will only 25% of them be able to afford graphing calculators and what happens to the other students? This is true especially in a rural area where funding is to the penny.” The calculator, TI15, that I used for this study costs less than $20. At that price schools could provide them for students that can’t afford calculators.

**Positive Beliefs**

I was able to categorize the positive beliefs that parents revealed to me during the focus group interviews into 20 categories. Even though there are more positive categories than negative categories, there did not seem to be as much fervor, in the focus group interviews, from the parents about the positive aspects of the calculator.

**Quicker/More efficient.** Twenty parents thought a calculator was quicker and more efficient than working problems by hand. Some of these parents were concerned that their children were spending a lot of time on their homework and if they used the calculator it would shorten the time their child would need to spend on homework. One of these twenty parents expressed this in the individual interview that I had with her, but because she did not participate in a group interview and the information she offered did not seem to be an opinion she gained from the intervention, I included it in this section.

Lu said, “A calculator helps you to work smarter. I don't think it is going to slow down things. . . . I think they can learn other subjects faster if they have a tool that is helping them with those numbers. You can get in depth in other subjects a little quicker if
you are not stumbling over math problems. . . . I think it would be a lot faster. I know they are not reworking the problems. They just go by an answer key.”

Val said, “And every once in a while if they have 30 problems to do, maybe they can get through those a little quicker, so they can move on to something else.”

Teresa said, “There is so much they have to do. . . . Time would not allow them without doing homework for 6 hours. Because sometimes they have a lot of problems they have to complete that time-wise I think it is a good idea [to use a calculator]. . . . [if they] are used to expedite their work, that's okay. . . . time and instant gratification. That's the only thing. . . . I think they can move more quickly through whatever the study at hand. . . . It is pretty much a time thing.”

David said, “There are times that I tell [my daughter] to use the calculator just to get it over with. I know she can do the arithmetic, I think she just uses it occasionally to speed things up a bit. . . . Otherwise their homework would just take that much longer and they already have a lot to do. . . . You don't have to spend an hour doing the arithmetic. . . With the calculator, it just makes life easier.”

Melanie said, “They may actually check work. They think that they can go back and it's not going to take them umpteen hours to do it by hand.”

Sue, who participated only in the group interview, said, “One little mistake in your computation can screw up the whole problem. . . .[The calculator] reduces time needed for calculations and reduces frustration.”

Bruce, who is a mathematics teacher and only participated in the focus group interview, said, “If you had to do it by hand, you can do it, but using calculator is much more efficient.”
Brad said, “You can be more precise and get to answer more quickly than doing it by longhand. . . . Calculators are more accurate and faster. . . . [A calculator] can save time. You don't need to do long division of two numbers that are part of the equation. A calculator can help that way.”

Dala, who participated only in the group interview, said, “The answers are usually right.”

These nine parents and Brenda, Carol, Cheryl, Greg, Hank, Joy, Joyce, Lucy, Sara, Sherry, and Tora mentioned that mathematics was quicker or more efficient when it is done using a calculator. They said that usually the answers are correct. Their children often spent long periods of time working on homework. Using a calculator might shorten the amount of time necessary to do their homework. If they are working with large numbers, they can do problems in a reasonable amount of time. If it takes them less time to do their homework, they might do more of it.

Use calculator in real life. Fifteen parents thought that the calculator would prepare students for life. The parents wanted their children to know how to use a calculator when they needed to use one in their adult lives. They believed the use of calculator tools is the reality of life after school.

Even Ann, who had very little positive to say about the use of calculators in mathematics education, thought that using a calculator would help students become more competent with a calculator. Ann said, “For technology purposes they need to know [how to use a calculator] because technology changes every day and so do calculators so they need to keep up with that.”
Lee said, “We need to look at it as a whole picture and what they are going to do with it in life. The important thing is that they know where to go to get help if they need it, whether it be calculators, spell check or whatever. . . . Kids need to be prepared to know how to use [calculators]; they've got to have that foundation. . . . I think a calculator is a natural stepping-stone to use of computers.”

Tora said, “If going into advanced math, you need to be exposed to a calculator and all the different functions on it. I used to have a calculator, and I would wonder what I would use that button for. I think if it were used to be able to learn how to use all of the different buttons on a calculator and to be able to go on to advanced math, it would be totally appropriate.”

David said, “One of the advantages to using the calculator now is that they will get used to using it, so when they get to higher math, it will be second nature to them.”

Sue said, “I want my kids to know how to use a calculator and how it works.”

Kate said, “The way our society is now with computers and technology they are expected to pick those calculators up and come up with answers quickly. They have to know how to use that tool as well as a computer and do some of that problem solving, creative thinking, and applications.”

Carol said, “It's what they are going to be using out in world. They aren't going to write it all out on paper. My son is going into engineering. I know they won't wait for him to take time to figure it out on paper. He would have ten pages of stuff writing it down.”

Peggy said, “It gives them experience. No matter what field you go into you are going to need to know how to use machines. To us they were complex machines, but they
are now considered simple machines. . . . I think it’s good that they get calculator training.”

Joyce said, “The way jobs are set up with calculators they need to know how to use one. They need to know how to do it with a calculator and on paper. . . . It is good that they become aware of the symbols [on a calculator] and their meanings and know how to use one. Some jobs you get into expect speed. I have an aunt who is in her sixties and she is always complaining about balancing her checkbook. I bought her a calculator and she can't use it. The world is more modern. . . . Kids should be aware of the calculators but not rely on them. I never used calculators when I was in school, but I use them a lot more now. . . . It may be good for preparation for the real world. . . . When they get out of school and they are adults they can do what they want. No one will stop them from using a calculator then. I think calculators should be in the schools.”

Fifteen parents saw the calculator as a valuable tool for children to use the calculator in life situations. Using a calculator will help them become competent with the calculator in situations that they might experience in later life. In addition to these parents, Cheryl, Dala, Deb, Hank, Lu, and Val also thought the calculator was quicker and more efficient.

**Helps students with learning problems.** Thirteen parents thought a calculator could help students with learning problems. They thought these children might not be able to learn mathematics without a calculator; therefore, it would be an advantage to children with learning problems to use a calculator.
Pat said, “I raised my youngest brother. He's in LD classes. I wracked my brain trying to teach that boy multiplication, and he just could not get it. He couldn't get it. Hours and hours and hours we spent. He can use calculator fine—it works for him.”

Lee said, “One of my sons has always struggled with rote memorization, whether it be math facts or spelling. He said that's what spell check is for on the computer. Kids have it down to a system. But he's right. In life, he's going to be able to use that, if that's a tool that is available. My guess is that he will make it available, if it's important. It's a similar kind of thing—calculator in math, spell check on computer, or spelling ace. Some kids don't have the rote memorization ability. We all have different talents. Some kids have it automatically.”

Sherry said, “There could be a mentally disabled child who cannot memorize. There are children who can remember what they did today, or even remember what they did yesterday, but if they don't use it all the time, they don't remember it. Yes, that's a child that should be permitted to use a calculator. It doesn't put a strain on them.”

Melanie said, “I have a niece who was not able to learn her basics. She is in the 8th grade now, but she is mentally deficient. It just is not clicking with this child at all. She is in a class for kids who have trouble with math.”

Kate said, “For students that have learning disabilities or memory problems, they are never going to memorize their tables.”

Ellen said, “If a child has a problem with math they should use a calculator.”

Sue said, “For our son [who has learning problems], even with a calculator, you could give him a story problem that he can't decode.”
Joyce said, “If they can't memorize and they can do it on a calculator then I think they should be taught that way. You need to figure out what they can do and what they need help with.”

These parents and Carol, Cheryl, David, Sara, and Val said that a calculator might help students with learning difficulties. Some of these parents had children with learning problems and have seen how a calculator helps their children do more mathematics. Many of these parents thought that students who have difficulties memorizing could use a calculator to do mathematics.

**Checking.** Ten parents thought a calculator was a good tool for children to use to check mathematics that they had already done by hand. This way the children would still learn mathematics and would also learn how to use a calculator.

When asked, “Under what conditions should calculators be used in mathematics classes,” Lu responded, “Other conditions would be in checking their work. . . . The calculator is there to validate rather than being the brain.” Ann added, “I'm like her. I think it's more for rechecking. They have the correct answer with them and they can practice.”

Greg said, “Double checking your answers, calculators are good for that.”

Sherry said, “They should be able to check work with [a calculator]. That gives a kid security, because they never know if it is right. . . . [There is] less aggravation on the teacher, if a kid is unsure. My kids don't want to go to the next problem in case they have done it the wrong way. You have the calculator to check your answers. . . . You can at least take the calculator to go through the problem. It can be frustrating with three-digit
multiplication or long division. You know you're messing up. I've done that with my daughter. I will use the calculator to check her answers. . . .—for security reasons to let them know they are doing it right. They have the hang of it—to check.”

Melanie said, “I think there is an advantage to the kids of being able to check their work faster than having to check it all by hand. They may actually check work. They think that they can go back and it's not going to take them umpteen hours to do it by hand.”

Todd said, “[My children] use [calculators], but they are used mostly to check their work after they do their work—after they do the steps, so they are learning, which I do like.”

Jackie said, “They can check the homework with a calculator. . . They can use it for checking their work. My kids all know how to use a calculator. . . They learn how to use a calculator when they use it to check their homework.”

Dala said, “If they were to use the calculator to check their answers, that would be a good idea. . . They can use a calculator to check.”

Ten parents, these eight and Jonda and Val, thought that it was okay for children to use a calculator to check their work. They thought the children should do problems using paper and pencil and then check to see if they have the right answer.

**Remove drudgery.** Seven parents thought the calculator would remove some of the drudgery from doing mathematics. These parents gave the impression that mathematics in general was time consuming and boring.
Lu said, “If a child can add, subtract, multiply, and divide numbers up to 100,000s, they understand enough to be able to do a problem that goes into the millions.”

Greg said, “I think that calculators are wonderful tool. . . . [for] taking the drudgery and boredom out of some of the things.”

Teresa said, “It would free them up because of the workload they have.”

Tora said, “ I think at different levels, it would be appropriate. You can start getting these crazy numbers like $\pi$. I think you would probably need a calculator for that.”

Brad said, “A calculator is for tedious operations.”

David said, “If they know how to do it, why shouldn't they use a calculator to get over the tedium of doing the arithmetic by hand. . . . There is no reason to spend a long time doing these tedious tasks, when they could be working on the actual principles of figuring out what equations you need and how to solve them.”

Sue said, “[A calculator] reduces time needed for calculations and reduces frustration.”

These seven parents said that the use of a calculator removes some of the drudgery of doing mathematics. It not only speeds up the process, but gives them a chance to work on other aspects of mathematics.

**Deeper thinking.** Seven parents thought that by using a calculator to do mathematics, children could think deeper about the mathematics they were doing. By thinking more deeply about mathematics, children might understand it better.
Lu said, “I think they can learn other subjects faster if they have a tool that is helping them with those numbers. You can get in depth in other subjects a little quicker if you are not stumbling over math problems.”

Greg said, “[A calculator] frees up time for the student to learn to go a little deeper and explore other things.”

Jonda said, “[My sister] and I have come to the assumption they're trying to teach kids more by a certain age than what we learned; not spending as much time on basic things.”

Sherry said, “My son, who can't read very well, is really good with math. He doesn't know how to use a calculator. How much better could he be in math if he could use a calculator?”

Sara said, “The important thing is that they get an overall view of what the problem is. The work that the calculator is doing is not a big part of it. It is understanding what to calculate; looking at the bigger picture. . . . They think it through over and over again.”

David said, “Maybe you could do it, but with the graphing calculators, you can give more advanced problems. . . . You can spend that time actually learning things.”

Lucy said, “It leaves more time for higher level of thinking.”

Seven parents thought that by using a calculator to do the computations of mathematics, students would have an opportunity to do some deeper thinking about problems they are doing. They would be able to do more advanced problems that they would not be able to do if they were not using a calculator.
Aids learning. Six parents thought the calculator aids children in learning mathematics and other subjects that use a lot of mathematics. Even though they thought calculators could aid children’s learning, these parents still thought mathematics concepts should be taught before children use a calculator.

Lu said, “I think they can learn other subjects faster if they have a tool that is helping them with those numbers. You can get in depth in other subjects a little quicker if you are not stumbling over math problems. . . . I think that is where they are reinforcing the children now by teaching them how to estimate so they can get an answer at least in the ballpark, they will feel confident that they enter the right information.”

Teresa said, “I kind of feel that it is helpful throughout because kids being different and what they pick up on, even at the elementary level, I don't think it would be good to be the only means, but in addition to the whole process I think it would be helpful. They can show them a formula and they can do it on the computer. Just as an aid, I think it could be instrumental and it could help them pick up some things a little faster.”

Sherry said, “How much better could [my son] be in math if he could use a calculator.”

Sara said, “I don't think using the calculator impedes their learning; I think it helps it. . . . I think when you put them in higher math they don't want to waste time with the facts. They learn them.”

Peggy said, “I'll let [my son] mess around with a calculator after he's done. If he wants me to write out some multiplication or division problems, that' he's seeing it and the repetition helps him learn. Just seeing the answers helps.”
Joyce said, “There are some kids that need a calculator on tests because they have trouble doing it on paper. I think if it is really to their benefit I don't see a problem with it. Using a calculator can be a benefit.”

Six parents thought in certain instances the calculator would help students learn. The children could learn while playing with the calculator. They could learn by doing problems for practice.

**Fun, Exciting, Encourages doing math.** Six parents thought the calculator might encourage children to do mathematics. It might be fun and exciting for the children to use. These parents thought if mathematics were fun and exciting, children would be more interested in doing mathematics. If children are doing more mathematics, hopefully, they will learn more mathematics.

Cheryl said, “Another thing that comes to mind, this would be for the third and fourth graders, calculators are fun. Some kids that hate math can see a fun side to math. . . . So I think it adds a little bit of fun. I know the kids were all excited to get their calculators and play with them. Maybe they are not using their brains fully [when using a calculator], but they are using it a little, where they might not have even thought about a math problem before. . . . They need to learn how to use them whether it's to make it fun or enable them to do more.”

Val said, “They think having a calculator as a fun kind of tool for them to get excited about. Children who have certain learning differences think they're fun. . . . [It] may be an incentive to get them to get more excited about math. . . . Children who have real severe learning problems might really be excited about using the calculator.”
Sara said, “Sometimes kids are intimidated by a problem. If they have a calculator to do the number crunching, then they will go ahead and take on a more difficult problem, because they can have that help. They are not put off if there are 6 places.”

Melanie said, “We use calculators in some of the course I teach in college. They are statistics related. I have everyone figure it out and someone comes up with an answer. Everyone will do it. Everyone is more willing to try. We give them the formula. You have to figure out what figures you are going to use.”

Greg said, “It’s a little more exciting for the students.”

Pam said, “They could be fun.”

These six parents thought that using a calculator could make mathematics more fun and exciting and encourage children to do mathematics. The mathematics might not seem so difficult for them if they are allowed to use a calculator to do it and they might actually enjoy doing mathematics.

**Modeling real life data.** Five parents realized the value of using a calculator to teach problems dealing with real life data. These parents thought the children could learn how to do problems that they would need later in life.

Lu said, “If you are working with numbers and just change the words you can have more real world examples like gas mileage problems. You can find more practical uses there to help.”

Ann said, “They can teach you to use a calculator, because an adding machine is used in a lot of businesses. Even when you get into architectural design, physics, and stuff like that are a little more complicated so a calculator would help.”
When asked, “What do you think are some of the advantages of using calculators in mathematics classes,” Deb answered, “I think technology. It is a part of technology. I think at some point the teachers should teach the children how to use a calculator. Like Ann was saying on different jobs and Lu was saying you might have to use a calculator.”

Bruce said, “The big thing now, I’ve noticed, is modeling of real life applications. You give real life data, data on internet. With real live data you find this data. You try to have them come up with the equation of the line, which isn’t this nice neat \( y = 2x + 7 \), but these real live, ugly-looking numbers. The calculator really helps you do that. It kind of brings to life what \( y = 2x + 5 \) really means.”

Sara said, “When kids in a class generate their own data someway, you can have them operate on that data in some way. Kids do it with their grades. That's an example of working with their own data.”

Five parents thought students could do problems using data from actual life problems. They would also be able to use a calculator in life situations.

**Can advance without knowing basics.** Four parents thought that one advantage of using a calculator in mathematics education is that the child can advance to more involved mathematics without knowing the basics. More children may become involved in mathematics and enjoy it more, if they are not held back because they have not memorized the basic mathematics facts.

Bruce said, “One of the things that you kind of get in a quandary about once you get in high school—what do you do about a kid who can’t multiply by the time he gets in ninth or tenth grade, and what do you do then? And one of the things we try to do is, if
you are taking Algebra I, and you can’t add 2 + (-7) or whatever. We are using things that need that. We let them use a calculator even if they can’t do it without one. They need to understand how to do what we are teaching them.”

Jonda said, “They're trying to teach kids more by a certain age than what we learned; not spending as much time on basic things.”

Sara said, “I am talking about the kid, where the time for learning [the basics] is maybe several years past. They need to get it. They need to be using it and practicing it.”

Kate said, “If it's a tool that the child needs, they can move on to higher order thinking.”

These four parents thought that students would be able to advance in mathematics even if they had not learned the basics. They would not be kept from learning more mathematics.

**Learn concepts.** Four parents thought using a calculator in the mathematics classroom would help children learn the concepts in mathematics.

Cheryl said, “To me a lot of math is concepts and equations solving, even story problems. And I think by doing a lot of repetitions of the same kind of thing that they are going to understand the concepts that much more.”

Hank said, “I do agree that it speeds things up especially if they've got the math down pat, using it as a tool to get through more problems to get the concepts.”

Lucy said, “They can concentrate on the theory and not so much the facts.”

Ellen said, “I agree with you that it is good to have a calculator when they are actually learning a concept.”
These four parents thought that if the children did not need to spend time on computations, they would be able to concentrate on learning concepts.

**In place of primitive methods.** Four parents thought a calculator could be used in place of primitive methods, such as, sliderules, flashcards, and hand graphing. The three men, Hank, Bruce, and Greg, are from the rural school and Jackie is from the rural poor school.

Bruce said, “They are just like flashcards. Most of us grew up on flash cards. They are sort of the same kind of thing.”

Hank said, “To use them in place of sliderules that we used to use, I think that's great.”

Greg said, “Well, I never did it but maybe others before my time—using a sliderule or looking up in tables—calculators are a great benefit there.”

Jackie said, “My oldest is using a graphing calculator and I can see the value of seeing the graphs on the calculator.”

These four parents saw value of the calculator in place of primitive methods. They thought the calculator was easier to use and carry than using tables to find various values programmed into a calculator. It can be used like flashcards. It can be used as students once used sliderules. It can be used in place of graphing by hand.

**Tool.** Three parents thought of the calculator as a tool before the intervention. They did not think of it as a teaching tool, but as a device to help do problems at a higher level than when they are first learning a concept.
Hank said, “I know, higher functions, especially when you get to high school in chemistry, physics, and geometry, there it's certainly a tool. . . . There are certain functions for which it is invaluable. At times they can use a calculator as a tool to accomplish some work.”

Lee said, “I see calculators as an important tool, once they go to the next levels, whether it be physics, calculus, that kind of thing. . . . They need to be able to use these things as tools.”

Tora said, “I think it's a good tool at times.”

These three parents thought the calculator was a good tool. They thought this was especially true in higher mathematics or science classes.

*Aids memorization.* Three parents thought calculators could aid students in memorization. Ann and Joyce were both more negative than positive about the use of calculators in mathematics classes. Because they thought children need to memorize mathematics facts, they were willing to let them to play or practice with them. Cheryl was quite positive about the use of the calculator in mathematics classes and she was using this argument to convince the others in her group interview that calculators are good tools with which to learn mathematics.

Ann said, “They have the correct answer with them and they can practice, they will learn simple facts a little bit faster. If they are constantly having to type in multiplication problems that they are not used to, they will learn those facts.”

Cheryl said, “Maybe that child doesn't know that 4 + 3 is 7, but if they punch it into the calculator enough times, it may pop into their heads.”
Joyce said, “I feel a child can use a calculator to sharpen their skills on the facts.”

These three parents thought that students could memorize facts by using a calculator. A calculator always gives the correct answer so they will be learning correct facts as the key them into the calculator.

**Discovery.** Three parents thought calculators were tools that could be used in discovery lessons. Bruce is a high school mathematics teacher, who uses a calculator to teach his students. After his argument, Greg conceded that the calculator is a tool that could be used for discovery learning. Sara also teaches using calculators, but her students are middle school students, many of whom are special needs students.

Bruce said, “Calculators in Algebra I is the discovery part. If the students can discover what’s going on they internalize it more than if you just tell them. . . . You give them a few examples and then ask them, “What do you think is going to happen if \( y = 10x? \)” Most everyone in the classroom says, ‘It’s going to be steeper.’ They can discover that in 3 minutes. They have discovered something that if you made them plot that by hand they could do it, but the same thing would take them fifteen minutes to plot \( y = 2x, y = 3x, y = 10x \). That’s the visual part that I like. . . . Then the neat part, I ask them, ‘How do we make it flatter?’ They all say, ‘Make it negative.’ And, of course, they’re all wrong, but they see the results instantaneously and they can make adjustments to their conjectures of what’s happening. So I think discovery is important part of it. Not that we are doing away with the algebra. We can discover first and then say, ‘We can also do this by hand.’ And show them the \( x - y \) charts and those kind of things. At elementary
level, the pattern—they can discover patterns on the calculator, almost the same kind of thing. They can see what’s happening.”

Greg said, “Like Bruce was talking about the discovery aspect of calculators. I think that calculators are wonderful tool.”

Sara said, “I speed drill them with a calculator.” When asked, “You feel they can actually learn the arithmetic using a calculator,” Sara responded, “Yes, at an earlier level.”

Two of these parents are teachers and use discovery process in teaching their students. The third parent was in the same interview with one of the teacher-parents and was convinced by what that parent said about the discovery process.

**More repetitions.** Cheryl and Sara stated that children could do many more problems using calculators in mathematics lessons. By doing more problems, there is more of an opportunity for the students to see patterns in the mathematics they are learning.

Cheryl said, “But if they have to do everything out long hand, I'm thinking fifth, sixth grades where they get into some of the harder things where we are talking concepts, if they can use the calculator to help them through that, then they can do maybe 25 problems a night in the same amount of time it would take them to do 5 problems long hand. . . . I think advantages are they can do more repetitions of same kinds of concepts by using a calculator.”
Sara said, “They can use the calculator to do decimal problems and large number problems just so it becomes second nature to them. The kids here do hours of homework every night so it becomes second nature to them, too. They don't have to think about it.”

_Helps in problem solving._ Lu and Kate thought calculators help children in problem solving. NCTM (2000) contends that students can focus on problem solving when technological tools, such as, calculators are available to them. These two parents seemed to understand that before the intervention.

When asked what were some advantages of using calculators in the mathematics classroom, Lu responded, “As a reinforcement to problem solving. If you are working with numbers and just change the words you can have more real world examples like gas mileage problems. You can find more practical uses there to help.”

Kate said, “Get the calculator when you are doing problem solving.”

_Builds confidence._ Sara, also a teacher, has seen that the calculator builds confidence in children who are using calculators in the mathematics classes. As one of the parents in the pilot study focus group mentioned, the calculator is a great equalizer. He is also a teacher and has seen students, who prior to calculator use would not have participated in class discussion, were able to participate without fear of being wrong.

Sara said, “They need the success of solving the problem. That is intrinsic. They are rewarded by seeing the results. They see it. . . . I work with kids who are behind, who haven't had a lot of opportunities to solve problems. They don't think of themselves as good thinkers or problem solvers. If you give them a calculator they can do problems they didn't think they could do. It gives them that success to build on.”
Concern about not using calculator. Bruce, probably because he uses calculators in his teaching and has seen the benefits of students using them, was concerned about students not using calculators in the mathematics classes.

Bruce stressed, “I cannot believe that you can teach Algebra I without a graphing calculator in the year 2000 and 2001. I think that is my biggest concern for upper level kids. Algebra 2, Precalculus, Calculus—they don’t use graphing calculators! Our kids are being cheated because they are the 1% of the high school students in the population of the United States who don’t use graphing calculators. I talked with [the teacher] and gave her software to use.”

Summary
Using data from the focus group interviews and in one instance from an individual interview, I have answered Research Question Two. There were fourteen beliefs that appeared to cause the parents to have a negative attitude toward use of calculators in mathematics instruction. There were twenty beliefs that appeared to cause parents to have a positive attitude toward using a calculator in mathematics instruction. In Table 4.10 on page 158, I have listed these themes. There were more positive beliefs than negative and totaling the number of parents that expressed that expressed each belief, I found that the number was about the same for positive and negative beliefs. This is similar to the survey data, which showed that the parents had a neutral attitude about the use of calculators in mathematics instruction.
<table>
<thead>
<tr>
<th>Negative Attitudes</th>
<th>Number of Parents</th>
<th>Positive Attitudes</th>
<th>Number of parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Won’t learn basics</td>
<td>29</td>
<td>Quicker/ More efficient</td>
<td>20</td>
</tr>
<tr>
<td>Crutch</td>
<td>21</td>
<td>Use calculator in real life</td>
<td>15</td>
</tr>
<tr>
<td>Benefit by hand</td>
<td>14</td>
<td>Helps students with learning problems</td>
<td>13</td>
</tr>
<tr>
<td>Don’t always have</td>
<td>9</td>
<td>Checking</td>
<td>10</td>
</tr>
<tr>
<td>Only computational</td>
<td>8</td>
<td>Removes drudgery</td>
<td>7</td>
</tr>
<tr>
<td>Not necessary</td>
<td>6</td>
<td>Deeper thinking</td>
<td>7</td>
</tr>
<tr>
<td>Memorize keystrokes</td>
<td>5</td>
<td>Aids learning</td>
<td>6</td>
</tr>
<tr>
<td>We didn’t have them</td>
<td>5</td>
<td>Fun/exciting/Encourages doing math</td>
<td>6</td>
</tr>
<tr>
<td>Need estimation skills</td>
<td>4</td>
<td>Models real life data</td>
<td>5</td>
</tr>
<tr>
<td>Need drill</td>
<td>3</td>
<td>Can advance without knowing basics</td>
<td>4</td>
</tr>
<tr>
<td>Need same calculator</td>
<td>3</td>
<td>Learn concepts</td>
<td>4</td>
</tr>
<tr>
<td>Complicates math</td>
<td>3</td>
<td>In place of primitive methods</td>
<td>4</td>
</tr>
<tr>
<td>Teacher not involved</td>
<td>2</td>
<td>Tool</td>
<td>3</td>
</tr>
<tr>
<td>Cost</td>
<td>1</td>
<td>Aids memorization</td>
<td>3</td>
</tr>
<tr>
<td>Discovery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More repetitions</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Helps in problem solving</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Builds confidence</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Concern not using a calculator</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>Total</td>
<td>117</td>
</tr>
</tbody>
</table>

Table 4.10
Themes of Parent Beliefs

*Research Question Three: Did parents change their beliefs or attitudes toward calculator use in mathematics classes through an intervention that shows the calculator being used as a teaching and learning tool?*

To answer this third research question, data from the individual interviews, which occurred after the intervention, was used. Thirteen parents confirmed that they had changed their attitude toward calculator use in mathematics classes. I also compared the data from the focus group interviews, which occurred before intervention, with data from the individual interviews, which occurred after intervention.
In the intervention, I showed parents through a discovery lesson how the calculator could be used to teach and learn multiplication of fractions. I also showed them the built-in game that quizzes the user on the four basic arithmetic operations with problems ranging from simple single-digit addition and subtraction to more difficult multiplication of three-digit numbers and division by three-digit numbers. Thirteen parents expressed a change in beliefs or attitudes toward the use of calculators in the mathematics classroom after they participated in the intervention.

This section first has dialogue that the parents used to express if and why they changed their attitude about the use of calculators in mathematics education. This is followed by data, gathered from QRS N5, which compares the number of positive and negative statements each person made both before and after intervention.

Change dialogue

Brad said, “After I have seen [the demonstration with the calculator], I think it is a better teaching tool than I would have imagined before.”

Carol said, “After seeing the demonstration and how [the calculator] can be used as a practice tool, I have changed my mind.”

Most of David’s change in attitude occurred from what he saw as his son used calculators in his mathematics classes. I included David in this section because he seemed to be somewhat negative about the use of calculators in mathematics classes when he participated in the group interview, even though he thought that students in his wealthy middle school should use calculators because they had progressed to more difficult mathematics. David said, “If you are going way back, originally I thought there was over
reliance on it. I have changed my mind about that. . . . Years ago I thought the calculator would be a bad thing, but I have changed my mind about that.”

Gina said, “I understand more since our last meeting. I have a seven-year-old niece that's starting to really get into the math now. She is starting the second grade and she has found the calculator fascinating.” When asked, “So you have changed your mind from what you thought about calculators originally?” Gina responded, “Yes. Even to the point of the higher grades. My son and daughter are both using scientific calculators.”

After finishing the intervention, Jackie, who was very negative about calculator use when we spoke in the group interview, asked me why I wasn't teaching mathematics. Jackie said, “As long as the teachers would do it that way it wouldn't be so bad . . . Well, as long as they wouldn't depend on it and the teachers would show them how to use a calculator.”

When asked if she had changed her mind about the use of calculators in mathematics instruction, Leanne said, “Yes, I really have, after seeing this program and how the calculator could work.”

When Lee was asked if he had changed his mind about the use of calculators in mathematics classrooms, he said, “I think, now, I would have mixed reactions.”

Lu said, “I think you have really opened my eyes.”

Lucy said, “Before I talked to you, I never thought about it that way.”

When asked if she had changed her mind about the use of calculators in the mathematics classroom, Paula said, “Yes. I remember the first time we met. I didn't want them to use a calculator at all. Then when my daughter needed a scientific calculator and
I saw some of her homework, I decided she should use a calculator. . . . You have enlightened me a lot.”

I asked Therese, “Have you changed you mind on the use of the calculator in mathematics classes over time?” She responded, “Yes.”

Todd responded similarly, “Yes. . . . I think it looks pretty good. It looks better than I imagined it would be when we first talked.”

Tora said, in response to the same questions, “I really never gave it a whole lot of thought. I don't recall that I was ever allowed to use a calculator in my schooling until I got to the college level, unless it was a calculator-type class. . . . We are in a computer world and if the teacher tells my child to bring a calculator to class, I'm not going to go all a tizzy, because we have advanced in so many ways.”

Data comparing before and after intervention

In retrieving data from QRS N5, the number of text units, in this case sentences, and the number of documents that contain those units are listed. I have used that information to compare the number of statements made by the parents in the focus group interviews before and in the individual interviews after intervention. This section only contains information from those parents who participated in both the focus group interviews and the individual interviews.

The data for Table 4.11 and Table 4.12 were gleaned from the focus group interviews and the individual interviews. The rural school focus group interviews were conducted from December 2000 through February 2001 and the individual interviews were conducted from August 2001 through November 2001. The wealthy school focus group interviews were conducted during March and May of 2001 and the individual
interviews were conducted from October 2001 through February 2002. The rural poor school focus group interviews were conducted during June and July of 2002 and the individual interviews were conducted during September and October of 2002. The urban school focus group interviews were conducted during January and February of 2003 and the individual interviews were conducted during April 2003. The overall timeframe of data collection of the study covered a three-year period.

Table 4.11 on page 163 refers to the number of positive and negative statements made by the participants during the interviews. The documents before intervention consisted of 11 group interviews. The documents after intervention consisted of 24 individual interviews. The total number of statements made include those of the interviewees and those of the moderator. Note only 18 of the 24 documents after intervention included negative statements; this is because six of the interviewees had nothing negative to say about the use of calculators in the mathematics classroom after the intervention. The percent of negative statements made by the interviewees after intervention were considerably fewer than those made before intervention (5.8% versus 17%). The percent of positive statements made was nearly the same before and after intervention. Collums (1991) found that parents became more positive toward the use of calculators in mathematics classes after an intervention.
<table>
<thead>
<tr>
<th></th>
<th>Total number of sentences retrieved</th>
<th>Number of documents with retrievals out of documents for category</th>
<th>Percent of documents of before/after that had retrievals</th>
<th>Total number of sentences in documents that had retrievals</th>
<th>Percent of sentences retrieved from those documents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative Statements</strong></td>
<td>Before intervention</td>
<td>550</td>
<td>11/11</td>
<td>100%</td>
<td>3252</td>
</tr>
<tr>
<td></td>
<td>After intervention</td>
<td>188</td>
<td>18/24</td>
<td>75%</td>
<td>2125 (3238)*</td>
</tr>
<tr>
<td><strong>Positive Statements</strong></td>
<td>Before intervention</td>
<td>431</td>
<td>11/11</td>
<td>100%</td>
<td>3252</td>
</tr>
<tr>
<td></td>
<td>After intervention</td>
<td>461</td>
<td>24/24</td>
<td>100%</td>
<td>3238</td>
</tr>
</tbody>
</table>

*Six parents had nothing negative to say in the after intervention interview. Including these text units gives the information within the parentheses.

**Table 4.11**

**Statistics of Positive and Negative Sentences Before and After Intervention**

Table 4.12 on page 164 shows the number of positive and negative statements made by each participant of this study before and after intervention. Before the intervention, all of the parents had something negative to say about the use of calculators in the mathematics classroom. After the intervention 6 of the 24 parents had nothing negative to say about the use of calculators in the mathematics classroom. Before the intervention Gina had more negative statements than positive, Leanne had slightly fewer negative statements than positive, Jonda had nearly twice as many positive statements as negative, Lee had more than twice as many positive statements, and Sherry had more
than three times as many positive statements than negative ones about the calculator in the mathematics classroom. Each of two parents had only one negative statement about calculators in the mathematics classroom. Kate was concerned that the teacher would need to periodically check the students’ memorization of the basic facts and Tora was concerned that the calculator could become a crutch. Prior to the intervention, these two parents were more positive than they were negative.

<table>
<thead>
<tr>
<th>Parent</th>
<th>Before Intervention</th>
<th>After Intervention</th>
<th>Difference in percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
<td>% Positive</td>
</tr>
<tr>
<td>Ann</td>
<td>11</td>
<td>6</td>
<td>35.3%</td>
</tr>
<tr>
<td>Brad</td>
<td>16</td>
<td>6</td>
<td>27.3%</td>
</tr>
<tr>
<td>Carol</td>
<td>12</td>
<td>12</td>
<td>50%</td>
</tr>
<tr>
<td>Cheryl</td>
<td>4</td>
<td>18</td>
<td>81.8%</td>
</tr>
<tr>
<td>David</td>
<td>14</td>
<td>12</td>
<td>46.2%</td>
</tr>
<tr>
<td>Gina</td>
<td>11</td>
<td>7</td>
<td>38.9%</td>
</tr>
<tr>
<td>Greg</td>
<td>53</td>
<td>17</td>
<td>24.3%</td>
</tr>
<tr>
<td>Hank</td>
<td>11</td>
<td>11</td>
<td>50%</td>
</tr>
<tr>
<td>Jackie</td>
<td>71</td>
<td>5</td>
<td>6.6%</td>
</tr>
<tr>
<td>Jonda</td>
<td>4</td>
<td>9</td>
<td>69.2%</td>
</tr>
<tr>
<td>Kate</td>
<td>3</td>
<td>5</td>
<td>62.5%</td>
</tr>
<tr>
<td>Leanne</td>
<td>16</td>
<td>19</td>
<td>54.3%</td>
</tr>
<tr>
<td>Lee</td>
<td>7</td>
<td>17</td>
<td>70.8%</td>
</tr>
<tr>
<td>Lu</td>
<td>7</td>
<td>26</td>
<td>78.8%</td>
</tr>
<tr>
<td>Lucy</td>
<td>10</td>
<td>3</td>
<td>23.1%</td>
</tr>
<tr>
<td>Melanie</td>
<td>6</td>
<td>15</td>
<td>71.4%</td>
</tr>
<tr>
<td>Pam</td>
<td>11</td>
<td>8</td>
<td>42.1%</td>
</tr>
<tr>
<td>Paula</td>
<td>8</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td>Sara</td>
<td>4</td>
<td>33</td>
<td>89.2%</td>
</tr>
<tr>
<td>Sherry</td>
<td>7</td>
<td>23</td>
<td>76.7%</td>
</tr>
<tr>
<td>Teresa</td>
<td>15</td>
<td>11</td>
<td>42.3%</td>
</tr>
<tr>
<td>Todd</td>
<td>33</td>
<td>7</td>
<td>17.5%</td>
</tr>
<tr>
<td>Tora</td>
<td>8</td>
<td>11</td>
<td>57.9%</td>
</tr>
<tr>
<td>Val</td>
<td>6</td>
<td>11</td>
<td>64.7%</td>
</tr>
</tbody>
</table>

Table 4.12
Number of Positive and Negative Sentences Made by Each Participant Before and After Intervention
The last column of Table 4.12 is the difference of the percent of positive statements made before intervention and the percent of positive statements made after intervention. I chose to find the differences of these percentages, because some parents spoke more during the focus group interviews before intervention than they did during the individual interviews after intervention and others spoke more during the individual interviews than during the focus group interviews. Four parents Brad, David, Greg, and Sara had a small negative change in the percentage of positive statements made before and after intervention. Four other parents had little or no change in the percentage of positive statements made before and after intervention. For the rest of the parents, there were a greater percent of positive statements made after intervention than before.

Lucy and Teresa probably changed the most. Each had many more negative statements than positive statements before the intervention, and after the intervention, they had many more positive statements than negative ones. Ann, who had twice as many negative statements as positive before the intervention, had slightly more positive statements than negative ones after the intervention. Todd had many more negative statements than positive one before the intervention and had about the same number of positive and negative statements after the intervention. Carol had an equal number of negative and positive statements before the intervention and afterwards had more than twice as many positive statements as she had negative ones. Hank had an equal number of negative and positive statements before the intervention, and although he had a few more negative statements than positive ones after the intervention, he seemed to be more positive toward the calculator in the mathematics classroom than he was before the intervention. Jackie had many more negative statements than positive ones before the
intervention and not even twice as many negative statements as positive ones after the intervention. Sara, Lu, and Melanie had many more positive statements than negative statements both before and after the intervention. Pam and Paula had more negative than positive statements before the intervention and after the intervention they still had more negative statements than positive ones although the percentages of positive statements were greater after intervention. Greg, Brad, and David had more negative statements before and after the intervention and the percentages of positive statements were smaller after intervention than before.

David said that his son was in a class that was using the Chicago Mathematics program, which is a mathematics program based on the Standards. His son did not like having to discover the mathematics himself. David said his son no longer liked mathematics as he did the previous year when the school used a traditional program. David thought it would be just easier for everyone, the students and teacher, if the teacher just told the students how to do the problems. According to the research (Pesek & Kirshner, 2000), even though students think they are learning more using the traditional methods that is not always the case.

Greg and Brad are both engineers. They use mathematics a lot in their work. Brad spoke of how when he first got out of college he had to do problems by hand after the computer had done the designing. He thought that he had learned a lot by doing that. Greg said that he didn’t need a calculator for everyday math, because he had learned his basics and could do it in his head. He thought that there were some things “that need to be almost an instinct.”
Reasons that parents gave for a change in their attitude were this calculator, discovery lesson, students could be self-taught or self-paced, students would learn, students learn how to use a calculator, the students could do more involved problems, and they saw that the calculator could be used as a learning and teaching tool.

Table 4.13 on page 168 compares percent of positive statements made before and after intervention by the parents of the students in the different schools involved in the study and the differences of these percentages. I chose to find the differences of these percentages, because some parents spoke more during the focus groups than they did during the individual interviews and others spoke more during the individual interviews than during the focus group interviews. The wealthy school had very little change, but the other three schools had about a 25% increase in the number of positive statements made by the parents after intervention than before. Slightly more than half of the statements of the parents of students in the rural and urban schools were positive before intervention compared to three fourths or slightly more of the statements made after intervention. A little more than one fourth of the statements made by the parents of the rural poor school were positive before intervention, but more than half were positive after intervention. Overall the parents, who participated in both the focus group interviews and in the individual interviews, increased the percentage of positive statement after intervention by 23.2% over the percent of positive statements made before intervention.
<table>
<thead>
<tr>
<th>Type of School</th>
<th>Positive before</th>
<th>Positive after</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>52.4%</td>
<td>75.0%</td>
<td>22.6%</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>28.3%</td>
<td>53.3%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Urban</td>
<td>56.2%</td>
<td>79.2%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Wealthy</td>
<td>64.8%</td>
<td>63.1%</td>
<td>-1.7%</td>
</tr>
<tr>
<td>Total</td>
<td>47.4%</td>
<td>70.6%</td>
<td>23.2%</td>
</tr>
</tbody>
</table>

Table 4.13
Percent of Positive Sentences Before and After Intervention by Type of School

The data for Research Question Three suggests that the intervention with these parents did change their attitudes toward the use of calculators in mathematics instruction. Through their dialogue, these parents stated that their attitude toward the calculator in mathematics instruction changed. The data from the number of positive and negative statements made before and after intervention also shows a positive change in their attitudes.

Research Question Four: What did parents, who originally held negative attitudes or beliefs about the use of calculators in mathematics instruction, think caused them to become more positive about the use of calculators in mathematics instruction?

This question follows from the previous question that asked if parents changed their attitudes or beliefs about calculator use in mathematics instruction after intervention. I used only data from individual interviews to answer this question. Some of these parents were not quoted in the answers to Research Question Three as parents who changed their attitudes or beliefs about the use of calculators in mathematics classes, but they made statements that gave the impression of their being more positive than they were before the intervention. The dialogue in this section contains seven different reasons for the parents becoming more positive toward calculator use in mathematics instruction. This section includes all of the parents who participated in the individual interviews and
who appeared to change their attitudes and beliefs about calculator use in the mathematics classroom.

**Discovery Lesson**

Twelve parents thought using a calculator in a discovery lesson was positive. Most of these parents were surprised to see how the calculator could be used to teach mathematics.

Carol said, “After seeing the demonstration and how it can be used as a practice tool, I have changed my mind. . . . You don't see that type of thing out there.”

Jackie said, “It would teach them if it is taught like that. . . . If they would allow them to experiment with it, but not give them math papers to do with a calculator.” When asked what caused her to change her mind, Jackie replied, “Just from what you showed me.”

Jonda said, “Maybe kids have a more—you were trying to get us to do problems to see why the problem worked that way. . . . They would have more of an open mind and more flexible in understanding and in interpreting and more using it to learn than just to find an answer.”

Joy said, “As long as it is taken one step farther and they are asked what they are looking for.”

Leanne said, “I think with something like this, as long as you have the steps that they went through, it would be very easy to help them with that. That would be one thing and number two, I think it would keep the kids altogether. I know some kids when they are trying to write they get sloppy and it gets confusing.” When asked if she had changed
her mind, Leanne replied, “Yes, I really have after seeing this program and how the calculator could work.”

Lee, said, “I think it's a good program. I think it's a program that needs to be utilized. I think it should be utilized in the grade school programs so they can get used to it while they're still curious. It sounds like a good program. I would give it a thumbs up.”

When asked what changed her mind about calculator use in mathematics education, Lu responded, “I think actually thinking about it and hearing how you would explain it, such as the activities here.”

Lucy said, “Before I talked to you, I never thought about it that way. In fact I would have said, ”No, they need to understand the fundamentals and literally how to multiply. They needed to know how to do fractions like you showed, to multiply the top times the top and the bottom times the bottom, to reduce by dividing numerator and select the top denominator by number. They needed that basic understanding and then use a calculator to let calculator do it for them. But they knew what they were doing then. But having worked on some of your samples, I'm more convinced. . . If somebody were trained to use the calculator as a teaching tool, like you have nice steps and you have them do lots of problems. You force them to see the pattern. You force them or guide them to see the pattern. They see what it is you're actually doing. If they are trained to do that, that would be great. That would make sense. Now that I can see that can be done. It's just two different ways to get to the same thing. I can see that for a lot of kids it would be a lot less frustrating—the pure computational part. They could let the calculator do it. . . I would be as happy as I could be if they were using guided discovery. . . . This would be nice for those kids. You think of it like a puzzle. They could do it if they could figure
this puzzle out. They would know what they have to key in. It is a lot easier than having
to do that and having to do the calculations.”

Paula said, “That's fine that way to sit in class like we were doing here. That's
great. . . . Again, if it is presented as you did, I wouldn't have a problem with it at all. I
would go out and buy my son a calculator with no problem. . . . The students could learn
a lot using a calculator like this in class.”

Teresa said, “I think using it in the manner that we did it is helpful, because it
shows you the different formulas. I never really thought about the kids using a calculator
to discover rules.” When asked what changed her mind Teresa said, “Seeing how it can
be used.”

Todd said, “I think that would be good. That is like the old handbooks we had, but
we all did them by hand. Here they are keeping them in electronic memory so they can
figure out if they are learning or not learning how to do it.”

Tora said, “That was good, because even without being given an example I could
still figure it out logically and not necessarily depend on the calculator to provide me
with the answer, but at least show me the direction I should be going”

These twelve parents liked doing the discovery lesson. They were surprised how,
by using a calculator, they were able to see patterns and discover rule. Most of these
parents already knew the rule for multiplication of fractions, but at least one parent said
that she had forgotten how to multiply fractions and by using the calculator in a discovery
lesson, she was able to remember how to do it.
This calculator

Twelve parents said they thought various features of the TI15 calculator would make it a calculator that could be used in the mathematics classroom. They seemed to like the ability of the calculator to allow children to scroll through the problems they had done to look for a pattern. They liked that the display of the calculator that showed the entire problem to the child. Most of the parents were very impressed with the game that could quiz the students about basic arithmetic.

Ann said, “There are different types of calculators. Like this one has the reinforcement of showing the child this is how the process goes, so that would be a little better for the child than the basic calculator that does this times that and that's the end of it”

Brad said, “I think that's a nice feature, the way that calculator shows fractions and can simplify them. I was thinking I would just go in there and start dividing. That way you would get a lot of decimals and not be able to see what is going on. This way you can look across and see how the problem is done and what the rule is. I also like the game test that is on it. I think kids would like it and it would keep their interest.”

Carol said, “You can do so much on [this calculator].”

Greg said, “I thought the calculator was kind of nifty. Yeah, it helped to open your eyes to see the relationship between the fractions—to see that 18 over 36 is the same as 9 over 18 is the same as one-half.”

Hank said, “I can see that with this calculator that it is teaching them their basic math facts. . . .I can see this particular [calculator] doing that. I can see that this [calculator] will keep kids a bit more enthused and focused too, because listening to
anyone giving information in a lecture form is boring. You lose your audience real [sic] quick, especially the younger ones. There are capabilities in the [calculator] that I was not aware of. I don't know why I didn't realize that this technology would advance like everything else, I guess because I don't deal with it on a regular basis.”

Jackie said, “The game is better than flash cards, because everyone wants to give my 5th grader the answers before he has a chance to figure them out.”

Jonda said, “It just has a big display. . . . If they were going to use that type of calculator [TI15] to learn those things—I don't think another kind of calculator would have the display that that calculator has. I don't think they could see it like they could on that type of calculator.”

Leanne said, “I really didn't think of the calculator as a learning tool, I thought of it as a checking tool or a way to cut some corners. But especially seeing that particular calculator, I can see where kids could use that to get excited about learning. It really would make it clearer to them.”

Melanie said, “I think that that would be a fun instrument. I think it would help the kids develop thinking skills and problem solving skills. With the calculator they can see it and get feedback right away.”

Teresa said, ” [The TI15 is] set up like a game. It simplifies everything for them. When you use flashcards and then they come home with a ditto and it is set up differently, it's not familiar to them and I think that hinders them from being able to do the work. . . . This calculator has things on it that will show you and allow you to figure things out. I think this is pretty neat. It's almost like a game.”
Todd said, “If they were using the [calculator] you showed that would be okay.”

When asked, “Have you changed you mind on the use of the calculator in mathematics classes over time?” Todd answered, “Yes. Seeing the calculator and seeing what it could do. There aren't a lot of calculators out there that can do what you showed me this calculator can do. It can show you the patterns by scrolling back through. . . . I think [the calculator] looks pretty good. It looks better than I imagined it would be when we first talked.”

Val said, “I'm glad you showed me how to use the calculator. . . . I would think that would be very helpful.”

These twelve parents liked the calculator [TI15] that they used in the intervention. They could see what the problem was after they had keyed it in. They could go back to see if the problem was keyed in correctly after they pushed the enter-key. They could look for patterns. Children could practice their basic arithmetic facts using the game feature.

**Students self-taught or self-paced**

Six parents liked the use of calculators in the mathematics classroom, because they thought students would be able to proceed on their own to learn mathematics. They thought this would free the teacher to work with individual students that might need more attention. Some of these parents also thought that some children could advance faster than some of their classmates.

Carol said, “It's not like you have to have total teacher attention. The students can be self-taught.”
Gina said, “They say they shouldn't have to memorize until later. I think they start soaking it up at 3 or 4 years old. The same way with language, they can learn it by working with [the calculator].”

Hank said, “I can see that with class work, it has some built in stuff, it can be used on its own to teach. . . . [The calculators] may diminish the time the teacher needs to spend with each student.”

Leanne said, “I think just being able to play with it and see for themselves how they come out.”

Todd said, “This reminds me a lot of the V-Tech computers they have where they teach you how to do it.”

Tora said, “That was good, because even without being given an example I could still figure it out logically and not necessarily depend on the calculator to provide me with the answer, but at least show me the direction I should be going.”

These six parents liked the ability of a calculator to allow the students to learn at their own pace. Students can advance if they wish to go faster than their classmate. Students can spend more time on certain areas that they do not pick up so quickly.

**Students learn**

Five parents felt that children would learn even if they were using calculators in their mathematics classes. After they learned how a calculator could be used to teach, they were not worried that students would not learn.

David said, “I don't think [the students] learned it any less because they are using calculators. Possibly they learned it better.” When asked if he changed his mind because he saw that the calculator was not a problem, he replied, “I guess it is partly that and it is
partly seeing the kinds of problems my kids, especially my son, did in high school. . . . I
guess, over time just getting accustomed to these things has given me a more positive
outlook on it. . . . The more we become accustomed to it and kids growing up with it, the
easier it is to accept.”

Gina said, “When I sat down with my niece, I had a small computer that had
simple math that she worked herself up to. . . . It gives you "yeahs" and "nays" and tells
them to try again. She got it within two days and then started moving on out. I thought
that this is what they need to do. She was sitting there making As.”

Leanne said, “I asked my kids this morning what the difference was between
using the calculator and using a times table; they are both methods to learn. The
calculator is visual just like the times table. I think calculators would be the next step.”

Sara said, “Part of it is how [the students] are doing. . . . You can do it twice to
make sure you are coming up with the same answer a second time.”

Tora said, “I could still figure it out logically and not necessarily depend on the
calculator to provide me with the answer, but at least show me the direction I should be
going.”

These four parents realized that students do learn using a calculator. The
calculator does not do all of the work for students. The students still need to figure out
what is happening.

**Learn how to use calculator**

Three parents liked children using calculators in mathematics classes, so they
would learn how to use a calculator.
David said, “It's important to learn how to use a calculator. Just in general, if you are going to be in any scientific or engineering type of field, you have to learn to use a calculator.”

Gina said, “I think they will become very familiar with [calculators].”

Sara said, “It's so useful and the kids are going to have to deal with it sooner or later. They might as well start now.”

**Can do more involved problems**

Three parents thought children would be able to do more involved problems if they were using a calculator in their mathematics classes. The problems don’t need to use small numbers that give integer answers.

David said, “Some of the more advanced problems they simply would not have been able to do without a calculator.”

Hank said, “I can see giving students more situational problems where they have to figure out formulas or what calculations to do, which is really what math is supposed to be about to start with.”

Lu said, “It seems like this will help them with the more difficult problems.”

**Learning/teaching tool**

Only one parent mentioned the calculator as a learning and teaching tool as a reason for becoming more positive about calculator use in the mathematics classroom. Leanne appreciated the calculator as a learning and teaching tool. Even though she was mostly positive about calculator use in mathematics classes before the intervention, she was surprised to see the way a calculator could be used as a pedagogical tool.
Leanne said, “I really didn't think of the calculator as a learning tool, I thought of it as a checking tool or a way to cut some corners. But especially seeing that particular calculator, I can see where kids could use that to get excited about learning. It really would make it clearer to them. . . . I guess I never really saw it as an evil in any way; I just never really looked at it as a learning tool, because it was presented to me as a checking tool. It wasn't something you learned with. They just said, ‘Here check your problem.’”

Most of the parents were surprised to see how a calculator could be used to teach with and to learn with. They knew of some values of a calculator, but had not experienced it as a discovery tool. By participating in using a calculator as a pedagogical tool, these parents realized the real value of a calculator in the mathematics classroom.

*Research Question Five: What did parents with negative attitudes or beliefs think was the reason they continued to think negatively even after the intervention?*

Even though many parents became more positive about the use of calculators in mathematics education, some parents still held negative feelings about the use of calculators in the mathematics classroom. This section explores some of those negative attitudes and beliefs about the use of calculators in the mathematics classroom. Again the individual interviews provide the data to answer Research Question Five. The parents expressed twelve beliefs that caused them to think negatively about the use of calculator in mathematics education. Some of the beliefs—that it’s a crutch, benefit by hand, don’t always have it, memorize keystrokes, and the teacher not being involved—that they had before intervention were still present. The parents added some new concerns to the list—that not all can discover, students will not try, needs to be told rules, teacher not using as a
teaching and learning tool, lacks understanding, and not available at home. Before intervention the parents were concerned that students wouldn’t learn the basics, but after intervention that was not a concern that they mentioned.

**Crutch or too reliant on calculator**

Fourteen of the twenty-five parents that participated in the individual interviews were worried that children would become reliant on a calculator and it would become a crutch for them. Before the intervention most parents, a little more than 85% of the parents, were concerned that the students would not learn mathematics if they were using a calculator in their mathematics classes. About 62% expressed concern that the calculator would be a crutch. After the intervention, 56% of the parents, who remained for the final interview, were most concerned about the calculator being a crutch for their children. Being a crutch rather than not learning was there concern after intervention.

Ann said, “I'm afraid some children will become reliant on [the calculator].”

Brad spoke about cashiers giving him incorrect change. When asked if calculators made that more prevalent, he responded, “I think it could if people depend on the calculator from the beginning—like a crutch.”

When asked, “What are your concerns about the use of calculators in mathematics classes?” Carol answered, “That [the children] become too reliant on the calculator. . . . That is the only concern that I would have that they become too reliant on the calculator.”

Cheryl said, “I think you have to have a concern that the kids start relying on it to do all of their work rather than letting their mind think about a problem. There is also the concern that a kid would think; ‘I can't do it without my calculator.’ They may become so reliant on it that they, even if they know the concept, need that security blanket.”
David said, “My concern is when you get a little more advanced than that, and you rely on the calculator, and don't learn how to do it—telling them how to do it on the calculator is just a crutch. They don't know how to do it so they are relying on the calculator.”

Greg said, “Well, I think there are just some things that you need to know—that need to be almost an instinct. Like when you see the numbers 6 times 8, you just know automatically that's 48. You shouldn't have to think about that. Or you shouldn't have to say, ‘Where's my calculator?’ It's okay to maybe use the calculator to double check. . . . I can use the calculator for that if I have to know, but in everyday life there are a lot of times when—if I'm buying gas and I put in 10 gallons and it's $1.789 a gallon I should be able to know without getting a calculator that it should be $17.89 and they try to charge me $21.54, I shouldn't even have to think, it should be automatic that I know that something is not right here. . . . It might have just been this one person, but I was talking with a guy I work with, just talking the other day. He was talking about his younger brother. He had trouble with math in school. He would try to help [his brother] get through these things. He finally realized that there was a serious problem with [his brother's] math skills. He asked his younger brother, ‘What's 50 times 10?’ And his brother said, ‘I don't know. I have to get my calculator to find that out.’ . . . Was he taught to rely on the calculator? If so that's a problem. Or is he just one of those people who can't do math[ematics]? . . . You are teaching a kid that if they can't get along in a normal way, I'm not sure ‘normal’ is the right word, then it is okay to use a crutch. There are many instances where it is not okay to rely on a crutch. . . . The reason we didn't need calculators is because we didn't have to have a calculator to do the basic [arithmetic]
operations. We knew how to work with fractions. We didn't need a calculator to do that for us."

Hank said, “This is a crutch that could get you past that, so you could accomplish the work. That would be my only real concern, that and becoming totally dependent on it. It is possible for kids to become dependent on it if they can't do the work.”

When asked, “What are your concerns about the use of calculators in mathematics classes?” Jackie answered, “That they will depend on it. . . . I know from my 7th grader that he is dependent on the calculator. . . . I am concerned that when they get out on their own they will not be able to function if they have depended on it. There are some very smart kids that don't want to show it and want to take the lazy way out.”

Lu said, “Personally I would get lazy, if I knew that problems are formulated in such a way that they can be solve with a calculator, I would know that the calculator will give me the right answer and I don't have to think.”

Melanie said, “The only concern that I would have, would be if there were a child who uses it as a crutch rather than as an aid. If the child really doesn't learn the basics instead as a supplement to understanding how something works.”

Paula said, “If I knew they were doing this, I would still question it, because I know my son. He just wants to get finished.”

Sara said, “I think my daughter is overly dependent on the calculator.”

Todd said, “As long as they don't rely on it and they can formulate in their minds, because you don't always have a calculator on hand.”

Tora said, “My main concern would only be that it is a springboard and not a crutch.”
Parents were still concerned that the calculator could become a crutch. Even after seeing how the children could learn using the calculator this was a concern.

**Benefit by paper and pencil**

Seven parents wanted the children to still do calculations using paper and pencil, because they thought there was something that the children would learn that way better than with a calculator. These parents may be concerned about children finding answers and getting “correct answers.”

Brad said, “If you have done it by hand and you understand the concept and you actually get involved in it, then you have that sense when you get an answer whether it makes sense. . . . I know when I first got out of college, after the mainframe computer did the designing, we had to go back and find the same answer by hand. It forces you to do it. If you don't get the right answer, you have to figure out what you did wrong, what you left out. That really is a learning process, rather than fill out a card and fill in the squares and rely on the answer that comes out. . . . I think it is a mental exercise. It stimulates your mind, your thought processes. It helps you in the future. You know how to do problem solving so when you get out later.”

Cheryl said, “At a certain point in time in working with least common denominators they need to be able to do that in their head.”

David said, “If you don't know how to write out a division problem and you don't know how to show your work, then maybe you are not learning what is shown on the paper.”
Jackie said, “When my 7th grader comes home and he has math homework, he asks for the calculator. I tell him he is not going to use the calculator. I tell him he needs to figure it out.”

Lu said, “Fractions have always been a problem with some of my older children. We have to go back and revisit fractions every year. I thought the process where they had to list all of the common denominators and find the lowest common denominator reinforced their math facts. The calculator skips that part.”

Pam said, “I think kids need to be able to do that quickly in their head and automatically know how to do it.”

Paula said, “I still think at that age they need to do it with pencil and paper. . . . If you have a teacher that is willing to do it. The students could learn a lot using a calculator like this in class, but I would still like their homework done on paper. . . . They still should have some idea of how to do it with paper and pencil.”

These seven parents thought that doing mathematics with paper and pencil benefited their children. They must have thought there is some link between the brain and the paper that isn’t there between the brain and a calculator.

**Not all kids can discover mathematics using a calculator**

Six of the parents were not convinced that all children could discover mathematics using a calculator. They were concerned that only the better students could learn mathematics in this manner.

Ann said, “Some kids might be able to figure out that that is what it was doing, but other kids may not. . . . I still think as a supplement it is fine, but to totally do it and
say you figure it out on your own, that's fine for some kids, but other kids can't figure that out. They just cannot do it.”

David said, “If a kid somehow misses something, it gets very frustrating. . . . If you have mathematically inclined kids or kids who like to work out puzzles and have the time that might be a very good way to do it—for the really curious types.”

Greg said, “I don't really know at that age. I don't know if they would get the connections. That I don't know.”

Lucy said, “I'm thinking some kids would make the connection, but some kids would not make the connection. . . . There are some kids that will never come up with the same rules.”

Pam said, “I think a lot of kids would be lost. When it automatically changes the denominator, I think it would confuse them. . . . My kids are proficient in math, but overall there are kids that can't do it.”

Paula said, “If he is in the right mood, [my son] will maybe catch on to a pattern or whatever they are doing at the time.” When I asked her, “You don't think that they could learn how to do it with paper and pencil using the calculator in this way?” Paula answered, “It all depends on the child. My daughter would, but I'm not sure about my son.”

These six parents were able to discover the rule for multiplication of fractions, but they questioned whether all of the children would be able to use discovery. This assumes that all children learn the rules for multiplying fractions when it is taught the traditional way.
**Student will not try**

Four parents were concerned that children would not try if they had a calculator available to them. It would be for easier them to just use the calculator than to do even the simplest problems without it.

When asked if she had any concerns, Carol responded, “That if I were to hand them a problem of reducible fractions and ask them to reduce it for me, they might not be able to think that 6/36 is 1/6.”

Jackie said, “He had multiplication of simple fractions to do; they are showing him how to cancel on a calculator, he wants to use a calculator to do it

Pam said, “I think that if [the children] had this [calculator] in their hand and they were given the answer, they wouldn't learn it. . . . I know just how kids are; they don't want to think.”

Sara said, “[My daughter] doesn't want to shorten it up by going ahead and doing what she knows. She will just put it in her calculator.”

These four parents worried that children would not try to do mathematics if they had easy access to a calculator. They would let the calculator do the work for them. If they get the right answers they will pass.

**Student will not learn**

Four parents were concerned that the children would not learn mathematics if they used a calculator.

Greg said, “I can do in my head, because it was pounded into me when I was a kid growing up. I can do it in my head now. I think that if you can't do those kind of things you are going to be perceived as stupid and you are going to be taken advantage of.”
Hank said, “It would be possible kids to slip through and not learn his math facts, especially if the teacher is not paying attention.”

When asked if she had any concerns, Kate answered, “That the teacher would continue to balance it out with memorization of basic facts, because that's where the speed comes from.”

Paula said, “But to give them a calculator and have them go do their work, it's not teaching them anything; it's just numbers.”

These four parents thought children would not learn if they were using a calculator in mathematics instruction.

**Don't always have a calculator**

Four parents were concerned that if the students learned using a calculator, that they would always need a calculator and there would be times when they would not have a calculator with them when they needed it.

Ann said, “They aren't going to be able to use that calculator when they go for a job interview. . . . When they go to the job interview, most of them give math tests now and if you can't do the math they aren't going to hire you.”

Carol said, “That was the only concern, because you are not going to always be somewhere that you are going to have one when you have to figure something.”

Jackie said, “When it comes test time they aren't going to have that calculator or when they are out in life.”

Todd said, “As long as they don't rely on it and they can formulate in their minds, because you don't always have a calculator on hand.”
These four parents were concerned that the children would not always have a calculator when they needed one. Before intervention there were nine parents with this concern.

**Memorize key-strokes**

Three parents were concerned that the children would just learn how to key in problems and not really understand what they were doing.

Brad said, “My son who is a senior is required to use the graphing calculator. As long as you put in the right sine and cosine you get the graph. You don't really need to know what you are doing. What does that mean? Why does it go up and down? Why does it cross the x-axis where it does?”

Melanie said, “If someone said, press this button, and press that one, I would never know how to do it, and how it happens, if I were really naive about things. If someone gave a test and said, ‘Do this question.’ I wouldn't know how to do it, because I don't have the foundation.”

Paula said, “[My son] could just punch in the numbers and get the answer and he would be all done. . . . They can learn that way, but to sit and do his homework every night, he would just push the buttons and that's all.”

These three parents were concerned that the children would only memorize keystrokes. They worried that the teacher would not get them to think about what they were doing when they used a calculator to do mathematics.
**Needs to be told the rules**

Two of the parents thought that it would be more productive if the teacher told the children the rules and then let them do problems. They thought it may take too long for the students to discover the rules and some children would never discover the rules.

Ann said, “Unless they have been told what the rules are to start with, they aren't going to figure those out. . . . But [rules for operation of fractions] is something the teacher is going to have to tell them first. . . . If the calculator kept telling them that this is not right they may finally figure it out. I think they would have problems with it. A lot of kids still have problems when they are using their brain to figure it out.”

David said, “I think sometime you do have to tell them the rule. Let them get the memorization down first. Let them know how to do a problem. Then if you have to explain the principles behind it you can do it. . . . They spend a lot of time going off into space when it would have been much easier to just tell them the rule to begin with. They will learn how to do it and then if there is an underlying principle, you can tell them. . . . but sometimes, it seems to me that if you just tell the kids that here is the way you do this, they will learn it a lot faster than if they have to go through all of these exercises and then stop and figure it out. . . . But for most kids, you just want to teach them math—tell them, here's the way you do it.”

**Teachers not using as teaching tool**

Two parents were concerned that teachers may use calculators in the mathematics classes they are teaching, but not use them as a teaching tool.

Cheryl said, “Different teachers will make sure the calculator is used as a tool and not as a crutch. There is a concern that there will be teachers out there that will let it be
just a crutch. They won't verify that the kids actually know the thought processes behind it.”

Paula said, “I would be against it, because I know most of that would not change and take the time to do like you are doing by asking the questions that go along with the calculator.”

**Lack understanding**

Two parents were worried that children might not understand what they are doing when they are using a calculator. Joy, who only participated in the intervention and individual interview, thought children would understand if they had to formalize the rules for what they were doing. Lu thought they needed instruction and guidance to understand using the calculator.

Joy said, “The understanding needs to be there rather than them being handed a calculator and thinking they have a magic box that will do all the problems for them. . . . I think it can, but my concern is that they memorize it without any understanding. . . . Without taking it one step further to come up with the rules, they will just use calculators, not think it through, and not understand it for themselves.”

Lu said, “You have simplified it and it is done for them. I'm not sure they would understand what is being done. Eventually I think they would. . . . I wouldn't have figured that out without instruction and guidance.”

**Not available at home**

Carol was concerned that children would not be able to do their homework, because they would not have the same calculator at home that they were using in school.
Carol said, “If you have these in the classroom and the kids don't have these at home and they are relying on that in class, then they won't be able to get their homework done.”

**Replace teacher**

Teresa was concerned that the children would not get enough guidance from the teacher, if the class were using calculators to learn mathematics. She said, “I think that pretty much from the beginning when I filled out the survey and from the time that we met in the group interview, my only concern would be that the calculator would be teaching the class. I think if you let them loose with the calculator all of the time and did not monitor them, you could run into problems because people would start falling through the cracks.”

**Summary**

Table 4.14 on page 191 shows a comparison of the negative beliefs that parents held before and after intervention. The table shows about the same number of themes of negative beliefs after intervention as before, but it also indicates that the total number of negative beliefs after intervention was less than half of the number before intervention. Even adjusting for the fact that there were fewer people in the group (24 as opposed to 34), this is still a considerable decrease. These data indicate that, even though there are parents who still think positive after intervention, intervention does help some parents become less negative about the use of calculators in mathematics education.
<table>
<thead>
<tr>
<th>Belief</th>
<th># of Parents</th>
<th>Belief</th>
<th># of Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Won’t learn basics</td>
<td>29</td>
<td>Crutch</td>
<td>15</td>
</tr>
<tr>
<td>Crutch</td>
<td>21</td>
<td>Benefit by hand</td>
<td>7</td>
</tr>
<tr>
<td>Benefit by hand</td>
<td>14</td>
<td>Not all can discover</td>
<td>6</td>
</tr>
<tr>
<td>Don’t always have</td>
<td>9</td>
<td>Students will not try</td>
<td>4</td>
</tr>
<tr>
<td>Only computational</td>
<td>8</td>
<td>Students will not learn</td>
<td>4</td>
</tr>
<tr>
<td>Not necessary</td>
<td>6</td>
<td>Don’t always have</td>
<td>4</td>
</tr>
<tr>
<td>Memorize keystrokes</td>
<td>5</td>
<td>Memorize keystrokes</td>
<td>3</td>
</tr>
<tr>
<td>We didn’t have them</td>
<td>5</td>
<td>Needs to be told the rules</td>
<td>2</td>
</tr>
<tr>
<td>Need estimation skills</td>
<td>4</td>
<td>Teacher not using as teaching tool</td>
<td>2</td>
</tr>
<tr>
<td>Need drill</td>
<td>3</td>
<td>Lacks understanding</td>
<td>2</td>
</tr>
<tr>
<td>Need same calculator</td>
<td>3</td>
<td>Not available at home</td>
<td>1</td>
</tr>
<tr>
<td>Teacher not involved</td>
<td>2</td>
<td>Replace teacher</td>
<td>1</td>
</tr>
<tr>
<td>Complicates math</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>Total</td>
<td>51</td>
</tr>
<tr>
<td>Adjusted total</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|**Table 4.14**  
Negative Attitudes of Parents |

Research Question Six: Were there parents who were originally positive about calculator use in mathematics intervention and are now negative about it? If so, why did they think there was this change?

There were no parents who originally held positive attitudes about the use of calculators in mathematics education that changed their attitude and became more negative after the intervention. Although some of the parents who had mostly positive attitudes about the use of calculators in mathematics education, still held some negative beliefs about the use of calculators in the mathematics classroom.

Before the intervention, Cheryl, a very positive parent during the focus group interview, said, “I think there is probably abuse of the calculators and kids are taking it easy right now and they are not learning it. . . . They need to know basics and not use
them as crutches.” After the intervention she commented, “I think you have to have a concern that the kids start relying on it to do all of their work rather than letting their mind think about a problem. There is also the concern that a kid would think; ‘I can't do it without my calculator.’ They may become so reliant on it that they, even if they know the concept, need that security blanket. Different teachers will make sure the calculator is used as a tool and not as a crutch. There is a concern that there will be teachers out there that will let it be just a crutch. They won't verify that the kids actually know the thought processes behind it.” The percent of positive statement Cheryl made before intervention was 90% and after intervention was 82.9% (see Table 4.12 on page 164). I don’t believe that Cheryl became less negative after intervention. The discrepancy may be that she only made two negative statements during the focus group interview—she seemed to be more intent trying to convince the other members of the focus group that the calculator in mathematics classes is a good idea.

Before the intervention Kate said, “They will get dependant on the calculator.” After the intervention Kate stated that her only concern was, “that the teacher would continue to balance it out with memorization of basic facts, because that's where the speed comes from.” Kate made 62.5% positive statements during the focus group interview and 92.3% during the individual interview. Even though she appeared to be very positive before the intervention, Kate appeared to be even more positive after the intervention.

Before the intervention Lu said, “I think they are good tools after the basics are learned. They need to understand the problem they are trying to solve, and then use the calculator as a tool. . . . It can be a stumbling block when someone becomes too
dependent on a calculator. . . . I think at the level of math that they are teaching children now they are asking them to get calculators far more powerful than they need. They want the graphing calculator or the scientific calculator. They don't need all of that right now. They will probably only use a quarter of the buttons on them. . . . It's not about the cost. It's just more powerful than what they need. It does more processes than they need. . . . I think [the calculator] makes things more complicated. They accidentally hit a function key and then they are taking square roots.” After the intervention she said, “I think that maybe they could, but for some just adding a calculator may be overwhelming, but then it may seem more fun. . . . You have it simplify it and it is done for them. I'm not sure they would understand what is being done. Eventually I think they would. . . . I wouldn't have figured that out without instruction and guidance. . . . Math is becoming so time consuming, even for us as parents to help our children complete their homework. Personally I would get lazy, if I knew that problems are formulated in such a way that they can be solve with a calculator, I would know that the calculator will give me the right answer and I don't have to think.” Before intervention Lu had 78.8% positive statements and after she had 75.0% positive statements. Even though her percentage of positive statements decreased, I think she actually seemed more positive after intervention as she was before.

Before the intervention Sherry said, “Give that kid basics so in case battery goes dead, ‘I can do this.’ You really don't want your kids to give up because they don't have the calculator.” After the intervention, Sherry had no negative views.
Summary

In analyzing the data in this chapter I have answered the six research questions that I started out to answer.

Research question one was “What are parents’ attitudes about the use of calculators in mathematics instruction?” To answer this question I used mostly data from the surveys. The survey data showed that the parents in all of the schools were fairly neutral about the use of calculators in mathematics education. I also included dialogue to from the focus group interviews to indicate the attitudes of the parents who participated in the focus groups.

The second research question was “What are parents’ beliefs about the use of calculators in mathematics instruction? Why do parents hold their beliefs and attitudes toward calculator use in mathematics classes?” To answer these questions I used data from the focus group interviews. The data suggested fourteen beliefs that I thought caused the parents to have negative attitudes about the use of calculators in mathematics education. The data revealed twenty-one beliefs that I thought caused positive attitudes toward calculator use in school mathematics.

To answer Research Question Three—“Did parents change their beliefs and attitudes toward calculator use in mathematics classes through an intervention that shows the calculator being used as a teaching and learning tool?”—I first used dialogue from the parents when they told whether they changed their attitudes toward calculators in mathematics education. I then compared data from the focus group interviews with data from the individual interviews. Both the parents’ dialogue and the comparison data
indicated that most these parents changed their attitudes about the use of calculators in mathematics classes.

Research Question Four was “What did parents, who originally held negative attitudes and beliefs about the use of calculators in mathematics instruction, think caused them to become more positive about the use of calculators in mathematics instruction?” I used data from the individual interviews to answer this question. The data indicated seven themes that parents thought caused them to think more positively toward calculator use in mathematics instruction. I used parents’ dialogue to show these themes.

Research Question Five, “What did parents with negative attitudes and beliefs think was the reason they continued to think negatively even after the intervention?” To answer this question I used data from individual interviews, which indicated twelve beliefs that the parents still held after the intervention. I used dialogue from the individual interviews to show these beliefs. I also compared these negative beliefs with the negative beliefs used to answer questions two and three. There were about the same number of themes of beliefs before and after intervention, but there were fewer negative beliefs after intervention than there were before intervention.

To answer Research Question Six—“Were there parents that originally were positive about calculator use in school mathematics and are now negative about it? If so, why did they think there was this change?”—I compared data from the focus group interviews with data from the group interviews. There were no parents who originally were positive about the use of calculators in mathematics education, who became negative after intervention.
CHAPTER 5

Conclusions and Discussions

There appears to be a consensus that the children in the United States don’t do as well in mathematics as children in other industrialized countries. In fact, the Third International Mathematics and Science Study (TIMSS) found that eighth-grade students in the United States performed lower than eighth-grade students of 14 nations (U.S. Department of Education, n.d.). The National Council of Teachers of Mathematics has developed several books of Standards that they hope will help teachers teach in ways that make it easier for students to learn mathematics. The Standards suggest that calculators be used in mathematics instruction for all grade levels from prekindergarten through grade 12. Much of the general public is opposed to students using calculators at various points in mathematics learning (Hiebert, 1999).

Parents are an important component in the success of any educational program. Influential parents who disagree with practices in the school may work to change the practices with which they disagree (Konzal, 1997; Peressini, 1998). Studies have shown that an educational program can help parents become more positive about the use of calculators in mathematics classrooms (Collums, 1991; Bitter and Hatfield, 1993).

In this study, I conducted group interviews with parents to find out what their attitudes about calculators in the mathematics classroom and what beliefs formed these
attitudes. After an intervention, I interviewed parents again, this time individually, to learn if these attitudes and beliefs changed. In this chapter I will attempt to discuss some of the findings reported in Chapter 4 of this study. I will also make recommendations for teachers and offer suggestions for research.

**Discussion of Findings**

The parents in this study participated in focus group interviews that took place at various places in their community. Dodd (1997) indicates in her study that parents will reveal more in conversations that take place in a nonthreatening environment. She recommends focus group interviews as a way to learn about parents’ beliefs. Only one group interview took place in the school. I felt that the parent might be less likely to link me to the school administration, if I held the focus group interviews away from the school; therefore, they would be more open in the interviews.

The parents seemed very willing to talk and revealed many concerns about calculators in the mathematics classroom. They were concerned the children wouldn't learn basics, it would be a crutch, the children needed drill, the children don’t always have a calculator, the cost of a calculator, the children don’t need calculators, they all need the same calculator, there is benefit from doing mathematics by hand, the students would only memorize the keystrokes, the students need estimation skills, the calculator complicates math, mathematics would lack stimulation if the calculator were used, and the teacher would not be involved. Dodd (1997) found that parents oppose practices that they think might be detrimental to their children’s learning.

During the focus group interviews, the parents made positive comments about the use of calculators in high school and middle school mathematics classrooms. Some of
these positive comments could have been a result of sociocultural learning, especially in the interview with Greg and Bruce. Bruce is a high school mathematics teacher and spoke very positively about the use of a calculator as a pedagogical tool. Greg seemed to be more positive at the end of the group interview. In the interview with Hank, Pat, Val, Cheryl, and Lee, and the interview with Jonda, Pam, Brad, Sherry, all parents of rural school students and in the interview with Todd and Leanne, parents of rural poor school students, I believe some of the parents in the groups were socially constructing new beliefs about calculators in school mathematics. Cheryl in the first group, Sherry in the second group, and Leanne in the other group began, as they were discussing the calculator, to see more value to the calculator as the discussion continued. As Cheryl began speaking more positively about the calculator, Val and Lee began mentioning more positive aspects of the calculator. Hank and Pat did not seem to be any more positive than they were at the beginning of the interview. In the second group mentioned, Sherry began talking more about positive aspects of the calculator and Jonda seemed to become more positive. Neither Brad nor Pam seemed to change their view as the interview continued. In the interview with Leanne and Todd, Todd seemed to be slightly more positive about the use of the calculator as Leanne began to speak more about the advantages of using a calculator in mathematics classes. Tora, an urban parent, seemed to become more positive about calculator use in mathematics education as the group interview progressed, but I don’t think Teresa, also an urban parent, was any more positive at the end than she was at the beginning. In the other six group interviews, I did not see any evidence of parents convincing other parents that the calculator would be a better teaching and learning tool than they originally thought; although, I did notice that Joyce seemed to
become more positive about calculator use the more Jackie talked about the negative aspects of calculator use. Some of the positive statements that parents made about using the calculator in mathematics class, I put in the following categories: prepare students for life, quicker, helps students with learning problems, good for checking answers, more efficient, removes drudgery, causes deeper thinking, tool, aids learning, models real life data, helps students advance without knowing the basics, helps students learn concepts, encourages doing math, fun, aids memorization, a discovery tool, more repetitions, more exciting, can use in place of primitive methods, helps in problem solving, and builds in success. Bruce, who is a math teacher, was concerned that calculators are not being used enough to teach mathematics.

The intervention attempted to teach the parents how the calculator could be used as a pedagogical tool in one area of mathematics. Dodd (1997) recommends that educators provide opportunities for parents to learn about unfamiliar classroom practices. By using discovery learning and the calculator, I hoped to show parents how their children might use the calculator as a teaching and learning tool. My goal was that the parents would not be as concerned about calculator use in mathematics education as they were before the intervention.

After the intervention most of the parents were more positive. Many of the parents still had some worries, but there were fewer parents with each concern than there was before the intervention. Weak constructivism would explain why some parents became more positive. My attempt, through discovery learning, was to “remedy learners errors and misconceptions,” (p. 346) as Ernest (1996) recommends in his list for pedagogical
implications for constructivist learning. With only one teaching session, it would be
difficult to reach each misconception or error that a parent might have.

Many of the parents said they became more positive because of using the
discovery lesson. One parent expressed that “[the children will] have more of an open
mind” using this approach. She also thought the children would have better
understanding and do a better job interpreting problems using discovery lessons. Another
parent thought discovery should be used, especially in elementary school. Some of the
parents thought the calculator would be a good way for children to learn and discover
rules, like the rules for multiplication of fractions in the same manner as they did. Some
parents thought the children would learn using this approach. They thought that in
discovery, students would learn how to find patterns in what they are doing and use these
skills to find other patterns. They thought that lessons should guide the students toward
the concepts that they are to learn and they thought that group discussions could be used
to keep students working toward a goal.

But, not all of the parents were certain that discovery was a good way to teach.
Some of these parents raised valid criticisms of discovery lesson, but many of their
criticisms could be a result of not understanding completely how discovery can and
should be used in teaching. Some parents were concerned that using the calculator would
be too challenging and only some of the children could do the discovery lesson or learn
the material. As Bruner (1966) contends, “Children do not need to discover all
generalizations for themselves” (p. 96). He states that through discovery children will
develop a greater confidence in “their own powers of thinking” and will be more able to
work independently.
Parents were also concerned that teachers would not be using calculators as teaching or learning tools. They were worried that the calculator would replace the teacher or that the teacher would not be involved. There is a legitimate concern that teachers won’t use the calculator as a teaching and learning tool. In my experience, many teachers do not know how to use a calculator as a pedagogical tool. Those who don’t, generally will only allow the use of a calculator sparingly. If a teacher is using a calculator in the educational process, it will actually involve the teacher more. Bruner (1960) insists that a “teaching machine” will not replace the teacher, “Indeed, it may create a demand for more and better teachers” (p. 84).

Some of the parents thought that the children need to be told the rules. They thought trying to discover the rules would be too time consuming and that there was a benefit from doing the problems by hand. Some of the parents thought that discovery would take too much time and that the teacher needs to tell the children the rules. I have used discovery lessons in classes that I have taught and students seemed to learn better and retain what they learned than when I taught the same material in the traditional method. Pesek & Kirshner (2000) found that giving students the rules actually confused the children. They learned the material better and in less time when they discovered and formulated the rules themselves.

Some parents thought, by using the calculator in the learning process, children would learn how to use a calculator. Some of the parents were concerned that by using the calculator the children would only memorize key-strokes and would not understand what they were doing. They thought that if the children had a calculator available to them that they would not try. If the children are only using calculators to solve computational
problems, then they probably will only memorize key-strokes. But if the children are using calculators to discern patterns in mathematics, they will not be memorizing key-strokes. They will be learning to understand what mathematics is and developing problem-solving skills. If assessment involves the patterns that the students find, then they would be motivated to try as much as they are with traditional teaching methods. More students will be willing to do and try mathematics, because they will be involved in what they are doing and it will not seem so strange to them. They will not be memorizing mathematics facts, but learning them in a way in which they can understand mathematics.

Some parents thought that children using discovery lessons with the calculator could be self-taught. Those students who catch on to the concept more quickly could either delve more deeply into it or move on to the next concept that develops. Other parents were worried that the calculator would become a crutch or that the children would become too reliant on it. They worried that the children would not learn the basics. These worries are not unlike the parents in the Bitter and Hatfield study (1993). In the Bitter and Hatfield study the percentage of parents who thought the calculator would hinder students’ understanding of basic computation skills increased after their children had been involved in a program that used calculators in mathematics classes. Calculators are great teaching tools. If they are used as such, children will actually learn mathematics. They will not become helpless without their calculators. The research (Ellington, 2003; Groves & Stacey, 1994; Hiebert, 1999) shows that by using calculators, students’ operational skills either improved or showed no difference.

Some parents were concerned that the children would not always have a calculator with them when they needed it. They said that the students would all need
same calculator. Many calculators can be bought for under $10; so many people have more than one. The cost of the TI15 that I used in this study costs about $15. Schools can buy classroom sets so all of the students have the same calculator. They can allow the students to check the calculators out, similar to the method of checking books out of a library, so they will have the calculator to use at home.

Some parents thought that, by using the calculator, the students would be able to do more involved problems. Other parents said that it complicates mathematics and that mathematics would lack stimulation if the calculator were used.

Other parents said that there is benefit from doing mathematics by hand, that the students need estimation skills. Students should learn how to do mental arithmetic. NCTM’s (2000) *Principles and Standards* recommend that students need to know how to compute fluently. Computing fluently does not mean rote memorization. It “requires a balance and connection between conceptual understanding and computational proficiency” (p. 35). When doing problems, children should look for answers that make sense. While teaching a class of remedial math at a college, I had a student answer the question, “How far can a car go on 8 gallons of gasoline if it gets 27 miles per gallon of gasoline?” The student was using a calculator for the test and answered 3.375 miles. I talked with her about how her answer did not make sense and that if she had a small car she would need to stop for gas every 3 miles. Another student, after spending time talking about answers making sense, wrote on his paper, “More than I got.” At least he understood that his answer didn’t make sense. When children are taught to check their answers to see if they make sense, they need estimation skills, which involve being able to do mental mathematics, as well as, knowing the basic operations of arithmetic.
Ellington’s (2003) study found, “When calculators were available during instruction but not during testing, students in grades K-12 maintained the paper-and-pencil skills and the skills necessary to understand mathematical concepts. …Students received the most benefit when calculator had a pedagogical role in the classroom” (p. 456). I have had people tell me that students can’t do arithmetic because they depend too much on the calculator. If that were the case the students I have had in class would have known how to use a calculator. Many of the students that I taught at a community college could not use a calculator to do any more than single operation problems on a calculator.

As mentioned in chapter three, only the reader can determine transferability. This study was conducted with a small group of middle school parents. They were shown how to use the TI15 calculator to discover the rules for multiplication of fractions. Through reading the dialogue with the parents, the reader will need to decide if this study can be generalized for circumstances other than those in this study.

**Recommendations for Teachers**

In this study, I found that parents were willing to talk with me and share their feelings about the use of calculators in the mathematics classroom. Most of the parents in this study became more positive after experiencing the calculator as a teaching and learning tool. Before the intervention most of the parents in this study preferred the standard methods of teaching and thought the calculator should be used to check their work, do problems with large numbers, or be used in advanced classes. After the intervention they were more likely to approve of calculator use in mathematics instruction. If the curriculum is to incorporate calculators, parents should be shown how the teachers are planning to use calculators to educate the children.
Some of the parents were still mostly negative about calculators in mathematics education, but even these parents thought that the calculator could be used in teaching as long as the teacher made sure the students knew the basics and could do the work without the use of calculators.

This study reveals concerns that parents have that need to be addressed by teachers. The evidence of this study suggests recommendations that teachers should make to help parents accept the use of calculators in mathematics curriculum. When parents fully understand how teachers are implementing innovative practices and how those practices will affect their children, they are more likely to approve of the practices (Dodd & Konzal, 1999).

Teachers need to know how to teach with the calculator. They need to be able to design lessons that will guide the children to discover the concepts that they are teaching. If they do not feel comfortable using a calculator as a pedagogical tool, they need to seek help. There are many opportunities for teachers to participate in professional development that will instruct them on how to use a calculator pedagogically. NCTM is a good source for ideas and training. A search of the Internet is certain to find resources. But, the best way to learn is by participating in a calculator education workshop. In workshops, the teacher can learn many ways of using the calculator pedagogically that will fit his/her teaching style. NCTM (2000) states, “Professional development is especially important in the middle grades because so little attention has been given in most states and provinces to the special preparation that may be required for mathematics teachers at these grade levels” (p. 213).
Teachers need to keep lines of communications with parents open. In the group interviews, I asked parents what they thought their school did not do so well. Parents from three of the schools said communication. They complained that when they called the school their calls were not returned. They said teachers didn’t inform them of what is going on in the school. It is difficult for parents to become involved in the school if teachers do not communicate with them.

Schools wishing to incorporate calculators into their mathematics curriculum, need to give their teachers an opportunity to get the training necessary. Not only do they need to give them the opportunity for the essential training, they need to require them to get the training. Most teachers find it difficult to change the way they teach, and using calculators and discovery in mathematics instruction will require substantial change (Heibert, 1999).

Teachers need to be vigilant when giving students discovery tasks. As with any teaching, they need to be aware of students who are not participating or who are not being productive in their investigations. The assessments used with discovery and calculator lessons should be more open ended. Ask students about patterns they find. Ask them to explain a process rather than have them compute arithmetic problems.

Teachers may worry that discovery lessons will take more time than traditional lessons. The lesson may take longer to plan the first time you use it, but like most lessons, should only need adjustments for future lessons. I found that students learn the material better, so there is no need to reteach as often as there is with traditional lessons. Pesek & Kirshner (2000) found that giving students the rules actually confused the children. They learned the material better and in less time when they discovered and formulated the rules
themselves. I have used some discovery lessons in classes that I have taught and it seemed that the students learned better and retained more of what they learned than when I taught the same material in the traditional method.

This study implies that teachers need to know how to teach with the calculator and they need to keep lines of communications with parents open. Another implication of this study is that if the curriculum is to incorporate calculators, parents should be shown how the teachers are planning to use them to educate the children.

_Suggestions for Research_

This study concentrated on parents’ attitudes and beliefs about calculator use in middle school mathematics instruction. The parents in this study often said that they would not mind students using calculators once they knew the basics. Few of the parents were in favor of calculators being used in elementary mathematics classes. Research should be done with parents of elementary students to see if education would change their beliefs about calculators in elementary mathematics instruction.

Most of these parents were in favor of calculators being used in high school mathematics classes. Research should be done with parents of high school students to learn if this indeed is true. The research needs to determine if the parents approve of calculators in all high school classes or in just the higher-level courses. According to Dodd (1997), little research has been done with the attitudes and beliefs of parents of students in high school.

There were 24 parents involved in the intervention and the individual interviews of this study. These parents were mostly women; only six men participated in the individual interviews. Three of the men were not convinced that calculators are good
teaching and learning tools. Would this be true of a larger sample of men? Similar research needs to be done with more male subjects. The research should also include study on ways to get more men to participate in school activities.

I conducted this study as an outsider in the schools that were involved. Teachers in these schools were only involved in distributing and collecting the surveys. Less than 2% of the parents of the schools were involved. Additional research should be done involving teachers more in the study. If the teachers had been more involved, would probably be a greater percentage of parents participating in the study.

The attitudes of the parents in the wealthy school changed less than the attitudes of the parents of the other three schools. The children in the wealthy school had been using calculators in their mathematics instruction; therefore, they were more accustomed to calculators being used as pedagogical tools. Bitter and Hatfield (1993) found that parents become more positive about calculator use after their children have been in a program that uses calculators in their classroom instruction. Research should be done to determine if parents continue with a positive attitude about calculators after their children have used calculators in their mathematics classes for several years.

One of the parents, who seemed extremely negative about the use of calculators in mathematics instruction, became much less negative after the intervention. Research should be done to study the effects of a parent education program on parents with extremely negative attitudes about calculator usage in mathematics instruction. This parent still was slightly negative after the intervention. Would the parents, who were originally very negative, still be negative after their children have been involved in a calculator-based mathematics curriculum?
The intervention that I used worked well with the one-on-one parent/teacher format. Would it work with a group of parents? What types of parent educational workshops or programs would work well? What would be optimal duration of the workshops or programs? Fractions seemed to work well with these parents. What other concepts should be investigated?

In summary, implications from this study for further research would include the following:

- Research with parents of elementary students to determine if an intervention would change their beliefs about calculators in elementary mathematics instruction.
- Research to determine if the parents approve of calculators in all high school classes or in just the higher-level courses.
- Research to determine ways to get more men to participate in school activities.
- Research to determine if parents continue with a positive attitude about calculators after their children have used calculators in their mathematics classes for several years.
- Research to determine if parents with extremely negative attitudes about calculator usage in mathematics instruction will change with intervention.
- Research on length and types of educational workshops or programs that would be effective in informing a larger group of parents of calculator use in schools.
REFERENCES


Eads, T. G. (1986). An evaluation of the future-oriented mathematics and computer literacy development project for elementary schools (teacher, preservice, microcomputers, manipulations, calculators), Dissertation Abstracts International, A 47(06), 2065. (University Microfilms No. AAT8612841)


APPENDIX A

Consent Forms

January 26, 1999

Dear Parent or Guardian,

I am a graduate student at The Ohio State University. My doctoral dissertation is on “The Attitudes or Beliefs of Parents about the Use of Calculators in Mathematics Instruction.” I will be interviewing parents or guardians of students in middle schools.

As part of my study I am asking you to participate in a small group discussion with other parents and possibly in an individual interview. The interviews will center on what you think about students using calculators in their mathematics classes. After the focus group interviews, I will conduct individual interviews with some of the participants. Your input is important to me and to my study.

My goal is to analyze the materials from the focus group and individual interviews in order to understand your attitudes or beliefs about calculator use in mathematical education. I am also interested in what has led you to the attitudes or beliefs that you hold about the use of calculators in mathematics classes. As part of the dissertation, I may use parts of your interview in your own words to demonstrate various attitudes and beliefs held by parents. I may also wish to use some of the interview material for journal articles or presentations to interested groups or for instruction purposes. At some point I may write a book based on the dissertation.

Each discussion will be audiotaped and later transcribed by me or a typist (who is committed, as I am, to confidentiality). If all members of the group agree, I may also videotape the discussions. In all written materials and oral presentations in which I might use materials from your interview, I will not use your name or your child’s name. Transcripts will be typed with initials for names and in final form the interview material will use pseudonyms.

You may withdraw your consent to have specific excerpts used at any time. If I were to want to use any materials in any way not consistent with what is stated above, I would ask for your additional written consent.

In signing this form you are agreeing to participate in the interviewing process. In addition to signing below, please fill out the attached survey, and return to your child’s teacher by Friday, January 29. Please return the survey and this permission form together. If you choose, you may place the form and survey in a sealed envelope with my name on the outside.

Thank you,

Sharon Sweeney

I, __________________________ have read the above statement and agree to participate as an interviewee under the conditions stated above.

________________________________________________ ___________________________________
Signature of participant        Date

________________________________________________ ___________________________________
Mailing Address         Phone

________________________________________________ ___________________________________
E-mail

Days and times available: ____________________________________________________________
CONSENT FOR PARTICIPATION IN RESEARCH

I consent to participating in research entitled “Parent Attitude and Beliefs about Calculators in Mathematics Education.” Sharon Sweeney or her authorized representative has explained the purpose of the study, the procedures to be followed, and the expected duration of my participation. Possible benefits of the study have been described.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am free to withdraw consent at any time and to discontinue participation in the study without prejudice to me.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Participant signature: ___________________________________________ Date: ______

Witness: _______________________________________________________

Sharon Sweeney
Investigator
APPENDIX B

Survey

For each of the three statements (1, 2, 3) below, choose the letter of the type of calculator below that will fill in the blank that reflects how you feel about calculator use in mathematics classes.

A. No If you think no calculator should be used by these students.
B. Simple If you think these students should use a calculator that does addition, subtraction, multiplication, and division only.
C. Scientific If you think these students should use calculators that uses the correct order of operations and can work with fractions and trig functions.
D. Graphing If you think these students should use programmable calculators that can draw graphs of equations.

1. I think high school students should use ______ calculators in their mathematics class.
2. I think middle school students should use ______ calculators in their mathematics class.
3. I think elementary school students should use ______ calculators in their mathematics class.

For the following statements, please circle the response that most expresses your feelings about the phrase.

SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. My child should be taught mathematics like I was taught.
5. Mathematics is rules that must be learned and applied.
6. Mathematics is computations only.
7. I think all students need to be able to do their mathematics by hand before they use a calculator to do it.
8. There is some mathematics that students can learn better if they first do it using a calculator.
9. I think no students should use calculators in their mathematics class.
10. Students will enjoy mathematics more if they can use calculators in their mathematics class.
11. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.
12. Calculators are effective teaching and learning tools in mathematics classes.

13. Your name and phone number.
14. What is the gender and grade of your children?
15. Does your child use a calculator in his/her mathematics class?
16. Are you male or female? (circle one)
17. What is the highest amount of education you have achieved?
18. What is your occupation?
19. On what day of the week and at what time would you be available to participate in a group discussion?
APPENDIX C

Urban School Survey

For the following statements, please circle the response that most expresses your feelings about the phrase

SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>S</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think high school students should use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I think middle school students should use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I think elementary school students should use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I think all students need to be able to do their mathematics by hand before they use a calculator to do it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. There is some mathematics that students can learn better if they first do it using a calculator.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I think no students should use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Students will enjoy mathematics more if they can use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Calculators are effective teaching and learning tools in mathematics classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please answer the following questions about yourself. All information will be kept confidential.

10. What is the gender and grade of your children? ________________________________.
11. Does your child use a calculator in his/her mathematics class? ____________________.
12. Are you male or female? (circle one)
13. What is the highest amount of education you have achieved? ________________________.
14. What is your occupation? ________________________________.
15. On what day of the week and at what time would you be available? ____________________.
APPENDIX D

Focus Group Questions

1. Tell your name and the age and gender of each of your children.

2. What are some of the areas of education that you feel your child’s school does well?

3. Are there areas in which you feel your child’s school does not do so well?

4. What do you think of the mathematics program in your child’s school?

5. Does your child’s mathematics program include calculators? If so, how are they used?

6. What do you think about the use of calculators in mathematics classes?

7. What do you think are some of the advantages of using calculators in mathematics classes?

8. What are your concerns about the use of calculators and computers in mathematics classes?

9. Under what conditions should calculators be used in mathematics classes?

10. Is there any other comment you would like to make about the use of calculators in mathematics classes?
APPENDIX E

Individual Interview Questions

I will be asking you some questions and I would like for you to respond as completely as you can to each of them. I will be taking notes during your interview, and if you don't mind, I will also be taping it.

Will it be all right to tape this interview?

1. Please state your name and the gender, age, and grade of each of your children.
2. What do you think of the mathematics program in your child’s school?
3. Does your child’s mathematics program include calculators?
   If yes, follow with these questions. If no, go to question 11.
4. When you first heard that calculators would be used in your child’s mathematics class, what were your reactions?
5. Did anything happen as you expected?
6. Did you express these expectations to anyone?
7. Did you observe your child’s work to see if these things happened?
8. Does the school have any program to inform parents how the calculator is being used?
   If yes, ask these questions. If no, go to question 13.
9. Did you attend the program?
10. What were some of your thoughts about the program
    Go to question 13.
11. How would you feel if you heard that your child would be using calculators in his/her mathematics class?
12. What would you expect to happen?
13. What do you think are some of the advantages to using calculators in mathematics classes?
14. (if not already answered) What are your concerns about the use of calculators and computers in mathematics classes?
15. Under what conditions, should calculators be used in mathematics classes?
16. Is there any other comment you would like to make about the use of calculators and computers in mathematics classes?
APPENDIX F

USING A CALCULATOR TO LEARN HOW TO WORK WITH FRACTIONS

MATERIALS

- Ten TI30 calculators (or calculators school uses for child's grade level)—enough for every 3 or 4 parents in attendance—Ask parents to bring their children's calculators
- About 20 or 30 copies of the handout

OBJECTIVES

- Parents will see how a calculator can be used as a teaching and learning tool

PROCEDURE (2 hours)

- Introduce myself and anyone else who is helping
- Introduce the calculator
  - Show order of operations on a scientific calculator vs simple calculator
    \[2 + 3 \times 4 = 14 \text{ on scientific} \quad 20 \text{ on simple}\]
  - Which is right? Why is that right? How do you feel about your child using a calculator that does not give the correct answer?
- Discussion questions
  - Do you remember learning how to work with fractions?
  - Do you remember how to add fractions? Subtract them? Multiply? Divide?
- Explain how to key in fractions on the calculator by showing several examples. Check if the parents have keyed the fractions in correctly.
- Using the calculator, groups of 2, 3, or 4 parents will work on the enclosed handouts
- As parents work through the worksheet, circulate around the room and answer questions
- After each page of the worksheet, discuss the rules the group(s) developed.
- If all rules are not the same, discuss the validity of each rule. Ask if anyone can think of a problem that disproves the any of the rules.
- In the last fifteen minutes discuss how parents feel about this method of learning to work with fractions.
- Ask parents to participate in individual interviews

ASSESSMENT

- Individual interviews
WORKING WITH FRACTIONS

Addition of fractions

Using the calculator and working in your group add the following fractions:

\[
\begin{align*}
\frac{2}{5} + \frac{1}{5} &= \frac{12}{37} + \frac{18}{37} = \frac{5}{43} + \frac{19}{43} = \\
\frac{3}{19} + \frac{8}{19} &= \frac{15}{1107} + \frac{75}{1107} = \frac{3}{7} + \frac{2}{7} =
\end{align*}
\]

What pattern do you notice about your answers? __________________________

What rule would you use to add fractions with the same denominators? ___________

Check your rule to see if it works with these fractions.

\[
\begin{align*}
\frac{27}{37} + \frac{8}{37} &= \frac{2}{9} + \frac{5}{9} = \frac{1}{29} + \frac{2}{29} = \\
\frac{5}{17} + \frac{3}{17} &= \frac{3}{16} + \frac{5}{16} = \frac{5}{12} + \frac{11}{12} =
\end{align*}
\]

Did your rule work for all of these? __________ Did you get the same answer for all of the problems that the calculator gave? ________________________________

If not, what do you think is the reason? ________________________________

If so, why do you think someone might think his/her answer is different than what the calculator found? ________________________________
What rule that considers these last statements do you think could be used for adding fractions?


Subtraction of fractions
Now let's look at subtraction of fractions. What do you think the rule for subtraction of fractions should be?  


Check your rule to see if it works with these fractions.

\[
\begin{aligned}
\frac{2}{5} - \frac{1}{5} &= \frac{18}{37} - \frac{12}{37} &= \frac{15}{43} - \frac{9}{43} \\
\frac{17}{19} - \frac{8}{19} &= \frac{2}{9} - \frac{5}{9} &= \frac{1}{29} - \frac{2}{29} \\
\frac{5}{17} - \frac{3}{17} &= \frac{3}{16} - \frac{5}{16} &= \frac{5}{12} - \frac{11}{12}
\end{aligned}
\]

Did your rule work for all of these?  


Did you get the same answer for all of the problems that the calculator gave?  


If not, what do you think is the reason?  


If so, why do you think someone might think his/her answer is different than what the calculator found?  


More Addition and Subtraction of fractions

Look at these fractions.

\[
\frac{3}{16} + \frac{3}{4} = \frac{5}{8} + \frac{3}{4} = \frac{1}{3} - \frac{2}{9} = \\
\frac{1}{2} + \frac{1}{3} = \frac{2}{9} - \frac{5}{8} = \frac{5}{6} - \frac{3}{5} =
\]

How do these fractions differ from the previous ones? 

What rule would you use to add or subtract these fractions? 

Does your rule work for the following fractions? 

\[
\frac{5}{8} + \frac{7}{12} = \frac{4}{9} - \frac{1}{6} = \frac{8}{15} + \frac{7}{20} = \\
\frac{5}{6} - \frac{3}{4} = \frac{3}{16} + \frac{5}{24} = \frac{7}{12} - \frac{3}{16} =
\]

What rule would you use that would work for adding or subtracting any of the fractions that you have seen so far? 


**Multiplication of fractions**

Using the calculator and working in your group multiply the following fractions:

\[
\begin{align*}
\frac{2}{5} \times \frac{1}{3} & = \frac{2 \times 1}{5 \times 3} \\
\frac{2}{3} \times \frac{1}{7} & = \frac{2 \times 1}{3 \times 7} \\
\frac{3}{4} \times \frac{1}{4} & = \frac{3 \times 1}{4 \times 4} \\
\frac{3}{8} \times \frac{3}{8} & = \frac{3 \times 3}{8 \times 8} \\
\frac{5}{7} \times \frac{5}{10} & = \frac{5 \times 5}{7 \times 10} \\
\frac{3}{7} \times \frac{2}{7} & = \frac{3 \times 2}{7 \times 7}
\end{align*}
\]

What pattern do you notice about your answers? ______________________________________

What rule would you use to multiply these fractions? ______________________________________

Check your rule to see if it works with these fractions.

\[
\begin{align*}
\frac{2}{7} \times \frac{7}{9} & = \frac{2 \times 7}{7 \times 9} \\
\frac{2}{9} \times \frac{3}{4} & = \frac{2 \times 3}{9 \times 4} \\
\frac{1}{2} \times \frac{3}{4} & = \frac{1 \times 3}{2 \times 4} \\
\frac{5}{7} \times \frac{4}{15} & = \frac{5 \times 4}{7 \times 15} \\
\frac{15}{16} \times \frac{6}{25} & = \frac{15 \times 6}{16 \times 25} \\
\frac{5}{12} \times \frac{18}{5} & = \frac{5 \times 18}{12 \times 5}
\end{align*}
\]

Did your rule work for all of these? ______________________________________

If not, what do you think is the reason? ______________________________________

If so, why do you think someone might think his/her answer is different than what the calculator found? ______________________________________

What rule that considers these last statements do you think could be used for multiplying fractions? ______________________________________
Division of fractions

Using the calculator and working in your group divide the following fractions:

\[
\begin{align*}
\frac{1}{3} \div \frac{1}{2} &= \quad \frac{1}{7} \div \frac{1}{5} &= \quad \frac{1}{5} \div \frac{1}{7} &= \\
\frac{2}{5} \div \frac{1}{3} &= \quad \frac{1}{7} \div \frac{2}{3} &= \quad \frac{3}{4} \div \frac{1}{4} &= \\
\frac{3}{8} \div \frac{1}{2} &= \quad \frac{5}{7} \div \frac{5}{14} &= \quad \frac{3}{7} \div \frac{3}{7} &= \\
\frac{3}{4} \div \frac{2}{3} &= \quad \frac{5}{8} \div \frac{3}{1} &= \quad \frac{2}{3} \div \frac{1}{7} &= 
\end{align*}
\]

What pattern do you notice about your answers?  

What rule would you use to divide fractions these fractions?  

Check your rule to see if it works with these fractions.

\[
\begin{align*}
\frac{2}{7} \div \frac{7}{8} &= \quad \frac{2}{9} \div \frac{2}{3} &= \quad \frac{1}{2} \div \frac{3}{2} &= \\
\frac{3}{19} \div \frac{8}{19} &= \quad \frac{15}{16} \div \frac{5}{24} &= \quad \frac{5}{12} \div \frac{3}{10} &= 
\end{align*}
\]

Did your rule work for all of these?  If not write a rule that will work for all of the fractions on this page.
LET ME INTRODUCE MYSELF AND MY STUDY
My name is Sharon Sweeney. I am a graduate student at The Ohio State University in mathematics education working on my Ph.D. I am the parent of three grown children. When my children were young, I thought like many of you that a child would not learn mathematics if he/she used a calculator. As I began using a calculator and working with my children, I realized that they could learn many mathematical facts by using the calculator.

Through my studies I have found that research has shown that the calculator can be a useful teaching tool. As part of my graduate work I would like to show parents how a calculator can be used as a teaching tool in a workshop. After you have participated in the workshop, I would like to know what you think of the teaching technique that I show you.

Please attend a calculator workshop that I will be conducting at your school.

Please Come!

You are Invited to a Calculator Workshop
“Date will be inserted.”

A drawing for A Texas Instrument’s New TI-15 Calculator and other items will be held and given to those attending the workshop. Refreshments will be served.

THE CALCULATOR AS A TEACHING TOOL
Many people think of the calculator as a computational tool and for many that is the only way they use the calculator. But for the classroom the calculator can be a useful teaching tool. Students can use the calculator to discover facts that they should and will learn. If a child keys into his/her calculator 3x5 and always sees 15 when he/she presses the “=” key, he/she will soon learn that 3x5=15. This should be reinforced with the use of manipulatives, such as, three rows of five blocks, so the child understands what multiplication can be used for. Eventually the
Sharon Sweeney  
The Ohio State University  
Graduate Student  
5419 Election House Road  
Carroll OH 43112  
740-756-4606

Why was your school chosen?  
This project will involve four different types of schools as classified by the Ohio Department of Education. Your school was chosen because I live in close to it and because I have had some connection with your school and/or administrators and personnel and your school’s administrators were willing to let me work with you.  
I want to thank you in advance for all of the help you will give me on this project and for any time that it will involve. I am very much interested in what you have to say and in your opinion. I need the information that you have to offer me.

ACTIVITIES THAT YOUR CHILD CAN DO WITH THE CALCULATOR

- To reinforce multiplication facts have your child write all of the ways she can write various numbers as a multiplication problem. E.g. 3 can be written as 1 x 3 and 3 x 1; 4 can be written as 1 x 4, 2 x 2, and 4 x 1. The child can use the calculator to find combination that she doesn’t remember. Ask her if there are more combinations for the numbers as you get larger numbers.

- Wipe Out! Teaches your child place value. Key in a number with or without decimals, depending on the level of your child. The object is to change one of the numbers to a zero by subtracting only one number. For example: Change 378.94 to 378.04 by subtracting 0.9 or to 308.94 by subtracting 70. Or a variation—Have the child change 304 to 374 by adding a number.

- Names for One-Half: Have your child find as many names as possible for one-half. After your child has recorded his/her names for one-half, he/she can categorize the names. Possible categories are names that are equivalent fractions such as 2/4 or 18/36, names that are decimals such as 0.5 or 2 - 1.5, names that use addition such 0.25 + 0.25 or 1/3 + 1/6, and names using multiplication 2 * 1/4 or 5/6 * 3/5.

- Take your child grocery shopping with you. Have him/her use a calculator to keep a running total of the amount that you have in your shopping cart. How accurate is his/her total.

What the Research Says:  
Children use more and different strategies when they use calculators.

- The use of calculators does not impede students basic paper and pencil skills.

- Students become better problem solvers when they have calculators available.

- Calculator use in instruction and testing enhances learning and the performance of arithmetic concepts and skills.

- Students who use calculators in mathematics classes have more positive attitudes toward mathematics.

- Students are more persistent in solving mathematical problems if they have access to calculators.

- Calculators free students to think mathematically when they use calculators to free themselves from tedious paper and pencil calculations.

- Students will not learn mathematics if they refuse to try mathematics.

- Calculators help students see that mathematics has value.
APPENDIX H

Copy of Human Subjects Form

APPLICATION FOR EXEMPTION FROM HUMAN SUBJECTS COMMITTEE REVIEW

All research activities that will involve human beings as research subjects must be reviewed and approved by the appropriate human subjects review committee, or receive exemption status, prior to implementation of the research.

Principal Investigator: Owens Douglas, T. (Must be OSU Faculty)

Academic Title: Professor

Department: Education Teaching and Learning

Department No:

Campus Address: 257

Room Number: Arys

Building: 1945 N. High Stree

Street Address:

Co-Investigator(s):

Sweeney Sharon K

Signature:

PROTOCOL TITLE:

Parents Attitudes and/or Beliefs about Calculator Use in Mathematics Education and How to Positively Affect Them

THE ONLY INVOLVEMENT OF HUMAN SUBJECTS IN THE PROPOSED RESEARCH ACTIVITY WILL BE IN ONE OR MORE OF THE EXEMPTION CATEGORIES LISTED ON THE BACK OF THIS APPLICATION.

CATEGORY: (Check one or more)

#1 #2 X #3 #4 #5 #6

SOURCE OF FUNDING FOR PROPOSED RESEARCH: (Check A or B)

A. OSURF: Sponsor RF Proposal/Project No.

X B. Other (Identify) PERSONAL RESOURCES

RECEIVED JUL 19 2000

OVER FOR APPROVAL
### APPENDIX I

1. High school students should use (no, simple, scientific, graphing) calculators. 1-2-4-5 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>No</th>
<th>Simple</th>
<th>Scientific</th>
<th>Graphing</th>
<th>No Answer</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>12</td>
<td>1</td>
<td>4.3</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>0</td>
<td>4.8</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>5.0</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>18</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>4.3</td>
</tr>
</tbody>
</table>

I think high school students should use calculators in their mathematics class. 5-4-3-2-1 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>44</td>
<td>11</td>
<td>15</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3.4</td>
</tr>
</tbody>
</table>

2. Middle school students should use (no, simple, scientific, graphing) calculators. 1-2-4-5 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>No</th>
<th>Simple</th>
<th>Scientific</th>
<th>Graphing</th>
<th>No Answer</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>3.9</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>2</td>
<td>13</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

I think middle school students should use calculators in their mathematics class. 5-4-3-2-1 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>44</td>
<td>10</td>
<td>15</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>3.4</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Table I.1
Survey Compilation Table

continued
### Table I.1 continued

3. Elementary school students should use (no, simple, scientific, graphing) calculators. 1-2-4-5 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>No</th>
<th>Simple</th>
<th>Scientific</th>
<th>Graphing</th>
<th>No Answer</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>14</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>20</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1.4</td>
</tr>
</tbody>
</table>

I think elementary school students should use calculators in their mathematics class. 5-4-3-2-1 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>44</td>
<td>9</td>
<td>5</td>
<td>11</td>
<td>6</td>
<td>13</td>
<td>2.8</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2.0</td>
</tr>
</tbody>
</table>

4. My child should be taught mathematics like I was taught. 1-2-3-4-5 (FG stands for those who participated in focus group.)

(This question was not on the survey for the urban parents.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>3</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>2.9</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>3.3</td>
</tr>
</tbody>
</table>

5. To learn mathematics, you only need to learn rules and how to apply them. 1-2-3-4-5 (FG stands for those who participated in focus group.)

(This question was not on the survey for the urban parents.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>5</td>
<td>3.6</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>4.4</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3.7</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3.7</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td>11</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table I.1
Survey Compilation Table

---

234
Table I.1 continued

6. Mathematics is computations only. 1-2-3-4-5
   (FG stands for those who participated in focus group.)
   (This question was not on the survey for the urban parents.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>12</td>
<td>7</td>
<td>4.1</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>4.6</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>4.6</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>15</td>
<td>3</td>
<td>3.7</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

7. I think all students need to be able to do their mathematics by hand before they use a calculator to do it. 1-2-3-4-5
   (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>18</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>27</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
</tbody>
</table>

8. There is some mathematics that students can learn better if they first do it using a calculator. 5-4-3-2-1 (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>2.3</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>2.8</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3.6</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>1</td>
<td>9</td>
<td>12</td>
<td>6</td>
<td>4</td>
<td>2.9</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>6</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table I.1
Survey Compilation Table

continued
Table I.1 continued

9. I think no students should use calculators in their mathematics class. 1-2-3-4-5
   (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>3.7</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>4.7</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>4.9</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>16</td>
<td>4.2</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>21</td>
<td>14</td>
<td>4.0</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

10. Students will enjoy mathematics more if they can use calculators in their mathematics class. 5-4-3-2-1
    (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3.7</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3.8</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3.7</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>2</td>
<td>13</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>5</td>
<td>24</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>3.6</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

11. Students will not learn mathematics well if they are allowed to use calculators in their mathematics class. 1-2-3-4-5
    (FG stands for those who participated in focus group.)

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>3.0</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>4.1</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>4</td>
<td>3.2</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>17</td>
<td>4</td>
<td>3.2</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table I.1
Survey Compilation Table
Table I.1 continued

<table>
<thead>
<tr>
<th>School</th>
<th>Total</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>22</td>
<td>5</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3.6</td>
</tr>
<tr>
<td>FG Rural</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4.1</td>
</tr>
<tr>
<td>Wealthy</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.5</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.7</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>32</td>
<td>7</td>
<td>16</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>3.9</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>10</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3.9</td>
</tr>
<tr>
<td>Urban</td>
<td>44</td>
<td>7</td>
<td>17</td>
<td>11</td>
<td>7</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>FG Urban</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Average Overall Mean

<table>
<thead>
<tr>
<th>School</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>2.8</td>
</tr>
<tr>
<td>FG Rural</td>
<td>3.5</td>
</tr>
<tr>
<td>Rural Poor</td>
<td>3.1</td>
</tr>
<tr>
<td>FG Rural Poor</td>
<td>3.1</td>
</tr>
<tr>
<td>Wealthy</td>
<td>3.6</td>
</tr>
<tr>
<td>FG Wealthy</td>
<td>3.9</td>
</tr>
<tr>
<td>Urban</td>
<td>3.2</td>
</tr>
<tr>
<td>FG Urban</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table I.1

Survey Compilation Table
APPENDIX J

Additional Quotes

Research Question Two: What are parents’ beliefs about the use of calculators in mathematics instruction? Why do parents hold their beliefs or attitudes toward calculator use in mathematics classes?

Negative beliefs

Won't learn basics. Lu said, “I think they are good tools after the basics are learned. They need to understand the problem they are trying to solve, and then use the calculator as a tool.”

Deb said, “Yes, that's where I am. . . . I want them to use their brain first.” Lu continued, “They know enough about basics to understand what has to be done . . . or to write a program to make it do the work for them. Like reports to understand what has to be done like taking this money from here and put it in another place and this is what is left over.” Deb said, “You need to know how to do the math. You need to be able to show me that you know how to do the math and do the problem . . . . My thoughts are basically the same as theirs. I would like to see children learn the basic formulas to math problems and be able to work out before using calculator.”

Greg said, “Once that's ingrained in their minds, then I don't have a problem using calculators in elementary schools to do the basic functions. In the prealgebra, I disagree with Bruce a little. . . . In precalculus I think a graphing calculator is good thing to have. Again, most of learning should be done by hand. Once the concepts are learned, then using the calculator to find certain points on curve, I don't have a problem with that.”

Pat said, “I think that if there was some way to see if the individual child could be tested to make sure he knows the basics. I think there are lots of children who are getting through the system who don't know those and are doing their homework on the calculator and their class work on the calculators, and it’s just not sinking in.” Her husband Hank agreed, “I think that later, in high school particularly, to use for higher functions of math where arithmetic isn't the problem, but they're solving the equations and learning how to set up the problem.”

Lee said, “I think there is probably a place for the calculator, but I think they need to have their basics down first. They need to be able to add, subtract, multiply, and divide first and then use calculator as a supplement for more difficult problems.” Pat said, “As
long as they have the basics down when they get there, I don't see a problem with it in high school. I still think the kids need to do the basics first. . . . They need to know the basics and not use the calculator as just a toy. . . . I think they still have to have basics down. The foundation needs to be laid before you can strengthen that. . . . At this age, 6th, 7th, and 8th grades, we still need to make sure they have the basics of understanding math concepts.”

Hank said, “Some kind of tool needs to be developed to determine when a student is proficient enough in basic mathematics that they can use a calculator to speed up their work. At times they can use a calculator as a tool to accomplish some work, but using a calculator to speed up their work is a valid use, if they determine that they are already proficient and not using it to replace the ability to calculate. . . . At some level we need to make sure they know the basics. What level of testing we do for that I'm not sure, because to just let them cram for a test that is stated in advance, I can remember anything overnight”

Tora said, “Sometime you will be in a store and the computer will shut down and they can't even give you your change back because the computer doesn't tell them. As long as you know your basics the calculator will catapult you.”

Sherry said, “In the classroom, I agree with everyone else, the kids should know how to do basics. It's not to replace the basics. I can't see that a calculator would hurt [my son] now that he knows the basics. After the basics when it goes into repetition.” Pam said, “I don't think they need a calculator for any of the basics.” Brad said, “If you're in an advanced class, hopefully you will know basics. Advanced classes teach the next step.”

Sara said, “The more advanced [the students] get, the greater the number of problems they have done becomes and they know the facts.” David said, “As long as they know how to do the problems, by the time they get in 8th grade, especially if they are in honors classes, they are going to know how to multiply and add.” Melanie said, “I agree with David that as long as they know the arithmetic, it's all right. My son didn't use a calculator in elementary school.” David said, “Once you've gotten that out of the way, then I think it is a great thing to use. You don't need a calculator to learn basic math.”

Sue said, “No matter what their level is, they have that foundation where they know their math facts. Once they know that then they build on what they can and what their abilities are. Which gets to the calculator.” Lucy said, “In grade school there are so many basics to be learned, so that it is second nature for them. I don't believe that they should use calculators. It's basic fundamental abilities that they have to learn.” Lucy said, “My fourth grade son has to have a lot of problems. He has to get those tables down—the multiplication tables and things like that.” Sue said, “If you don't have that foundation you can't go up in math.” Ellen said, “I think they should be able to tell me what 4 x 6 is and even 4 x 6 + 2.” Ellen said, “In the seventh and eighth grades they already know their fundamentals, but what I find is that if they punch into the calculator and find that 17 times 12 is 52, they go with that answer and they put it down.” Sue said, “They have to know the fundamentals in order to break down and understand the story problem.”

Carol said, “It's possible with the calculators now. They take you through it. The scientific calculators show you everything. I don't think they are getting it. It doesn't show you why divide. You have to multiply this one by x and divide that one by y.” Paula
said, “I have gone into a store when the register doesn't work. They cannot do simple math on paper.” Gina said, “I like when you give them $5.25 and they have already put $5 in there, they have no clue how to give change back. Kids can't make change.” Peggy agreed, “Right. They have no clue. . . . My daughter who is going into the 8th grade uses calculators most of the year this year. She always wanted to take my calculator to class. I told her to use the ones in class. She told me that there wasn't always enough to go around. Obviously the teacher allows them to use a calculator. I don't mind it with my daughter because she does know her facts. She doesn't need to write everything out on paper.” Gina said, “I think [my son] needed the basics first.” Paula said, “By the time they are in the 11th or 12th grade they better have the basics down, then [the calculator] helps you with what you are doing. But not in the younger grades when they still need to get the basics down.” Peggy said, “The basics are supposed to be taught in 1st, 2nd, and 3rd grades.”

Joyce said, “They can check their homework with a calculator but they should not be taught with them. . . . I still think they need to be able to do it with pencil and paper, too. They need to realize that they have a brain and to try to understand what adding and subtracting means. A calculator will take that completely away from you. . . . I feel a child can use a calculator to sharpen their skills on the facts but not to learn them, but it doesn't show the why. . . . They need to be sure the kids and do their adding and subtracting first to make sure kids do understand their basics. . . . Even when adding big numbers, they need to be able to do it on paper before they can use the calculator. . . .

Even when adding big numbers, they need to be able to do it on paper before they can use the calculator. We are being forced into it. In some college courses, if you don't use a calculator you are going to be sitting there for six hours doing it compared to someone who has a calculator and has it done in an hour. I don't mind that as long as they understand the basic techniques and why the calculator is giving you that answer. . . . The biggest thing is understanding why a calculator works. I don't have a problem with them using it after that. I think they need to review their facts every so often. When they get out of school and they are adults they can do what they want. No one will stop them from using a calculator then. I think calculators should be in the schools, but the students should not be depending on them. Maybe not give the students calculators until the fifth grade or whatever grade they quit teaching the basics.” Jackie said, “When they get out on their own they won't have a calculator to figure their math. . . . I think calculators can take away from learning.” Brenda said, “My concern is that [calculators] can be abused. . . . They can be a crutch. . . . Some of these instruments, I see, though, as being used as crutches.”
Cheryl, a very positive parent said, “I think there is probably abuse of the calculators and kids are taking it easy right now and they are not learning it.” She was concerned that, “They need to know basics and not use [calculators] as crutches.”

Brad, said, “I think they depend too much on it. I don't think they should depend on the calculator.” Pam simply said, “It's a crutch.” Jonda was concerned that, “Kids will cheat with it. We won't notice it, because they're getting good grades and teachers won't notice it either.” Brad agreed with Jonda saying, “I think the same thing. They shouldn't have to totally depend on a calculator.”

Melanie said, “I don't have a problem with it as long as they are taught the method of operation—how to do it manually and they are not totally dependent on the calculator.”

Ellen said, “I think we rely too much on the calculator. . . . I just think they use them too much.” Kate was also concerned, “They will get dependant on the calculator.”

Joyce said, “It makes them rely on a tool. They need to realize that they have a brain and to try to understand what adding and subtracting means. A calculator will take that completely away from you.”

Jackie said, “My friend’s son depends on that calculator. He won't go anywhere without that calculator.” About her own child Jackie said, “I feel my 11 year old depended on the calculator until I took it from him. He is lazy with math when it comes to doing math using the calculator. My kids will not learn it on the calculator. My kids would be lazy and just depend on the calculator. I have noticed they do better when I don't allow them to use a calculator. . . . I just don't like anything being taught with a calculator. It is just like they are not teaching them. The calculator is just making them lazy. I don't think they should learn how to do everything using a calculator.”

**Benefit by hand.** Ann said, “When you have to do it by hand, you have to write out each individual step. When you go to the calculator it shortens that.” Deb added, “You need to know how to do the math. You need to be able to show me that you know how to do the math and do the problem. Later if you want to use a calculator, just to speed up the process, but you already know how to do the math then, that's fine.” When asked their concerns, Ann said, “That they will not learn the proper way to do the problem to start with and they will depend on the calculator without using their own brain. If you learn the facts and learn how to do it properly to start with, you can actually do it faster without a calculator.”

Bruce said, “I think Greg kind of mentioned it when he said, as long as they understand in elementary school, once they understand the multiplication tables and those things, that he didn’t mind them using calculator to do problems.” Greg said, “I think that it may be beneficial to expose them how to do things by hand. Should they have to do it on a test? Well, maybe not. But it doesn’t hurt to show them how. It might, for some students give them a little bit of insight that might, somewhere along the line, make something else click.” He later added, “You do 20 problems and it’s long and it’s tedious and boring, but the benefit is definitely there. If they are only taught how to add using a calculator then that person is going to miss something useful.”

Pat said, “I think there are lots of children who are getting through the system who don't know [the basics] and are doing their homework on the calculator and their class work on the calculators, and it’s just not sinking in.”
Teresa said, “Like I said before, if they're being audited they can see they know what the process is.” Tora, “I really don't agree with it at the elementary level, because that is just the basic facts, which everybody needs to know.”

Jonda said, “Kids will cheat with it and not learn the basics. We won't notice it, because they're getting good grades and teachers won't notice it either.”

Melanie said, “That was my concern as well, that they didn't really learn the times tables first or really understand how to add or subtract.” Ellen in a different interview said, “They have [the students] show [that 7³ is 7*7*7] and maybe some of [the teachers] will have them figure it out the first time, but then they show them how to do it on a calculator. Then that is it and after that all of the others are done on a calculator.”

Jackie said, “My oldest is using a graphing calculator and I can see the value of seeing the graphs on the calculator, but not for negative numbers or adding and subtracting. . . . My 10 year old was using a calculator in class until I told the teacher he wasn't using it, because it is just confusing him. You can divide and get an answer. They don't need a calculator to divide. In my opinion calculators shouldn't be in the schools. It is just confusing them. In the long run, it's not helping them. I went to college and I have trouble with a calculator, but I can figure it out on paper.” Joyce said, “A calculator will not figure out word problems for them. They really need to be able to do it on paper before they should use a calculator.” Jackie also said, “[My friend’s son who is mentally handicapped] learns more when I sit down with him and give him addition and subtraction problems. I give him simple second and third grade work. He is better on paper than he is on a calculator. He can only do so much. He will focus more on pencil a paper than he will using a calculator.” Joyce then added, “I think the calculator ruins their mind. With a calculator they don't understand why two plus two equals four. With a calculator, it is just numbers and it just shows you what the answer is. In their mind they can understand that there are two items here and two items there and that makes four.” Jackie emphasized, “My kids will not learn it on the calculator. My kids would be lazy and just depend on the calculator. I have noticed they do better when I don't allow them to use a calculator. My daughter that is using a graphing calculator has now put the calculator aside and is doing it with pencil and paper. I don't think they should learn how to do everything using a calculator. There are some teachers that will push the calculator. I finally found a couple of teachers that agree with me that a calculator may be handy to check homework but not to do it.”

Brenda said, “They can use a calculator to solve a word problem as long as they know how it goes together.”

Positive Beliefs

**Quicker/More efficient.** Greg said, “Again, you take drudgery out of mathematics and it’s a little more exciting for the students, it frees up time. I think calculators are very beneficial in trigonometry rather than looking up sine or tangent of an angle and trying to use that number to do a calculation is easier with a calculator. I don’t see any benefit to trying to do that with slide rule or a table of any sort.”

Bruce said, “applications in this textbook. It does require them to use calculators—distances from here to the moon and that kind of thing. If you had to do it by
hand you can do it, but using calculator is much more efficient. So I think they are doing more of that.”

Cheryl said, “It speeds up the process.”

Hank said, “I do agree that it speeds things up especially if they’ve got the math down pat, using it as a tool to get though more problems to get the concepts. . . . At times they can use a calculator as a tool to accomplish some work, but using a calculator to speed up their work is a valid use, if they determine that they are already proficient and not using it to replace the ability to calculate. . . . They are going to be a tool that is going to be used by someone throughout life, but in the classroom—that's going back to where we've been, if they already know the math and it's just speeding things up, go for it, but I don't think using it in the classroom is going to change anything other than their basic math skills.”

When asked, “What do you think are some of the advantages of using calculators in mathematics classes?” Tora replied, “Time. I think mostly just time.”

Sherry said, “Technology is to make things better and to make it easier. . . . I think it would help move on and lessen [my son’s] homework time.”

David said, “I think that as long as the kids know how to do the arithmetic there is no reason not to use the calculator just to make things easier.”

Sara said, “The more advanced they get the greater the number of problems they have done becomes and they know the facts. They are just using the calculator to make it quicker.”

Lucy said, “In the middle school they should know the basics, so some of what they do need to learn the concepts and use of the calculator can save time on the long arithmetic.”

Sue, who participated only in the group interview, said, “I want them to be able to use a calculator, but I also want them to be able to go into a grocery store and estimate what they have.”

Joyce said, “Some jobs you get into expect speed. . . . I think it is just modern technology. We are being forced into it. In some college courses, if you don't use a calculator you are going to be sitting there for six hours doing it compared to someone who has a calculator and has it done in an hour. I don't mind that as long as they understand the basic techniques and why the calculator is giving you that answer.”

Brenda said, “It's quicker.”

Carol said, “It's what they are going to be using out in world. They aren't going to write it all out on paper. My son is going into engineering. I know they won't wait for him to take time to figure it out on paper. He would have ten pages of stuff writing it down.”

Joy, who only participated in the individual interview, replied to the question about “What the benefits of the calculator in mathematics instruction?” “When they are working with really large numbers. . . . I use one to do my checkbook, because I may make a mistake if I don't. It teaches them accuracy by using it to check their work.”

**Use calculator in real life.** When someone mentioned that a person wouldn’t have a calculator for an exam for an entry-level job, Lu responded, “A lot of those are stuff that your middle school child could do. A lot of them are multiple-choice. So if they know the basics they can pretty much look at them to get the answer by estimating. They
are teaching the kids to estimate now. If they give you a choice of answers that vary a lot, a child can pretty much tell what the answer is by estimating. . . . If you are working with numbers and just change the words you can have more real world examples like gas mileage problems. You can find more practical uses there to help. . . . When you have a calculator in your hands the problems are worked a little different. It's more like programming.”

Ann said, “They can teach you to use a calculator, because an adding machine is used in a lot of businesses. Even when you get into architectural design, physics, and stuff like that are a little more complicated so a calculator would help.”

When asked, “What do you think are some of the advantages of using calculators in mathematics classes,” Deb answered, “I think technology. It is a part of technology. I think at some point the teachers should teach the children how to use a calculator. Like Ann was saying on different jobs and Lu was saying you might have to use a calculator.”

Bruce said, “The big thing now, I’ve noticed, is modeling of real life applications. You give real life data, data on internet. With real life data you find this data. You try to have them come up with the equation of the line, which isn’t this nice neat y = 2x + 7, but these real live, ugly-looking numbers. The calculator really helps you do that. It kind of brings to life what y = 2x + 5 really means. That’s my thoughts to what the advantages are.”

Val said, “That's the one thing they were teaching them—how to utilize these calculators, because they are going to need to know that which I think is a good thing. . . . I'm hoping that when 5th and 6th graders—even 4th graders, I think, could have calculators, too—as long as the teacher is using them, and helping them get familiar with it.”

Hank said, “In the junior high level to teach them how to use a calculator, I'm all for it. . . . It certainly can make a person not skilled more functional. That would be a crutch, but a crutch is for people with injured limbs that can't function.”

Cheryl said, “They definitely need to know how to use a calculator when they get out into the world. . . . They need to learn how to use them whether it's to make it fun or enable them to do more. . . . So if they are working in an auto parts store, maybe they can't rattle off their times tables, but if they can use calculator. They can at least function in life.”

Pam said, “I think the kids need to get out of high school with life skills. If they go to a sale what's 20 per cent or if you get a job waitressing you need to add up a long list of numbers or a checkbook to subtract—the basic things. They're doing more tedious things that you may not use again unless they become a mathematician. They're using their gray matter. As long as they can function as an adult, they should do be able to do those things without a calculator.”

Carol said, “I think technology-wise, our school does well as far as getting them access to computers. I am pleased about that. It makes me sick when they come home and they can do it all. They can set it up and punch it in. All I can do is –on—off.”

Joyce said, “I used to think I was slow in math but when I look at other adults I can at least add and subtract in my head. . . . It may be good for preparation for the real world. The biggest thing is understanding why a calculator works. I don't have a problem with them using it after that. I think they need to review their facts every so often. . . . I
think calculators should be in the schools, but the students should not be depending on them. Maybe not give the students calculators until the fifth grade or whatever grade they quit teaching the basics.”

Dala said, “When you get out of school, most people use calculators. If you are going to be an accountant or something, I’m sure they all use calculators.”

**Helps students with learning problems.** Val said, “Children who have certain learning differences think they're fun. They think having a calculator is a fun kind of tool for them to get excited about. I don't know if children with learning differences that that might be an advantage to using a calculator even in the younger grades—fourth, fifth, and sixth. . . . Children who have real severe learning problems might really be excited about using the calculator. That might help their learning rather than hinder it. The calculator may help them master multiplication, division, and so that the calculator may help them do that.”

Cheryl said, “If a parent isn't going to take the time to help them or if they are not capable to learn them, as they get into life, maybe being able to do a huge math problem is not something they will have to do, but there's always going to be a calculator around.”

David said, “If you are talking about kids who aren't going to learn it otherwise, that's a different situation.”

Sara said, “I am talking about the kid, where the time for learning that is maybe several years past. They need to get it. They need to be using it and practicing it.”

Carol said, “If this is just a memorization problem, it may be okay.”

**Checking.** When asked, “Under what conditions should calculators be used in mathematics classes,” Lu responded, “I think they need to look at how someone else solved the problem and what steps they used, I think that's what teachers should grade on even at this young age. I have taken some college mathematics classes and you get some credit for the way you worked the problem. If some time in the calculation you made some little mistake you get some credit for it even if your answer may be off a little bit. It's the process.”

Ann added, “I'm like her. I think it's more for rechecking. They have the correct answer with them and they can practice, they will learn simple facts a little bit faster if they are constantly having to type in multiplication problems that they are not used to they will learn those facts.”

Val said, “I say, ‘Let's get your calculator to see if you have that problem correct.’”

Jonda said, “So [my son] did it all by longhand and I turned on the computer and brought up the calculator. I told him to use this to check it with. He said that it was okay. He had no idea if he did it right. . . . Maybe the calculator should be used to check those tedious operations. If you write down the wrong number, it's going to be wrong. You may have gotten the whole formula right, but you get it wrong if you write down the wrong number. . . . In regular multiplication, division, addition, and subtraction, a calculator will make it quicker and easier to check.”

Carol said, “If they know the process and know the theory behind it, then I don't have a problem with them using the calculator.”

Brenda said, “I don't mind them as long as they know what they are doing before they start using them.”