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Calculators: Should They Be Used in the Math Classroom?

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Honors Thesis

Abstract

The National Council of Teachers of Mathematics (NCTM) stresses the importance of utilizing technology in the classroom to help students learn mathematical concepts and values. However, have teachers at both the elementary and secondary levels adopted the NCTM's recommendations? Several aspects of this issue were examined in the research project, including a full explanation of the NCTM's beliefs, various opinions held about the use of calculators in education, the degree to which teachers have included calculators in their classrooms, and mathematical concepts teachers have experienced success in teaching with calculators.

The research involved examining articles and books written about calculators in mathematics education, in addition to analyzing previous studies done on this topic. Lastly, the author formulated and distributed a survey to 148 high school mathematics teachers in order to investigate the acceptance of calculators by the teachers and their schools.

Through the research, it was discovered that elementary teachers seem to use calculators less in their classrooms than secondary teachers. It was also found that the availability of calculators in the schools does not quite meet the suggestions of the NCTM. Another result is that while the use of calculators is disregarded by many people, the advantages of their use are felt by many others. Only time will tell if calculators will be accepted into the mathematics classroom to the degree the NCTM favors.

As technology has advanced over the years, our society has gone through a transformation from an industrial culture to more of an informational one. While it is uncommon to hear of a business that does not utilize computers in their daily business affairs, it is also becoming rare to be informed of a school, whether it be elementary or secondary, that is not incorporating technology into its mathematics curriculum. Many people may disagree with the use of calculators by students, but it is becoming an increasingly popular belief that such technology is not only an asset in the math classroom, but also a fundamental need.

One group of people who are strong proponents of the use of calculators in the classroom is the National Council of Teachers of Mathematics (NCTM). The position held by this organization will be examined in detail. According to the NCTM, "The educational system of the industrial age does not meet the economic needs of today" (1989, p. 3). In 1986, the Board of Directors of the NCTM established a commission, entitled the Commission on Standards for School Mathematics, in an effort to improve the quality of the teaching and learning of mathematics (p. v). The Commission formulated curriculum and evaluation standards to help attain four specific social goals, which the Commission feels are necessary to aid in producing educated and competent citizens. These include developing (1) mathematically literate workers, (2) lifelong learning, (3) opportunity for all, and (4) an informed electorate (p. 3). After all, as the members of the NCTM believe, as society changes, so, too, must its schools (p. 5).

In March of 1989, the lists of curriculum and evaluation standards were published. The Standards were divided into four sections; one section contained the curriculum standards for grades kindergarten through fourth grade, another included the curriculum standards for fifth grade through

eighth grade, while yet another described curriculum standards for grades nine through twelve (i.e. the high school years). The fourth sectio~ introduces standards for evaluating students' progress.

Three characteristics of mathematics are included in the NCTM Standards. First of all is the belief that "'knowing' mathematics is 'doing' mathematics" (NCTM, 1989, p. 7). Secondly is the idea that some aspects of doing mathematics have changed in the last decade. For example, the ability of a computer to process large amounts of information has aided areas such as business, economics, linguistics, biology, and medicine in the quantification and logical analysis of information. While such advances have occurred, it is the notion of the Commission that "fundamental mathematical ideas needed in these areas are not necessarily those studied in the traditional algebra-geometry-precalculus-calculus sequence" (p. 7). Finally, changes and growth in the discipline of mathematics itself have resulted from changes in technology and the broadening of the areas in which mathematics is utilized (p.7).

The Commission believes that the development of science and technology makes new demands on mathematics for assistance, thus, creating new mathematical questions. As the Commission states, "The new technology not only has made calculations and graphing easier, it has changed the very nature of the problems important to mathematics and the methods mathematicians use to investigate them" (1989, p. 8).

As a direct result of the changes technology has bestowed upon the area of mathematics, the NCTM has illustrated its concern for technology by incorporating its use into the devised standards. While the lists of standards for the specific grade levels vary so as to relate to the abilities and thought processes of the different grade levels, all of the levels contain the utilization

of technology, such as calculators and computers, in the descriptions of their lists of standards for the teaching and learning of mathematics.

For instance, one of the basic assumptions that helped govern the selection and formulation of the kindergarten through fourth grade curriculum standards is stated as "The K-4 curriculum should make appropriate and ongoing use of calculators and computers." The Commission feels that it is essential to accept calculators as "valuable tools for learning mathematics" (1989, p. 19). The members provide reasons as to why they feel this should be done. The notion is held that calculators allow children to develop concepts, explore number ideas and patterns, focus on problem-solving processes, and analyze realistic applications. In addition, proper use of calculators can increase the quality of the curriculum as well as the quality of children's learning (p. 19). The idea that calculators also highlight the importance of teaching children to recognize reasonable computed results is yet another concept the Commission cites to support their approval of calculators in the primary grades' mathematics curriculum. According to the Commission's statement in the Standards, calculators do not replace the need to learn basic facts, to do reasonable paper-and-pencil computation, or to compute mentally. Instead, it is written that "classroom experience indicates that young children take a commonsense view about calculators and recognize the importance of not relying on them when it is more appropriate to compute in other ways" (p. 19). The Commission members think a broader view of the various ways of computation must be developed by primary teachers, in addition to less emphasis being placed on complex paper-and-pencil computation (1989, p.19).

The use of calculators is incorporated into the NCTM's suggestions for fifth through eighth grade curriculum improvement when the Commission

criticizes that the curriculum existing in some schools inhibits many students from studying a broader curriculum until they have "mastered" basic computational skills. One reason that is stated as to why it is important that schools shift their focus to a broader curriculum is that "basic skills today and in the future mean far more than computational proficiency" (NCTM, 1989, p. 66). The skills and understanding required to make skillful use of technology thus become more important as paper-and-pencil computation becomes less essential. Not only is it believed that technology will free students from tedious computations, but technological devices will also allow students to concentrate on problem solving and other important content areas, such as geometry, algebra, probability, and statistics (p. 66-67).

How the NCTM Commission views the role of calculators in the high school mathematics curriculum is as a source of transformation for the mathematics classroom into a laboratory similar to the environment in many science classes, in which students use technology to investigate, speculate, and verify their findings (NCTM, 1989, p. 128). As a result of such an experimental environment, the educator's role would be altered to a certain extent. The teacher, for example, would encourage experimentation and provide "opportunities for students to summarize ideas and establish connections with previously studied topics" (p. 128). An emergence of a new classroom dynamic would also result as a consequence of changes in instruction in a technology-rich classroom environment in which teachers and students would "become natural partners in developing mathematical ideas and solving mathematical problems" (p. 128).

The Commission on Standards of School Mathematics did not only intend to facilitate changes in the daily instruction of mathematical concepts in the classroom. Changes in the curriculum and instruction ultimately

bring about alterations in the evaluation of the students because as the Commission states, "Assessment of student learning should be viewed as an integral part of instruction and should be aligned with key aspects of instruction, such as the use of technology" (1989, p. 128). It is the opinion of the Commission that it is necessary for assessment to reflect the important aspects of instruction. When such materials as calculators are used during instruction, it is believed that they should also be available during assessment, as long as their use is consistent with the assessment's purpose (p.195).

The position described in the evaluation standards does not imply that teachers should only alter their previous assessment procedures by allowing students to use calculators on tests and quizzes. There is more to the incorporation of calculators in student evaluation. According to the Commission, "Test items must be appropriate for use with these materials" (1989, p. 195). For instance, a test that expects students to write their answers as decimal approximations may be an assessment tool on which students are allowed to use calculators rather than a multiple-choice algebra test on which students are expected to express their answers in radical form, such as (1+.J5) (p.195).

Being informed that the NCTM advises the use of calculators in the mathematics classroom does not fully describe exactly to what extent calculators are intended to be used. For example, schools may be unsure of the amount of calculators that should be available to the students. The Commission explains its intentions on the availability of calculators by stating that schools should make appropriate calculators available to all students at all times (1989, P: 8). It is important to note that the Commission does not feel that such availability of technology to students will guarantee

that any student will become mathematically literate. Instead, the notion is held that "calculators and computers for users of mathematics, like word processors for writers, are tools that simplify, but do not accomplish, the work at hand" (p. 8).

The Commission gives some general comments about the content of their suggested mathematics curriculum involving calculators. The members believe that the availability of calculators does not eliminate the need for students to learn algorithms. While some proficiency with paper-and-pencil computational algorithms is important, it is thought that such knowledge should stem from the problem situations that have caused the need for such algorithms. Furthermore, the Commission contends that one should be aware of the possible methods available when an answer to a problem needs to be calculated. For instance, when an approximate answer is adequate, estimation can be used. If a precise answer is necessary, on the other hand, then an appropriate procedure must be selected. The NCTM encourages the use of estimation in calculations of precise results to help students in their ability to judge the reasonableness of their answers. Calculators can easily assist students with either one of these methods. Other suggestions on the part of the Commission include solving some problems through mental calculation, while using standard paper-and-pencil algorithms for computations that are not too complex. However, for more complex calculations, the calculator should be used. Examples of such calculations would be included in lessons on long division and column addition. Finally, the Commission recommends the utilization of computers in the case that many iterative calculations are required (1989, p. 8).

Just because the NCTM has developed a commission to formulate a collection of standards for teachers to follow and incorporate into their

mathematics classrooms does not mean that the educators will actually accept the standards or that they will fully apply them to the education of their students. Teachers' personal feelings on the inclusion of calculators in the mathematics curriculum is a major determiner of their acceptance of the suggestions in the Standards. The views of teachers and the public in general represents important areas to focus some attention on.

The opinions of people who oppose calculators in the math curriculum will be looked at first. The fact that many people do not favor the use of calculators by students is explained in a NCTM publication, Calculators in Mathematics Education. It is written that negative attitudes about calculators "seemed to evolve from concerns that the handheld computing machine would displace students' skills with mental arithmetic and paper-and-pencil algorithms" (Hembree & Dessart, 1992, p. 23). While such a concern seems reasonable, it is important to note that such skills as using paper-and-pencil algorithms can still be taught in a classroom environment in which calculators are allowed. A piece of advice that teachers can be given is to never teach a skill on a calculator until the students have been taught the skill and have been given the opportunity to adequately practice it by hand. A problem arises when skills are inappropriately practiced by hand to a degree where students are required to do timely, unnecessary rigorous computations. For example, consider the skill of dividing large numbers, of say, four or five digits, into each other. While it is important that students understand the process of long division, it is possible for students to master the technique and then be allowed to use calculators in solving problems. After all, is it not the case that students will use calculators for such computations as adults?

Thompson (1992) provides another reason as to why calculators are not approved of in the mathematics classroom. She believes that paren~s want the best for their children, including in their mathematics education. Because of the fact that parents remember arithmetic as the focus of elementary school mathematics, they seem to "want their children to acquire the computational skills that they see as necessary for everyday life and future work" (p. 42). In fact, she states that parents expect their children to learn mathematics in the same manner they did (p. 42). The fact is, however, that the innovations in communications and computer technology were not as substantial during these parents' school years, and citizens did not need the advanced technological skills in order to be competent and successful in an informational world as is presently the case.

Two educators, Schielack and Dockweiler (1992), from Texas A&M University provide another concern of opponents of student calculator use. They cite a previously published article in which the author, M.S. Bell, identified cost as a concern in 1979 of the incorporation of calculators in the classroom. It is interesting to note that this concern has virtually disappeared. They indicate, "[R]elatively inexpensive, durable calculators are being produced" (p. 392).

Schielack and Dockweiler include an instructional concern in their article as to why teachers are reluctant to make use of calculators with their students. They indicate that primary teachers express a discomfort with fitting calculators into the mathematics curriculum they teach. Some questions these teachers ask are "Is it developmentally appropriate? How will I find time to squeeze something else into a crowded curriculum? How does the use of the calculator relate to the emphasis on teaching with

manipulatives? ..And, of course, will it prevent students from learning the basic facts?" (1992, p. 392)

Kaiser (1991), a sixth grade teacher at Joslyn Elementary School in Omaha, Nebraska, gives an explanation as to why teachers are not promoting calculator use in the mathematics curriculum. She believes that many teachers hesitate to begin using calculators in their classrooms for a couple of reasons. First of all, no policy has been adopted by their district, and secondly, opinions vary about the appropriateness of calculator use (p. 6). Kaiser, however, does not agree with the position that calculators should not be utilized by students. She feels that "it is inconsistent for us to use calculators daily in our adult lives for personal and business purposes and yet deny students the opportunity to explore the power of...technology" (p. 6).

As with any controversial issue, there are two opposing sides. While those who resist the incorporation of calculators into the mathematics curriculum feel strongly about their concerns, people who favor the use of calculators feel equally adamant about their position. According to Kaiser, "My experience with calculators in my classroom during the past three years has convinced me not only that such progress is important but that classroom teachers can and must take a leadership role in this area" (1991, p. 6). In his article, Mercer (1992), a teacher at Glenbrook North High School in Northbrook, Illinois, promotes the use of calculators in the mathematics classroom. Under a section entitled "What do we lose by letting students use symbolic calculators?", he promotes the use of calculators by students as he writes, "Once we realize what is truly important in mathematics we will be less inclined to stick to our past prejudices about the necessity of training our students to do mechanical tasks. It doesn't really make a whole lot of sense unless, of course, we have nothing more important to teach. And even if

such skills are necessary ...they can be much more effectively taught after the more important analytical skills have been developed and the students have gained an appreciation of what mathematics is really all about" (p. 417).

Additional supporters of calculator use in education include Finley, a fourth and fifth grade math teacher, and Bitter and Hatfield (1992), two authors of an article which describes an Arizona project that combined the resources of personnel, university mathematics educators, and private industry to improve the utilization of calculators in mathematics instruction (p.200). According to Finley (1992), "I have seen many changes take place in my mathematics class and in the school, changes that I attribute directly to the use of calculators" (p. 197). In their support of calculator use, Bitter and Hatfield write, "Recent calls for educational reform consistently advocate an inquiry-oriented learning environment that promotes the development of students' mathematical power. The calculator can be used effectively in establishing such an environment if it is used as a tool for mathematical explorations and investigations" (1992, p. 207).

While the issue of promoting calculators in the mathematics classroom is both accepted and refuted, it remains to be investigated as to what degree teachers have included the technology into their daily learning environment and to what extent calculators are made available to students in their schools. The NCTM encourages the use of calculators at both the elementary and secondary levels, and it seems only appropriate to examine the incorporation of calculators into the mathematics classroom at each of these levels. Studies have been conducted on this issue, and a couple of these will be looked at in detail.

Hembree and Dessart (1992) studied how well mathematics education has incorporated the calculator into the learning environment. The method

these two researchers used was that of studying results that had been collected on this issue during the 1980s and the early 1990s. The results they found had usually been gathered by surveys involving the following areas, amongst others: (1) policies toward calculator use, (2) the accessibility of calculators in the schools, (3) modifications to the curriculum due to calculators, and (4) frequencies of actual use by teachers in the classroom (p. 27). The results of these areas collected from the surveys will be summarized.

In relation to the policy statements found in schools, according to Hembree and Dessart, perhaps half of the schools in the United States had declared a formal policy with regard to calculators as the 1980s began. In contrast, more than 80 percent of schools in Sweden had written policies. Japan seemed opposed to calculators, while only a few Ll.S. schools had outwardly forbidden their use. As the decade continued on, more and more schools began to view the use of this technology more positively. While few states have mandated their implementation, at least 64 percent of the states have recommended their use for instruction in high schools and 50 percent have proposed calculator use in all grades, kindergarten through twelfth grade. At least twelve states have also suggested that these devices be used in testing (Hembree & Dessart, 1992, p. 27).

The surveys have provided information of the availability of calculators. Connecticut was the only state by 1987 that had provided funds for the statewide purchase of calculators, and only six states had formally recommended the purchase of calculators. More recent surveys had indicated that access to these machines was probably less of a problem than the earlier surveys have suggested (Hembree & Dessart, 1992, p. 27).

Hembree and Dessart (1992) found that the surveys revealed curricular and instructional changes. According to the researchers, 42 percent of the

states had produced guidelines or model curricula for aiding the incorporation of calculators into mathematics education by the year 1987. Two states restricted calculator integration to grades seven through twelve, while the typical policy had supported calculator use across all of the precollege grade levels. The typical policy also stressed that the calculator be used as a tool and not as an object of study. It is suggested that guidelines provided by the states did not seem well implemented at the local school levels. In a selection of high schools in thirteen states, it was found that only 6 percent of the teachers reported a fairly substantial impact of ten or more changes in the curriculum as the result of the inclusion of calculators. Eighty percent of the teachers recorded five or fewer curricular changes, and no changes were reported by 40 percent of the teachers (p. 28). Bitter and Hatfield (1991) have reported that the regular use of calculators in classrooms is seldom the case even though they seem to be prevalent. In regards to change in instructional practice, Hembree and Dessart state that "twenty-two states have acted to (1) furnish information on new materials and techniques for teaching with calculators, (2) provide teacher in-service programs to study calculator technology, and (3) revise teacher certification standards to call for preparation in the use of calculators" (1992, p. 28).

The frequency of actual calculator use is one more aspect that the two researchers found information about in the collection of surveys they analyzed. Hembree and Dessart advocate that all grade levels have begun to use calculators, but the use has not been uniform; higher grade levels make use of these devices more than the earlier grades. It is also reported that the willingness of teachers to teach mathematics with the aid of calculators has seemed to increase across all grade levels. Percentages of teachers who integrated calculators in their lessons were given in one particular study.

These percentages were: "14 percent in primary grades, 23 percent in intermediate grades, 42 percent in junior high school, and 62 percent in senior high school" (Hembree & Dessart, 1992, p. 28). According to the researchers, similar patterns were noted by other studies as well (p. 28).

From their analysis of the collection of surveys done on the degree to which calculators have been integrated into mathematics education, Hembree and Dessart have developed several conclusions of their own. Among these include:

(1) "Most schools possessing calculators tend to have a single classroom set of the devices. It seems clear that for most efficient use, a calculator should be made available for each student. "

(2) "The years of the 1980s saw growth in the use of calculators in schools. It seems clear that this trend will accelerate through the 1990s" (Hembree & Dessart, 1992, p. 31).

In 1993, a study done by Struyk, Cangelosi, and Ehlert examined the impact of a calculator-based mathematics-teaching in-service program for elementary school teachers. Third and fourth grade teachers from fourteen rural school districts in Missouri were invited to participate in the study, which included a workshop conducted in the fall by a math education specialist. The two purposes of the workshop were "1) to familiarize teachers with the calculator and 2) to explain how to design learning activities which focus on higher level thinking skills" (Struyk, Cangelosi, & Ehlert, 1993, p. 4). Two additional workshops were conducted at later times. The first one was designed with the purpose of allowing teachers to share ideas about the use of calculators with one another, while the second one, which occurred in the spring, was intended to help teachers learn about more activities that can be used with the calculator and to allow teachers to share activities in which the

calculator was integrated that they deemed successful. The study's sample consisted of 29 teachers and their students. Of the 42 teachers who participated in the study, these 29 teachers had attended the original workshop conducted by the math specialists (p. 5).

Teacher questionnaires were used to help evaluate the different elementary teachers. The attendants of the fall workshop were given a questionnaire that was designed to gather information about "1) teachers' likes and dislikes related to teaching mathematics and 2) the level of understanding of the relevant mathematical concepts of the teachers" (Struyk, Cangelosi, & Ehlert, 1993, p. 7). A similar questionnaire was distributed to the teachers at the spring workshop, and the responses were compared. It is noted that 26 of the 29 elementary teachers returned the second questionnaire (p.p. 7-8).

Five items and the respective teachers' responses on the questionnaire will be focused on as to how they relate to the recommendations of the NCTM on calculator use in elementary school. One of the items asked the teachers if they were members of the NCTM. At the time of the first distribution of the questionnaire, only one of the 26 teachers noted that she was a member. At the spring workshop, this number increased to two teachers out of the 26 who indicated that they were members (Struyk, Cangelosi, & Ehlert, 1993, p. 8).

Another item that aids in understanding to what degree teachers integrate the recommendations of the NCTM Standards is one that asks, "Are you familiar with the NCTM Curriculum and Evaluation Standards?" (p. 9) According to the researchers, in the responses of the first questionnaire, two reported that they were somewhat familiar with them, 10 responded that they had heard of them but were not knowledgeable about them, and 14 indicated

that they had never heard of them (p. 9). It is interesting to note that not one of the teachers reported that they were completely familiar with the Standards. The results changed at the time of the spring workshop, but not to an alarming degree. In this case, eight teachers reported that they were somewhat knowledgeable about the Standards, 14 indicated that they had heard of them but were not familiar with them, and four noted that they had never heard of them. Once again, no one indicated that they were well-informed about the Standards (p. 9).

Responses to the question, "Do your students have access to calculators in your classroom? If so, who supplies them?" helps to measure calculator use by these elementary teachers (Struyk, Cangelosi, & Ehlert, 1993, p. 9). Twelve of the teachers reported that they had access to calculators, while 13 indicated that they did not. Different suppliers of the available calculators were noted by the teachers who indicated that they had access to these technological devices. The four given sources were "1) the school (one classroom pack for seven classrooms), 2) the teachers (one or two calculators that were passed around), 3) the PTa, or 4) students supplied their own (p. 9). These results hardly seem to represent the belief of the NCTM that appropriate calculators should be made available to all students at all times.

Two additional questions examined how these third and fourth grade teachers utilized calculators with their students. The first of these two questions asked "How, if at all, do your students use calculators as part of their work in learning mathematics under your directions; specifically as a tool to facilitate computations?" (Struyk, Cangelosi, & Ehlert, 1993, p. 9) Similar responses to this question were given at both the fall and spring workshops. The teachers reported that calculators were used to check

answers, answer calculator problems in the textbook, and study number patterns (p. 10).

The second question of the final two to be looked at inquired, "How, if at all, do your students use calculators as a part of their work in learning mathematics under your directions; specifically as a tool for exploring mathematical relationships?" (Struyk, Cangelosi, & Ehlert, 1993, p. 10) The responses from the two distributions of the questionnaire were once again similar. Different replies provided were that calculators were used to explore patterns, to complete the calculator exercises in the textbook, and for math games (p. 10).

This research analyzes the specific instructional practices of 26 elementary teachers. This number is only a small portion of all of the elementary teachers in the United States, but the practices of these individual teachers are undoubtedly similar to those of other elementary teachers in the nation. It is evident that the majority, if not all, of these teachers did not incorporate the suggestions of the NCTM to the maximum extent possible. This research indicates that there is room for changes in the mathematical instruction in order to integrate calculators into the students' elementary education. Struyk, Cangelosi, and Ehlert conclude that "results of the research study of the impact of the program on students' attitudes and teachers' instructional practices were somewhat disappointing, though providing interesting implications for the design of subsequent programs and research studies" (1993, p. 8). Additional in-service programs can greatly aid in the utilization of calculators in the classroom. It will be interesting to see how the incorporation of calculators in elementary education advances throughout the decade, as Hembree and Dessart (1992) predict.

In order to examine the calculator practices at the secondary level, a survey was given to 148 high school math teachers, representing 12 schools, in April of 1994. The demographic locations of the schools ranged from rural to urban. Of the 148 surveys distributed, 75 were returned. These returned surveys represented ten high schools of which four were from a rural area, four were located in the suburbs of Chicago, and two were in the city of Chicago itself. The ten schools also depicted eight different school districts. The percentages of teachers from each of the demographic areas who participated in the survey were distributed as follows: 17 percent were from a rural area, 67 percent represented a suburban location, and 16 percent were from an urban area. All of the schools were located in the northern part of Illinois. See Figure 1.

Information from the surveys indicated that the number of years taught by each teacher ranged from one year to 41 years, with a mean of 19.4 years. In addition, the data implied that the classes taught by the teachers ranged from fundamental math level courses to accelerated calculus courses, and biological and physical science courses and computer science classes were also included. The majority of teachers reported that they taught ninth grade through twelfth grade, but 14 indicated they have taught grades below ninth and one noted that he/she has taught at the junior college level.

The surveys proved to provide interesting information about calculator use in the classroom at the secondary level. The given information will be examined as to how it relates to the integration of the recommendations of the NCTM of calculators in instruction found in the Standards. It was reported that 41 of the teachers were members of the NCTM, while 33 responded that they were not. In addition, 92 percent of the respondents indicated that the schools they taught at encouraged the use of

calculators by students, while 5 percent reported that their schools did not support their use. This data seems to imply that the NCTM suggestions on technology utilization are being incorporated into the secondary mathematics education in northern Illinois.

In regards to the access of calculators for students, 50 educators responded that these devices were supplied for the students by their schools, whereas 23 teachers reported that they were not. When the teachers who indicated that their school did supply calculators were asked "[A]pproximately how many calculators does your school provide for use in the classrooms?", responses ranged from a classroom set per school to one classroom set available per teacher, with answers of varying degrees in between. Further inquiry as to what specific calculators were being used at the individual schools led to 57 teachers listing one or more Texas Instruments models as the devices. The most common Texas Instruments models listed were the TI-81 and the TI-82. Other responses given included Casio brand calculators and scientific and graphing calculators, in general. It was intriguing to see that eight teachers listed the newly developed Texas Instruments model, TI-85, in the listing of their schools repertoire of calculators.

As to the question of whether students are expected to purchase their own calculators and if so, whether students are told specifically which calculator to buy, 76 percent reported that students were expected to buy calculators, while twenty percent responded that they were not. Results given to the inquiry about the incidence that students are told which devices to purchase indicated that at a majority of the schools this is not the case, with 57 percent reporting that this did not happen at their schools and 32 percent noting that it did.

With most of the teachers indicating that calculators were being used in their math departments, further questions aided in gathering information about the use of calculators by the individual teachers with their own students. One inquiry requested the teachers to respond if they agreed with the belief of the NCTM as to the incorporation of calculators in the classroom. An alarming number of the teachers indicated that they did, with 71 out of the 75 educators responding in this way. Four teachers reported that they did not agree with this belief of the NCTM.

Similar results occurred to a question on the inclusion of work with a calculator in the classrooms by the individual teachers. Seventy teachers indicated that they did include work with this technological device in their classrooms, whereas 4 once again reported that they did not. The NCTM's Commission on Standards for School Mathematics would probably be very pleased if all surveys indica ted these types of responses.

Those teachers who had responded that they did indeed integrate calculator use in their learning environments were asked to provide some additional information about the extent of the use by answering the following questions:

(1) "Do you allow your students to use calculators when they do homework assignments? If so, approximately on what percentage of assignments?"

(2) "Do you allow calculators to be used on tests and/or quizzes? If so, approximately on what percentage of tests/quizzes?"

(3) "Do you incorporate calculators in the explanations of mathematical concepts? If so, approximately with what percentage of lessons?"

The responses to the first question listed revealed a tremendous amount of support by teachers for the use of calculators by students in aiding with homework assignments. Seventy-two teachers reported that they

allowed students to do so, and the percentages of assignments that teachers allowed calculators as aides ranged from 15% to 100%, with a mean of 88.8%. The results of the second question revealed similar results. Seventy teachers indicated that they approved of the use of such technology on tests and/ or quizzes, and the percentages of these assessment forms on which teachers supported calculator use was identical to those given to the question above. Responses on the first two questions illustrated that the opinions of the participating high school teachers seem to be in line with those of the NCTM in regards to the use of calculators in the mathematics classroom.

Results on the third question listed, however, deviated a bit from the above responses. While the number of teachers who incorporated calculators in the explanations of mathematical concepts was similar to the numbers mentioned previously (67 teachers indicated this was the case), the average percentage of lessons in which calculators were included was only 35.4%. This data seems to indicate that teachers may support the NCTM's recommendations of the use of technology in the learning environment to a certain extent, but possibly not to the degree that the NCTM suggests.

In another item of the survey the educators were able to provide a general description of the amount of time calculators were used in their individual classes. The teachers were instructed to circle one of the following phrases in order to do this: NEVER, SELDOM, SOMETIMES, FREQUENTLY, and ALMOST EVERY DAY. Out of the 71 teachers who responded to the question, not one teacher indicated that they never used calculators, but six noted that they seldom included such technology in their classrooms. Fifteen teachers reported that they sometimes did so. More favorably to the NCTM Standards, 27 teachers described their technology incorporation as

"frequently", and 23 stated that calculators were used with their students almost every day.

Even though only a small fraction of this country's high school teachers participated in the survey, the responses provided some insight as to the incorporation of technology in the secondary mathematics classroom. The information collected from the surveys is promising. See Figure 2 for a summary of key results of the survey. With society being described as "informational", it is encouraging to learn that a majority of the teachers in the schools included in the survey support the use of technology in the learning environment. While approval of calculators was evident in the teachers' overall responses, it is undoubtedly true that schools in the nation can adopt technology to a greater degree in their mathematics curriculum. Teachers seem to be heading in the right direction.

A couple items on the survey requested the teachers to list any advantages and disadvantages they have experienced in using calculators in the education of mathematics. Examples of advantages given include:

* Calculators allow less time to be spent on basic arithmetic computations and more time focused on problem solving.
* They help make it easier for students to understand mathematical concepts.
* They help students feel more confident with mathematics, instead of feeling "trapped" in large numbers and afraid.
* After graphing has been learned, calculators help to see results quickly.
* Utilization of calculators allows the students to learn how to use them correctly because they are going to use them outside of the classroom.
* They allow students to have more interest in the work assigned.
* Calculators allow longer problems to be solved within classroom time

constraints.

Some disadvantages provided include:

* Students seem to feel that they do not need to show their work on problems when they use calculators.
* Students tend to get wrong answers to problems as a result of rounding too soon with a calculator.
* Answers tend to be given as decimal approximations instead of exact numbers.
* Students may adopt the attitude that calculators will "do it all", so that they do not grasp the mathematical concepts.
* If students are allowed to use calculators too early, they may become dependent on them.
* When calculators are used to solve problems, students tend to not show all of their work in the solving of the problems.
* As a result of using calculators, students may have less understanding of what they are actually doing.

Examples of responses given in order to help reduce the effects of the disadvantages of using calculators include:

* Have the students do calculator work together as much as possible.
* Allow calculators to be used only after a concept has been taught.
* Require students to show the steps of their problem solving.
* Specify when calculators are to be used.
* Begin to teach students how to use a calculator as an aide and not as their "third arm".

People hold different opinions as to the advantages and disadvantages of incorporating calculators in the classroom. Although there are advantages to

their use, it is important for teachers to help make sure that they are used properly as a tool for mathematics.

The teachers who participated in the survey acknowledged that they have experienced success in utilizing calculators in the teaching of specific mathematical concepts. Examples of such concepts include:

* Multiplying and dividing large numbers
* Working with exponents
* Graphing functions
* Translating and stretching conic sections of graphs
* Matrices
* Rational/irrational numbers
* Percentages
* Number patterns
* Logarithms
* Trigonometric functions
* Dividing a number by zero
* Roots of numbers
* Probability
* Limits of functions.

This list does not cover all of the concepts with which calculators can assist in learning. The tremendous amount of features on calculators, especially on the newly developed models, make it possible for teachers to incorporate technology into the learning environment frequently.

The surveys provided helpful information about the present use of calculators in the mathematics classroom, but it was interesting to see that discrepancies occurred in the responses of teachers from the same school. This is expected on questions dealing with individual teachers' opinions or

preferences, but differences were seen in responses to questions inquiring about the schools' practices. For example, some teachers would report that their school did encourage the use of calculators by students, while teachers from the same school disagreed. The same is true for questions about the availability of calculators for the students.

It is difficult to explain why such discrepancies occurred, but possible reasons can be identified. For instance, teachers may be new to the school and do not know what materials teachers have access to, or possibly teachers have never used calculators in their classrooms before and have not taken the initiative to find out what kinds of calculators their school owns. Whatever the case may be, a teacher's knowledge about his/her school's resources is important not only for him/herself, but also for the students who are taught, in order for them to experience the most effective teaching possible.

The results of the survey introduce some interesting issues that are beyond the scope of this report. For example, it could be intriguing to look at the differences in calculator use in the schools in diverse demographic locations. In addition, analysis of the amount of years that teachers have educated students could provide interesting information related to their approval of calculators in the classroom. The present opinions about the incorporation of technology in the classroom could also be investigated as to how they compare with those held in the past few years, or how they will relate to the beliefs held in the future.

The NCTM is an organization which strongly advocates the use of technology in the mathematics classroom. Their position is clearly stated in the list of curriculum and evaluation standards published in 1989. Although the NCTM desires that teachers adopt a similar position, it is unknown exactly to what extent this is occurring. Educators have attempted to study

this trend, and a few results have been found. It seems to be the case that while many teachers have experienced the benefits of using calculators with their students, others are somewhat more reluctant to do so. The upcoming years can prove to be an exciting time for mathematics education as teachers and students have the opportunity to become more accustomed to technology. It will be interesting to see how the practices of teachers at all levels will change as a result of the newly accessible resources. It would be a shame for teachers to not utilize the materials available to them in the teaching of mathematics. With the emergence of an informational society in the United States, citizens are expected to be able to properly utilize technology, whether it be in daily living activities or those in job positions. What better place for students to acquire this skill than in the daily learning environments in which they grow and mature?

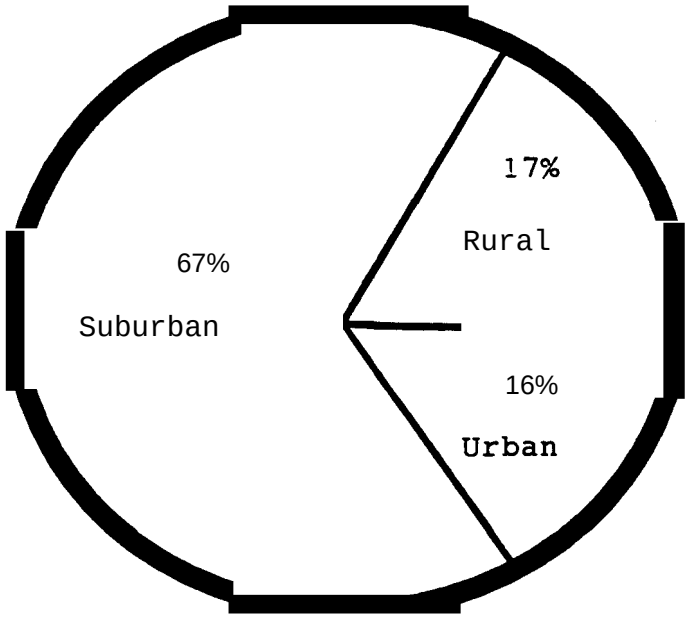

Figure 1. Percentages of teachers in the different demographic regions.

Percentages of teachers who reported ...

They are a NCTM member.	Their _schools encouraged calculator use.	Their schools supplied calculators for students.
55%	92%	68%
Students are expected to buy their own calculators.	They agreed with the NCTM's beliefs of calculator use.	They use calculators in their own classrooms.
76%	95%	95%

Figure 2. Summary of key results of survey on high school mathematics teachers.

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Survey on Calculators in the Math Classroom

Information about the Teacher

School you teach at: _____

District you teach in: _____

Grade(s) you teach or have taught: _____

Math class(es) you teach or have taught: _____

Number of years you have been teaching: _____

Are you a member of the National Council of Teachers of Mathematics? YES NO (Circle one.)

Information about the Use of Calculators

Does the school you teach at encourage the use of calculators by students?
YES NO (Circle one.)

Are calculators supplied for the students by your school?
YES NO (Circle one.)

If so, approximately how many calculators does your school provide for use in the classrooms? (For example, only 2 or 3 sets of 30 to be shared by all the teachers, enough for each student to have his/her own for the entire school year, etc...)

Are students expected to buy their own calculators?
YES NO (Circle one.)

If so, are they told specifically which calculator to buy?
YES NO (Circle one.)

What specific calculator(s) is (are) used at your school?

Do you agree with the belief of the NCTM that calculators should be incorporated in the math classroom?
YES NO (Circle one.)

Do you include work with a calculator in your classroom(s)?
YES NO (Circle one.)

If you answered "Yes" to the previous question, please answer the following questions.

Do you allow your students to use calculators when they do homework assignments? YES NO (Circle one.)
If so, approximately on what percentage of assignments? _

Do you allow calculators to be used on tests and/or quizzes?
YES NO (Circle one.)
If so, approximately on what percentage of tests/quizzes? _

Do you incorporate calculators in the explanations of mathematical concepts? YES NO (Circle one.)
If so, approximately with what percentage of lessons? _

How would you describe the amount of time you use calculators in your classes? (Circle one.)
NEVER SELDOM -SOMETIMES FREQUENTLY ALMOST EVERY DAY

What advantages have you experienced in utilizing calculators in your math classes? Please list.

Do you see any disadvantages in allowing students to use calculators during their math education? If so, please list.

How can you as a teacher eliminate or decrease these disadvantages you listed?

~ave yo~ found calculators to be especially useful and effective ~n help~ng students understand any particular mathematical concept, such as graphing functions, multiplying large numbers etc...? If so, what is the concept?

Thank you very much for your input and help with my research project.
Please'return this survey to me by April 11, 1994.

Data on the survey about ca1cu1ators in the Math Classroo.

	School	District	Gra4es '.raught	Classes '.raught	Years Taught
1.	Auburn	Rkfrd205	9-12	FA1,2 FA3,4 InA A3	15
2.	Auburn	Rkfrd205	9-12	A G CA	27
3.	Auburn	Rkfrd205	9-12	A CA AT	16
4.	Auburn	Rkfrd205	9-12	G T AG	28
5.	Auburn	Rkfrd205	9-12	PA G InA	1
6.	Auburn	Rkfrd205	9-12	GM BM A G	23
7.	Auburn	Rkfrd205	9-12	GM PA FA G CA T AG	19
8.	Auburn	Rkfrd205	7-12	FA PA BM CoA	11
9.	Auburn	Rkfrd205	9-12	GM PA A A2	3
10.	Auburn	Rkfrd205	9-12	PA CM (sp.ed.)	10
11.	Morris C	101	8-12,JC	APC A1 G CA T GM	21
12.	Morris C	101	9-12	G GM	1
13.	Morris C	101	9-12	A1 G A2 GM CL	10
14.	Morris C	101	9-12	All, Co	21
15.	Morris C	101	9-12	PC S A2 CoS A G T	18
16.	Morris C	101	9-12	A1 AM IA	1
17.	Morris C	101	9-10	PA A G GM	3
18.	King	Chicago	9-12	A1 A2 G CA GM	25
19.	Maine S	MTHS207	9-12	ALL	24
20.	Maine S	MTHS207	9-12	PM thru C	29
21.	Maine S	MTHS207	9-12	PM thru C	33
22.	Maine S	MTHS207	9-12	AM PG G T CA A1 A2	8
23.	Maine S	MTHS207	10-12	A PM G T PC C	27
24.	Maine S	MTHS207	9-12	IA FM A1 A2 T CA G PG	25
25.	Maine S	MTHS207	7-12	G C	33
26.	Maine S	MTHS207	9-13	IA A1 PG G A2 T CA PC C Ph	30
27.	Maine S	MTHS207	9-12	ALL but C	31
28.	Maine S	MTHS207	7-12	ALL	31
29.	Maine S	MTHS207	9-12	A G T MA PC	38
30.	EIgin	U46	9-12	PA A1 G GM	5
31.	Elgin	U46	8-12	A1 A2 G	15
32.	EIgin	U46	7-12	ALL thru CA,T	14
33.	EIgin	U46	9-12	A2 A3 A4 CM	28
34.	EIgin	U46	9-12	APC A1 A2 CM	24
35.	EIgin	U46	9-12	PC A3 A4 A1 G PA BM	17
36.	EIgin	U46	9-12	PA A1 A2 G1 G2 A3 A4	1
37.	EIgin	U46	10	Bio	27
38.	EIgin	U46	7-12	7 8 PA A1 A2 G1 G2	9
39.	EIgin	U46	7-12	7 8 PA A1 A2 A3 A4 CA T G CM	31
40.	EIgin	U46	5-11	5-8 PA A1 A2 G CM	23
41.	EIgin	U46	7-12	BM A1 A2 PA A3 A4 G CA T	15
42.	EIgin	U46	7-12	GM thru C	17
43.	EIgin	U46·	9-14	PA A G CA T C	35
44.	Maine E	MTHS207	9-12	PA A1 A2 G T	2
45.	Maine E	MTHS207	9-11	PG IA A	1
46.	Maine E	MTHS207	9-12	FM PA A1 G T CA C	25
47.	Maine E	MTHS207	9-12	PA thru C	5
48.	Maine E	MTHS207	9-12	A thru C	31
49.	Maine E	MTHS207	9-12	A1 A2 PA G T MA C DE	10
50.	Maine E	MTHS207	9-12	FM thru PC	29

School	District	Grades Taught	Classes Taught	Years Taught
51.Maine E	MTHS207	9-12	FM AM A1 A2 G CA T PS	34
52.Maine E	MTHS207	9-12	ALL	27
53.Maine E	MTHS207	7-12 GM	A123 PSG CA T MA C CoS PS	27.5
54.Maine E	MTHS207	9-12 A1	A2 PG T PS PA BP Pas Cob	17
55.Maine E	MTHS207	9-12	FM thru C	27
56.Maine E	MTHS207	9-10	PA A1 A2 G	10
57.Maine E	MTHS207	9-12	FM thru C	27
58.Maine E	MTHS207	9-12	ALL but PG	13
59.Lane T	Chicago	9-12	PA thru C	26
60.Lane T	Chicago	9-12	A G A2 T	28
61.Lane T	Chicago	9-12	A G A2 A3 T CA	21
62.Lane T	Chicago	9-10	A G	17
63.Lane T	Chicago	9-12	A G A2 T CA C	15
64.Lane T	Chicago	9-12	A CP G T CA SG AG	41
65.Lane T	Chicago	10-11	G1 A2	31
66.Lane T	Chicago	9-12	GM A G A3 T CA AG	31
67.Lane T	Chicago	9-12	A G A2 T	2
68.Lane T	Chicago	9-12	ALL	33
69.Lane T	Chicago	9,11	A G T CA	30
70.Indian C	425	9-12 JC	GM PA A1 G A2 CA T	17
71. Indian C	425	9-12	GM PA G A2	8
72.Malta	433	9-12	PC T	1
73.Malta	433	7-11	7 8 GM PA A1 G	12
74.Somonauk	432	6-12	G A PA	6
75. Somonauk	432	9-12	A1 A2 G CA PC GM PA	24

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
1.	Y	Y	Y	Y	N	TI-81,34
2.	N	Y	Y	Y	N	TI-81,34
3.	N	Y	Y	N	N	TI-80,35
4.	N	Y	Y	N	N	NONE
5.	Y	Y	Y	N	N	TI-35
6.	N	Y	Y	N		GRA. TI-34
7.	N	Y	Y	Y	N	TI-81,34
8.	Y	Y	Y	N	N	TI-81,34
9.	Y	Y	Y	Y	N	TI-81,35
10.	N	Y	N	Y	N	MISC
11.	Y	Y	Y	N		TI-81,34,30
12.	Y	Y		Y	Y	TI-81,82,35
13.	N	Y	Y	Y	Y	TI-81,30,35
14.	N	Y	YIN	Y	Y	TI-82,34
15.	Y	Y	Y	Y		YTI-81,82,86,36,30
16.	Y	Y	Y	Y	N	TI-81,36X
17.	Y	Y	Y	Y	Y	TI-81,30
18.	N	Y (SS)	Y (SS)	Y	Y	TI-34
19.	Y	Y	Y	Y	Y	TI-82,85
20.	Y	Y	Y	N		TI-81
21.	Y	Y	Y	N		TI-81,82
22.	Y	Y	Y	Y	Y	TI-81,82
23.	Y	Y	Y	Y	Y	TI-82,85
24.	Y	Y	N	Y	N	TI-81
25.	N	Y	N	Y	YIN	TI-81,82
26.	Y	Y	YIN	Y	N	TI-81,82,85
27.	N	Y	Y	Y	Y	TI-81,82,85
28.	Y	Y	Y	N		TI-81,82,85
29.	N	Y	N	Y	N	TI-81,82,85
30.	Y	Y	Y	N		TI-81,30
31.	Y	Y	Y	Y	Y	TI-81,30
32.	Y	Y	Y	N	Y	TI-81,30
33.	N	Y	Y	Y	Y	TI-81,30
34.	N	Y	Y	Y	Y	TI-81
35.	Y	Y	Y	Y	N	TI-81
36.	N	Y	Y	Y	Y	TI-81,30
37.	N	Y	Y	Y	Y	TI-81,30
38.	N	Y	Y	Y	N	TI-81,30
39.	Y	Y	YIN	YIN	N	TI-80,30
40.	N	Y	Y	Y	N	TI-81,31
41.	Y	Y	Y	Y	N	TI-81,30
42.	N	Y	Y	Y	N	ALL
43.	Y	Y	Y	N	N	TI-81,30
44.	Y	Y	Y	Y	N	C7\S, TI GRA.
45.	Y	Y	Y	Y	N	
46.	N	Y	N	Y	N	TI-81,82
47.	Y	Y	N	Y	N	CAS, TI
48.	N	Y	Y	Y	N	TI-81
49.	N		N	Y	N	CAS,TI-81,85
50.	N	Y	N	Y	Y	TI-81
51.	N	Y	N	Y	Y	TI-81,82
52.	Y	Y		Y	N	
53.	N	Y	YIN	Y	N	CASITI-8~,30

Question 1	Question 2	Question 3	Question „	Question 5	Question 6
54. N	Y	N	Y	N	CAS,TI-81
55. Y	Y	N	Y	Y	TI-81
56. Y	Y	N	Y	N	TI-81,82
57. Y		N	Y	N	GRA.
58. N	Y	Y	Y	Y	SCI.,GRA.
59. N	N	N	Y	N	
60. N	N	N	Y	N	
6l. Y	Y	N	Y	Y	GRA.
62. N	N	N	Y	N	
63. Y	Y	Y	Y	Y	CAS,TI-81,82
64. N	Y	N	Y	N	SCI. ,GRA.
65. N	Y	N	Y	N	GRA.
66. Y	Y	N	Y	N	
67. Y	Y	Y	Y	Y	TI-85
68. Y	Y	Y	Y	N	TI
69.	Y	N	Y	N	
70. y	Y	y	N	N	TI-34
7l. Y	Y	Y	N	N	
72. Y	Y	Y	N		
73. Y	N	Y	y	N	TI-34
74. Y	Y	N	N		TI-24
75. N	Y	N	y	N	TI-81,34

	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
1.	Y	Y	Y 90%	Y 90%	Y 90%	F
2.	Y	Y	Y 100%	Y 100%	Y 30%	F
3.	Y	Y	Y SO%	Y 90%	Y 10%	F
4.	N	N	Y	N	N	Se
S.	Y	Y	Y 100%	Y 100%	Y SO%	F
6.	Y	Y	Y 99%	Y 100%	Y	A
7.	Y	Y	Y 100%	Y 99%	Y 30%	So
8.	Y	Y	Y 9S%	Y 9S%	Y 2S%	So
9.	Y	Y	Y 100%	Y 100%	Y 10%	A
10.	Y	Y	Y 100%	Y	Y	A
11-	Y	Y	Y 100%	Y 9S%	Y 2S%	F
12.	Y	Y	Y 100%	Y 100%	Y 2S%	A
13.	Y	Y	Y 90%	Y 90%	Y 40%	F
14.	Y	Y	Y SO%	Y 9S%	Y 40%	A
lS.	Y	Y	Y 100%	Y 90%	Y 10%	A
16.	Y	Y	Y 100%	Y 100%	Y 2S%	So
17.	Y	Y	Y 100%	Y 100%	Y 40%	F
18.	Y	Y	Y 100%	Y 100%	Y 6%	So
19.	Y	Y	Y 100%	Y 100%	Y SO%	F
20.	Y	Y	Y Al all	Y Al all	Y 10%	Se
21-	Y	Y	Y 100%	Y 8S%	Y 2S%	F
22.	Y	Y	Y 100%	Y 100%	Y 100%	A
23.	Y	Y	Y 9S%	Y SO%	Y	F
24.	Y	Y	Y 100%	Y 100%	Y 2S%	F
2S.	Y	Y	Y Unlim	Y 7S%	Y 30%	F
26.	Y	Y	Y 100%	Y 100%	Y	A
27.	Y	Y	Y	Y Unlim	Y lS%	So
28.	Y	Y	Y	Y 80%	Y 40%	F
29.	N	N				
30.	Y	Y	*YIN* 7S%	*YIN* 7S%	Y SO%	F
31-	Y	Y	Y 90%	Y 9S%	Y 80%	A
32.	Y	Y	Y 100%	Y 100%	Y 2S%	Se
33.	Y	Y	Y 100%	Y 8S%	Y	F
34.	Y	Y	Y	Y 100%	N	So
3S.	Y	Y	Y 100%	Y 100%	Y 100%	A
36.	Y	Y	Y SO%	Y 100%	Y 20%	So
37.	Y	Y				
38.	Y	Y	Y 100%	Y 9S%	Y 2S%	So
39.	*YIN*	Y	Y 90%	Y 90%	Y S%	F
40.	Y	Y	Y	Y	Y 17%	Se
41-	Y	Y	Y 100%	Y 100%	Y 2S%	F
42.	Y	N	Y 100%	Y 100%	Y 10%	Se
43.	Y	Y	Y lS%	Y lS%	Y 10%	A
44.	Y	Y	Y 100%	Y 100%	Y 9S%	A
4S.	Y	Y	Y 100%	Y 100%	Y	F
46.	N	*YIN*	Y	Y SO%	Y 10%	So
47.	Y	Y	Y 100%	Y 100%	Y 7S%	A
48.	Y	Y	Y 100%	Y 100%	Y 42%	F
49.	N		Y 100%	Y 80%	N	Se
SO.	Y	Y	Y 100%	Y 100%	Y 60%	F
Sl.	Y	Y	Y 100%	Y 100%	Y 20%	A
S2.	Y	Y	Y 100%	Y 100%	Y SO%	A
S3.	Y	Y	Y 100%	Y 100%	Y 10%	A

	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12
54.	Y	Y	Y 20%	Y 20%	Y 20%	F
55.	Y	Y	Y 100%	Y 100%	Y 10%	So
56.	Y	Y	Y 100%	Y 100%	Y 20%	F
57.	Y	Y	Y	Y 100%	Y 15%	F
58.	Y	Y	Y 100%	Y 100%	Y 65%	A
59.	Y	Y	Y 100%	Y 100%	Y	So/F
60.	Y	Y	Y 100%	Y 95%	Y 5%	A
6l.	Y	Y	Y 50%	Y 100%	Y 50%	A
62.	YIN	N				
63.	Y	Y	Y 50%	Y 50%	Y 70%	A
64.	Y	Y	Y 15%	Y 10%	Y 10%	So
65.	Y	Y	Y 100%	Y 100%	Y	F
66.	Y	Y	Y 50%	Y 50%	N	So
67.	y	Y	Y 100%	Y 100%	Y 75%	A
68.	Y	Y	Y 99%	Y 95%	Y 40%	A
69.	Y	Y	Y 100%	Y	N	
70.	Y	Y	Y 100%	Y 100%	Y 20%	So
7l.	Y	Y	Y 95%	Y 95%	Y 50%	F
72.	Y	Y	Y 100%	Y 99%	Y 20%	F
73.	Y	Y	Y 78%	Y 78%	Y 40%	F
74.	Y	Y	Y 50%	Y 50%	Y 50%	So
75.	y	Y	Y 100%	Y 100%	Y 50%	A

xnterpretations of Syabols

QUESTIONS

Question 1:
Are you a member of the National Council of Teachers of Mathematics?

Question 2:
Does the school you teach at encourage the use of calculators by students?

Question 3:
Are calculators supplied for the students by your school?

Question 4:
Are students expected to buy their own calculators?

Question 5:
If so, are they told specifically which calculator to buy?

Question 6:
What specific calculator(s} is(are} used at your school?

Question 7:
Do you agree with the belief of the NCTM that calculators should be incorporated in the math classroom?

Question 8:
Do you include work with a calculator in your classroom(s}?

Question 9:
Do you allow your students to use calculators when they do homework assignments?
If so, approximately on what percentage of assignments?

Question 10:
Do you allow calculators to be used on tests and/or quizzes?
If so, approximately on what percentage of tests/quizzes?

Question 11:
Do you incorporate calculators in the explanations of mathematical concepts?
If so, approximately with what percentage of lessons?

Question 12:
How would you describe the amount of time you use calculators in your classes? (Circle one.)
NEVER SELDOM SOMETIMES FREQUENTLY ALMOST EVERY DAY

SCHOOLS

Auburn: Auburn High School

Morris C: *Morris* community High School

King: Dr. Martin Luther King, Jr. High School

Maine S: *Maine* South High School

Elgin: Elgin High School

Maine E: *Maine* East High School

Lane T: Lane Technical High School

Indian C: Indian Creek High School

Malta: Malta High School

Somonauk: Somonauk High School

DISTRICT

Rkfrd205: Rockford 205 District 205

MTHS207: *Maine* Township High School District 207

CLASSES

FM: Fundamentals of Math
GM: General Math
CM: Consumer Math
BM: Business Math
AM: Applied Math (Applications of Math)
MA: Math Analysis
FA (1,2,3,4): Fundamental Algebra (1,2,3,4)
IA: Introductory Algebra (Introduction to Algebra)
InA: Intermediate Algebra
A (1,2,3,4): Algebra (1,2,3,4)
CA: College Algebra
AT: Algebra Tutorial
PA: Pre-algebra
G (1,2): Geometry (1,2)
AG: Analytic Geometry
PG: Plane Geometry
SG: Solid Geometry
T: Trigonometry
C: Calculus
PC: Pre-calculus
APC: Advanced Placement (AP) Calculus
S: Statistics
PS: Probability and Statistics
Co: Computers
CoS: Computer Science
BP: Basic Programming

CP: computer Programming
CoA: computer Applications
CL: computer Literacy
Pas: Pascal programming
Cob: Cobol Programming
Ph: Physics
Bio: Biology
5,6,7,8: Fifth (Sixth, Seventh, Eighth) Grade Math
All: All math classes
thru: through
sp.ed.: Special Education

CALULATOR TYPES (Answers to Question 6):

TI-(24,30,34,35,36,36X,80,81,82,85,86): Texas Instruments Calculator Model 24 (30,34,35,36,36X,80,81,82,85,86)

CAS: Casio Brand Calculators

GRA.: Graphing Calculators

SCI.: Scientific Calculators

MISC: Miscellaneous Calculators

ADJECTIVES (Answers to Question 12):

Se: Seldom

So: Sometimes

F: Frequently

A: Almost every day

OTHER SYMBOLS:

Y: Yes

N: No

SS: Summer School

Unlim: Unlimited

Al all: Almost all