1993

The NCTM Standards: Implementation

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THE NCTM *STANDARDS*: IMPLEMENTATION

Technical Report

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November, 1993

Executive Summary

THE NCTM *STANDARDS*: IMPLEMENTATION

In 1989 the National Council of Teachers of Mathematics published the *Curriculum and Evaluation Standards for School Mathematics*. The NCTM *Standards* provides benchmark statements about specific aspects of the curriculum and about evaluation against which school divisions can judge their own specific curricula. The *Standards* has been a major focus of mathematics education since 1990.

In the fall of 1992 the Metropolitan Educational Research Consortium undertook a study to determine the extent to which local schools were implementing the NCTM *Standards*. The study of the schools in the Consortium focused on the broad themes of the *Standards* document: mathematics as problem-solving, mathematics as communication, mathematics as reasoning, and mathematical communication. To teach with these four standards in mind is to teach in a *Standards*-oriented manner. This report summarizes the findings of three data sources collected from elementary, middle, and secondary school teachers and principals in the MERC school divisions: a survey of teachers, a survey of principals, and focus group interviews of selected teachers. The questions and discussions explore awareness of the *Standards*, classroom practices, and aids and obstacles to implementation.

FINDINGS

Awareness and Change

Overall the data suggests that there is an unevenness in the level of implementation. Some teachers have made changes, but many have not. However, even within those who have changed, change is not uniform, nor at a level indicative of full implementation. With a recognition of this unevenness, there are some areas where progress can be reported.

Classroom Practice

At the elementary and middle grades, teachers report use of cooperative groups, an increased use of manipulatives and computers, and there is some evidence of discussion and interaction in the classroom. The greatest areas of strength at the secondary level are mathematics as reasoning, cooperative group work, and the use of calculators.

When looking at the frequency with which most any strategy is used, it is difficult to feel complacent about the data in any given area. Clearly, there remains a lot of work to be done before we can say teachers are actually implementing the *Standards.*

While problem-solving is reportedly done by all teachers, the evidence does not support the use of problem-solving as a global approach to mathematics or as a pervading theme. Nonstandard and project-type problems are infrequently used. The driving force in the classroom remains the textbook.

The area of assessment is perhaps least reflective of the *Standards* than any other area. There is little evidence of alternative forms of assessment, portfolios, or journals. Teachers made almost no distinctions between the use of assessment for diagnostic purposes and for grading. Traditional end-of-chapter and standardized tests remain the most common forms of assessment

Aids and Obstacles

There are two factors that appear to be correlated with a movement toward a *Standards*-like classroom: (1) The support of the administration, especially at the principal level. (2) The initiative of individual teachers to take advantage of opportunities and to be self-starters. In the case of the latter, it is not clear what causes these personal characteristics.

Other factors that influence implementation of change are time (for planning, for inservice and professional growth opportunities), the pressures of standardized testing, quality inservice (or lack of same), and the availability of resources (especially in the area of technology). Teachers at the upper levels note the difficulties of working with students of low abilities as a significant obstacle.

RECOMMENDATIONS

The findings for this study generally corroborate those of the NCTM pilot study indicating that considerable work needs to be done to implement the *Standards.* District policy statements should articulate a vision of mathematics curriculum reform and revised criteria for mathematics curriculum design. Teachers need support, direction, and in-depth training.

Curriculum

At the elementary level there needs to be less emphasis on paper and pencil, rule driven computational skills and more use of mental processing and problem-solving techniques using calculators and manipulatives. At the middle school level, number sense and

problem-solving should be expanded through open-ended exploration, projects, and group work with the text used only as a resource. The curriculum should be broadened to include measurement, statistics and probability. At the secondary level, the *Standards* call for a core curriculum in which all students have access to algebra, geometry,

probability, statistics and discrete mathematics. It was not clear from the study that such a broad curricular change had been implemented. An increased and more integrated use of computers and calculators in all courses at all levels is also needed.

Assessment

Perhaps the area found most seriously lacking was assessment. In order for a *Standards*-like curriculum to be integrated, both classroom assessment practices and standardized testing must change accordingly. This is not yet the case. Assessment practices must be in alignment with the objectives of the *Standards* and must become an integral component of instruction. Teachers will need considerable assistance in quality assessment practices. Standardized testing by school divisions must also be reflective of the *Standards* in order to prevent a conflicting message from being sent to teachers and to parents.

Policy

Meeting the NCTM *Standards* depends on the development of policies that clearly delineate the curriculum to be delivered and provide the resources to support teacher training, professional growth, curricular development, assessment techniques, and the technology to implement them.

THE NCTM *STANDARDS*: IMPLEMENTATION

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Preface

In November, 1992, the Metropolitan Educational Research Consortium (MERC) Policy and Planning Council approved a proposal to study the implementation of the NCTM *Standards*. The study builds on previous MERC work in the area of mathematics; particularly the analytic and interpretive review of the National Assessment of Educational Progress Results of 1990. It also lays the foundation for 1) MERC's continuing search for information to improve mathematics teaching and learning, and 2) school division efforts to provide appropriate curricula and staff development opportunities for their teachers.

The research agenda sought answers to the following questions:

1. What is the level of awareness of teachers about the NCTM *Standards*?
2. What is the level of implementation of the NCTM *Standards* in Consortium classrooms? How do the classroom practices of teachers who perceive themselves as implementing the *Standards* differ from those of other teachers?
3. What aids have helped teachers in making these changes?
4. What components are seen as hindering progress toward these changes?

A study group was formed from MERC's membership to guide the research and dissemination activities. The study group included Helen Edens from Chesterfield County Public Schools; Beverly Cook from Colonial Heights City Public Schools; James Bagby, Vandi Hodges, and Rosa Tapscott from Hanover County Public Schools; Steven Lapinski from Henrico County Public Schools; Linda Hyslop from Hopewell City Public Schools; Linda Weber from Powhatan County Public Schools; and Jacqueline Joyner from Richmond City Public Schools.

A research team was appointed which included Kathleen Cauley and John Van de Walle as the co-principal investigators and William Hoyt, MERC Research Fellow to work with the Study Group and conduct the research. Susan Goins assisted the team and study group in meeting arrangements and document preparation.

John Pisapia, Director
Metropolitan Educational Research Consortium

THE NCTM *STANDARDS*: IMPLEMENTATION

The purpose of this study was to identify the progress and obstacles encountered by schools and teachers who have attempted implementation of the National Council for Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards for School Mathematics* and the *Professional Standards for Teaching Mathematics*. The report summarizes the findings from three data sources: a survey of mathematics teachers, a survey of principals, and focus group interviews with selected teachers. The survey of teachers within the Consortium was to determine their awareness of the *Standards*, the extent to which they currently teach in ways that are consistent with the *Standards*, and their perspective of aids and obstacles when implementing the *Standards*. The principal survey was to determine principals' awareness of the *Standards* and their perspective of the aids and obstacles in implementing them. The focus group interviews were conducted with teachers who expressed knowledge of the *Standards* and were rated as either as high or low implementation teachers. The purpose was to obtain more in-depth information about their success at implementation and perceived aids and obstacles.

BACKGROUND INFORMATION

Calls for change in mathematics education have been growing in number and intensity over the past 15 years when the education community began to revolt against the public cry for "back to basics." That movement was influential during the eighties in directing parent attention to the lowest level of mathematics skills, namely computation and mastery of procedural knowledge. In 1977, the National Council of Supervisors of Mathematics issued its list of Ten Basic Skills in which problem-solving enjoyed the number one position. The following year, the NCTM published *An Agenda for Action* that outlined changes in curriculum and evaluation procedures as goals for the decade of the eighties. These documents had impact largely in terms of shifting the focus from the lower level skills of arithmetic to problem-solving and higher-order thinking processes.

The decade of the eighties began an almost universal acceptance on the part of the American public of problem-solving as a truly important part of mathematics education. No other single subject has so dominated the research and publication agenda of mathematics education as has problem-solving over the last 10 years. However, while more problem-solving has clearly entered our public school curriculum, studies and reports of the state of mathematics education in this country have sounded serious warnings that all is not well.

Early in 1987, *The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective*, presented hard data that clearly showed the nation to be seriously behind most industrialized countries in all aspects of mathematics. The data behind that report were collected in 1981-1982, but more recent comparisons of the U.S. with other countries have failed to change the view that the U.S. is far from number one among countries and in fact, is nearly last in the area of mathematics. In June 1988, *The Mathematics Report Card* was released providing trends in U.S. performance-based on the past four NAEP studies. These data were less than promising. They clearly demonstrated the effects of our preoccupation with computation and our neglect of even the most simple reasoning skills.

In 1988, a series of reports began to direct attention to the future and provide new direction for mathematics education. *Everybody Counts* provided a clear picture of the ills of mathematics education as well as prescribing areas in need of change. The most important booklet from the Mathematical Sciences Education Board (MSEB) called for change in the way we view the nature of mathematics, changes in the teaching of mathematics, increased use of technology especially calculators, as well as fundamental changes in the curriculum. Mathematics is described by this well-received document as a "science of pattern and order." Real mathematics, according to *Everybody Counts*, must be made accessible to all students, not just an elect few. A curriculum that uses computational skill to filter out the vast majority of students from participation in real mathematics is seen as unacceptable.

THE NCTM *STANDARDS*

In the same year that *Everybody Counts* was released, and after a full year of gathering input based on a draft version, NCTM published its now much heralded *Curriculum and Evaluation Standards for School Mathematics*. This comprehensive document has received virtual unanimous acceptance as a guide for curriculum and evaluation reform movements throughout the country. Stopping short of an actual curriculum, the *Standards* provides benchmark statements about specific aspects of the curriculum and about evaluation against which school divisions can judge their own specific curricula. The *Standards* has been the major focus of mathematics education for the past three years, successfully articulating the more general call for reform found in *Everybody Counts*.

The *Standards* not only focused thinking on such aspects of mathematics as number sense, estimation and mental computation, and problem-solving, but also suggested new goals for students that have quickly become guiding principles for curriculum reform: Students will 1) Learn to value mathematics, 2) Become confident in their ability to do mathematics, 3) Become mathematical problem-solvers, 4) Learn to communicate mathematically, and 5) Learn to reason mathematically.

Perhaps more important than the five goals for students are the first four standards in each of the three grade level sections of the document (K-4, 5-8, 9-12). Here the *Standards* speaks clearly to the nature of mathematics in describing standards for:

1. Mathematics as problem-solving.
2. Mathematics as communication.
3. Mathematics as reasoning.
4. Mathematical connections.

These four standards represent over-arching themes for the mathematics curriculum. They can be applied to nearly every area and every lesson. To teach with these four standards clearly in mind is to teach in a *Standards*-oriented manner.

MATHEMATICS AS PROBLEM-SOLVING

According to the *Standards*, "problem-solving should be the central focus of the mathematics curriculum." This means much more than learning to solve word problems. Rather, mathematics *as* problem-solving means that problem-solving is a part of all real mathematical activity. The standard speaks to learning a variety of general problem-solving strategies such as making guess-and-check or looking for a pattern. It talks about being able to formulate problems and assess results. It speaks about confidence in solving problems. Problem-solving is a way of thinking and reasoning that is used in the learning and the doing of all mathematics.

MATHEMATICS AS COMMUNICATION

The communication standards at each level point to the importance of being able to talk about, describe, and explain mathematical ideas. Symbolism in mathematics along with things such as charts and graphs should become ways of expressing mathematical ideas to others. This means that students should learn not only to interpret the language of mathematics but to use that language themselves. Learning to communicate in mathematics makes accessible the world of mathematics beyond the classroom. It also fosters interaction and exploration of ideas within the classroom as students learn in an active, verbal environment.

MATHEMATICS AS REASONING

To reason logically is as integral to mathematics as problem-solving. In the past, logical reasoning was relegated to the tenth-grade geometry class. The *Standards* tells us that reasoning should be a part of mathematical activity from kindergarten on. To observe and extend a pattern, to defend a result, or to decide if an answer is correct are all activities that involve logical reasoning. When reasoning is part of all mathematics, students learn that mathematics is not a collection of arbitrary rules but a system that makes sense and can be figured out.

MATHEMATICAL CONNECTIONS

The theme of connections is really three-fold. First, the standard refers to connections within and among mathematical ideas. Addition and subtraction are intimately related. Fractional parts of a whole are connected to concepts of decimals and percents.

Second, the symbols and procedures of mathematics should be clearly connected to the conceptual knowledge that the symbolism represents. Rules such as "invert the divisor and multiply" should never be learned in the absence of well developed supporting concepts.

Third, mathematics should frequently be integrated with other discipline areas, and real applications of mathematics in the real world should be explored. Children should see that mathematics plays a significant role in art, science, and social studies. Mathematics should be viewed as a meaningful and relevant discipline, in terms of both how it is done and how it is used.

RATIONALE FOR THE STUDY

The *Standards* documents have been the focus of mathematics education for the last three years. They were developed to address the national crisis in mathematics education by changing mathematics curriculum, instruction, and assessment to promote mathematical reasoning, problem-solving and communication.

Through inservice, lead teacher projects, curriculum reform, and other means, the MERC school divisions have been making initial efforts at reform. Many area teachers are involved with professional organizations and have been encouraged to make changes due to their involvement in that way. However, the *Standards* requires radical change in how most teachers approach mathematics. It is essential that school divisions obtain an accurate view of where they are presently situated in this early stage of reform so that future plans and initiatives can be well designed.

It is also important that schools create support systems - at grade level, building and division level - that encourage and promote the use of new approaches and revised curriculum. In designing such support it is important to be aware of those factors that teachers perceive to be an aid to their reform as well as those they perceive as obstacles.

This project provides descriptive data on how teachers are responding to the challenge of reform. It describes not only the practices of mathematics education at the elementary, middle and secondary levels, but also identifies those influences on teachers that they view as either aids or obstacles to reform. This information will not only provide benchmark data on which progress toward implementation can be gauged, but also guidance for significant change in mathematics education in the schools.

RESEARCH QUESTIONS

1. What is the level of awareness of teachers about the NCTM *Standards*?
2. What is the level of implementation of the NCTM *Standards* in Consortium classrooms? How do the classroom practices of teachers who perceive themselves as implementing the *Standards* differ from those of other teachers?
3. What aids have helped teachers make these changes?
4. What components are seen as hindering progress toward these changes?

METHODOLOGY

The survey team collected data from three sources: objective responses by elementary, middle, and secondary school teachers (the Teacher Survey), objective responses from elementary, middle, and secondary school principals (the Principal Survey), and focus group discussions with a small number of teachers who reported awareness of the *Standards*. The Teacher Survey was piloted with teachers in one school division within the Consortium, and was revised based on these teacher's responses and comments prior to distribution to teachers in the other six MERC school divisions. The survey included items to determine teachers' awareness of the *Standards*, the frequency of use

of various classroom practices, and their perceptions of aids and obstacles to implementation. Responses were received from a total of 1,892 teachers, with 55% of those surveyed responding.

The Principal Survey was adapted from a subset of Teacher Survey items, and was distributed along with the Teacher Survey. Principals reported on their perceptions of teachers' awareness of the *Standards*, and of the types of changes being made by teachers in their schools, as well as their perceptions of the aids and obstacles to implementation of the *Standards* at their schools. Responses were received from 108 principals, with 59% of those surveyed responding.

The focus groups were comprised of 24 teachers from a pool of 101 teachers who reported on the Teacher Survey that they were aware of the *Standards* and who volunteered to participate in the group discussions. Only teachers who scored at the extremes of a "*Standards* implementation" index (based on their survey responses) were invited to participate. This index included 9 critical items considered to differentiate between teachers who were and were not following the recommendations of the *Standards* in their classrooms, and allowed us to compare the perceptions of "high" and "low" implementation teachers regarding aids and obstacles to making use of the *Standards* in the classroom.

OVERVIEW OF FINDINGS

1. The majority of teachers and their principals are aware of the *NCTM Curriculum and Evaluation Standards* and are in agreement with them.

2. Approximately 21% of elementary and 53% of middle and secondary teachers report that they are implementing the *Standards*. The degree of implementation, however, is relatively low. This low degree of implementation is reasonable given that the *Standards* are a relatively recent development and that implementation

requires a reconceptualization of mathematics teaching and assessment. Evidence of the low level of implementation is indicated by the following points.

2a. Teachers at all grade levels rely too heavily on non*Standards* oriented textbooks and the problems in them. Instead, the *Standards* recommend that more emphasis be given to student generated problems, "real-life" problems, and nonroutine problems.

2b. The majority of teachers do not use teaching strategies recommended in the *Standards* on a weekly basis. Evidence suggests that a number of strategies, such as cooperative group work or student justification of answers to problems are beginning to be used 2-3 times a month.

2c. The curriculum at the elementary and middle levels in contrast to the *Standards*, continues to emphasize computation. Areas such as statistics and probability should be emphasized somewhat more.

2d. Technology, particularly computers and calculators, is underutilized at all grade levels. Teachers in the focus groups report frustration at the unavailability of appropriate calculators, computers and software. Manipulatives are not being used and/or are not readily available, especially at the middle and secondary levels.

2e. Teachers who report implementing the *Standards* show a somewhat higher frequency of use of most recommended teaching strategies than the unchanged teachers.

2f. Elementary and middle teachers who are making changes in their teaching seem to implement the connections and reasoning theme of the *Standards* more readily than problem-solving or communications themes.

2g. Across grade levels, writing about mathematical ideas is a weakness, both as a teaching strategy and as an assessment strategy.

2h. Virtually no attempt has been made to implement recommendations for student assessment. Both the survey and the focus groups indicate that the majority of teachers do not appear to use alternative assessment techniques. The majority of teachers do not appear to distinguish between

assessment for diagnosis of student understanding and assessment for grading.

3. Administrative support is viewed as a critical aid to implementation. Aids to implementation that teachers find helpful include notification of workshops and conferences, availability of grant money, maintenance of a library of instructional materials.

4. The "lead teacher" initiative was viewed as an important aid to implementation by both teachers and principals at the elementary and middle grades.

5. The focus group interviews suggest that the teachers who are implementing the *Standards* are often "self-starters" who find and take advantage of the supports they need rather than waiting for input from their school division.

6. Aids to implementation not currently available but considered helpful by teachers at all grade levels are: opportunities to observe one another's classes, opportunities to exchange ideas with other teachers, and meetings with teachers at other grade levels to coordinate implementation. Overall, teachers feel that they need time to develop materials, rethink the curriculum, and meet with other teachers.

7. Teachers who have begun to implement the *Standards* cite specifically focused inservice opportunities as essential for effective implementation. Furthermore, teachers who have not changed view their own lack of knowledge and training as an obstacle to implementation. Practical inservice activities are those that clearly address classroom needs or that "show how" rather than "tell how".

8. The teacher survey, principal survey, and focus group interviews all suggested that current curriculum objectives and standardized testing programs are obstacles

to implementation, particularly at the middle and secondary levels. This is a reasonable assessment since neither emphasizes many of the themes of the *Standards*. Teachers cannot effectively teach to two sets of objectives.

DISCUSSION

AWARENESS

The vast majority of teachers at all grade levels reported that they have access to either a copy of the *Standards* or to materials describing the *Standards*. Teachers' reported level of awareness differs by grade level, however, with 44% of elementary teachers describing themselves as "well aware" of the *Standards*, as compared with 82% of middle school teachers and 83% of secondary school teachers.

Awareness of the *Standards* does not guarantee efforts at implementation, however. Of the teaches describing themselves as well aware, less than half at the elementary level, and less than two-thirds at the middle and secondary school levels, reported that they have changed their teaching practices as a result of this awareness.

The focus group data suggest that the elementary teachers who have made real changes appear to be the group most knowledgeable of the *Standards*. At the upper levels, a true understanding of the spirit of the *Standards* is less evident.

CLASSROOM PRACTICES

The Teacher Survey included items concerning teaching strategies reflecting each of the four themes of the *Standards*. The data allow us to describe the extent to which teachers in the MERC schools are implementing these themes.

In the area of **mathematics as problem-solving,** a majority of teachers at all grade levels reported use of cooperative group problem-solving at least 2-3 times a month. There is evidence of encouraging students to move away from rote responding and instead verifying and interpreting their answers with respect to the original problem.

Other problem-solving strategies appear to be employed only on an infrequent basis (less than twice a month) by the vast majority of teachers. These include providing opportunities for students to work on more complex, open-ended "project" problems, to formulate their own mathematics problems based on everyday situations, and to use computers in the development of problem-solving strategies. Although computers appear to be more actively used for problem-solving at the elementary level, more than one third of all middle and secondary school teachers reported that their students never have the opportunity to use computers for problem-solving.

The use of strategies related to **mathematics as communication** appears to be fairly uniform across grade levels.

Most teachers report providing opportunities for students to discuss mathematical ideas or to relate models, pictures or diagrams to mathematical ideas in their classrooms at least twice a month. The frequency with which students are asked to write about mathematical ideas appears to be lower, however. At each grade level, one third to one half of all teachers report that their students never are asked to write about mathematical ideas. Likewise, students are rarely encouraged to formulate definitions and/or express generalizations of mathematical principles.

Teachers report active use of teaching strategies related to **mathematics as reasoning**. Students at all three grade levels are encouraged to justify their answers to mathematical problems, and to think about "whys" as well as "hows" when reporting on mathematical investigations.

Teachers also reported use of strategies for exploring **mathematical connections**. Working with multiple representations of a single concept, applying mathematical reasoning to real life problems, and making meaningful connections between different areas of the mathematics curriculum were all reported as being done at least twice a month by a majority of teachers responding to the survey.

Mathematical connections are reportedly somewhat less emphasized at the secondary school level, and this is particularly true of connections between mathematics and other subject areas--60% of elementary teachers report this as a frequent area of exploration, as compared with 40% of middle school teachers and only 25% of secondary school teachers.

Based on teachers' perceptions of their classroom practices, it appears that strategies related to mathematical reasoning and connections are relatively well represented in the classroom, whereas strategies found under the heading of problem-solving and communication are used less frequently.

In a cautious attempt to summarize these data, Table 1 presents an overview of the responses to items categorized under each theme. The numbers in this table were derived by averaging frequency data - not an orthodox procedure for aggregating this kind of data. Note, for example, that important and less important items are weighted equally. The table is only intended to give a "bird's eye" view of responding teachers' reported use of strategies related to each theme (overall score). It also shows the degree to which teachers who perceive themselves as changed have moved in the directions recommended by the *Standards* (comparison between "changed" and "unchanged" groups).

Table 1

Average Percent of Teachers Reporting Use of

Teaching Strategies Reflecting Themes of the NCTM Standards*

Theme (# of Items)	**Grade Level**	**Overall**	**Changed**	**Unchanged**
Problem-solving (11)	Elementary	41	51	38
	Middle	35	41	28
	Secondary	33	39	26
Communication (7)	Elementary	36	45	33
	Middle	37	44	30
	Secondary	38	44	28
Reasoning (3)	Elementary	67	79	64
	Middle	73	81	64
	Secondary	81	88	72
Connections (5)	Elementary	61	73	59
	Middle	53	59	47
	Secondary	41	49	31

* 2 or more times a month

DIFFERENTIATION OF CLASSROOM PRACTICES

It is useful to look specifically at those teachers who perceive themselves as changed as compared to the others. Such a contrast better describes how concentrated the global changes are and how well and in what specific areas motivated and informed teachers are actually implementing *Standards*-like practices. It is worth noting that this is not longitudinal data. The data in this section of the report are comparisons between teachers who report change based on their awareness of the *Standards* and teachers who report no such change.

The data in Table 1 indicate that teachers in the Changed group do indeed report higher frequencies for most of the teaching strategies we asked about, although for many strategies the percent of changed teachers reporting frequent use is still low in absolute terms.

For example, the frequency with which students in the Changed classrooms work on complex or open-ended "project" problems is higher at each grade level than the comparable frequency in Unchanged classrooms. However, fewer than 20% of Changed teachers report using this type of activity more than two times per month. More important, only 20 to 30 percent (depending on grade level) of teachers in the Changed group report that their students never work on project problems compared with 37 to 49 percent of the Unchanged group. Thus, although Changed teachers do not report use of project problems on a truly frequent basis, at all grade levels they are much more likely to use them, as compared with Unchanged teachers.

In a similar manner, with respect to the theme of mathematics as communication, although fewer than 25% of the Changed teachers report asking students to write about mathematical ideas two or more times a month, dramatic contrasts are also evident in the number of teachers in each group reporting that they never use this strategy. At all three grade levels, students in Changed classrooms are much more likely to be asked to do at least some writing about mathematics than students in the Unchanged classrooms.

The comparison of Changed with Unchanged teachers also allows us to identify areas in which even Changed teachers are not adapting to the recommendations of the *Standards*.

For example, the *Curriculum and Evaluation Standards* recommends that students make greater use of computer software to facilitate their development of problem-solving strategies. Although the slight differences in reported frequencies favor the Changed teachers in every case, the low numbers indicate that even teachers who are working to incorporate recommendations of the *Standards* apparently have had difficulty or are not willing to make changes in this area. Discussions in the focus groups identified a number of obstacles specific to the incorporation of technology in mathematics classrooms, including lack of access to hardware and to software applications, lack of training, and lack of time to experiment with existing applications in order to better integrate the use of such applications into their curriculum.

In summary, the evidence suggests that motivated teachers are making more frequent use of the teaching strategies recommended in each of the four areas highlighted by the *Standards*, as compared with the remaining teachers, who reported no efforts to change. These differences in implementation are evident with respect to the recommendations concerning reasoning and connections (which teachers as a whole already appear to be following to a significant degree), as well as those concerning problem-solving and communication (areas in which teachers as a whole report considerable room for improvement). The magnitude of these differences is sometimes substantial even in areas in which the recommendations of the *Standards* diverge from traditional practices, such as journal writing and work on open-ended problems. This analysis also highlights some areas in which progress has been slow even for motivated and aware mathematics teachers, suggesting the need for additional administrative support.

AIDS TO IMPLEMENTATION

Teachers report that more staff development is needed to assist them in making the transition to a more *Standards*-looking curriculum. Even focus group teachers who report that inservices are available often do not see much value in the type that they are receiving. They are requesting more content specific staff development. They overwhelmingly approve of time to see model teachers in action and having quality time discuss teaching ideas. Teachers see support from the principal and the guidance of lead teachers as very important. They want a principal who is well informed, who is able to discuss the *Standards* and who will work with mathematics teachers to find out what is required to implement them.

Comparison of Changed and Unchanged teachers in this area reinforces the impression that administrative support, and an active interest on the part of principals in teachers' efforts at implementation, are important sources of motivation for teachers who are working to change their instructional practices. Among elementary teachers, for example, teachers who were making changes in response to the *Standards* were much more likely to report that their schools or school divisions had:

- designated "lead" teachers
- provided special training for these lead teachers
- revised criteria for textbook selection
- offered one or more in-services on the *Standards*
- maintained a library of *Standards*-relevant materials.

The results of this comparison for middle and secondary school teachers were similar to those just reported for elementary teachers. Teachers who see themselves as changing in response to the recommendations of the *Standards* reported substantially higher levels of active administrative support, relative to teachers who do not see themselves as making such changes. This suggests that administrative changes may have a direct and beneficial effect on classroom practices in mathematics.

OBSTACLES TO IMPLEMENTATION

Time was a primary obstacle to implementation at all three grade levels. Elementary teachers described pressure to make changes in other curriculum areas, such as history and language arts, as well as in mathematics. Secondary teachers were more likely to cite lack of preparation time necessary to develop alternatives to the traditional, sequential mathematics curriculum. They also require time to coordinate with other teachers who worked with students during the prior year, or who would teach these same students the following year, to assure a coordinated sequence of instruction.

A second major obstacle, identified by teachers at all three grade levels, is the pressure to have students succeed on standardized tests. Teachers fear repercussions from administrators and parents in the event that changes in their class structure or content result in decreases in students' scores relative to national norms.

A third major obstacle is lack of resources, particularly technological aids (computers, calculators, and manipulatives). Teachers complained of having outdated equipment or severely limited access to the equipment that is available. Upper elementary and middle grade teachers do not have an accumulated supply of manipulatives and feel that these must be supplied.

Finally, an obstacle that emerged for teachers at the upper grades, but not for elementary teachers, was student ability levels and attitudes about mathematics. Apparently, teachers at middle and secondary schools perceive low levels of student ability as an obstacle to *Standards* implementation, as well as student attitudes about mathematics. These myths need to be addressed during inservice activities. Teachers in the focus groups commented on the improved learning and attitudes of low ability students. In the focus groups, secondary teachers of honors classes also report a reluctance on the part of these high-ability students to engage in open-ended, higher-order thinking activities due to the loss of grade security that such activities can cause.

GENERAL CONCLUSION AND SUMMARY

The implementation of the NCTM *Standards* appears to have the support of the majority of metropolitan teachers. Most are aware of the NCTM *Standards*, have access to a copy of the *Standards*' documents or related material in their schools and are in agreement with them. Significantly fewer teachers have actually made changes in their teaching consistent with the *Standards* or even feel prepared to explain them to colleagues. It is important to remember that "awareness" and "agreement with" the *Standards* is based here on teachers' self-reporting and not on objective classroom observation.

STRENGTHS

Overall the data suggests that there is an unevenness in the level of implementation. Some teachers have made changes, but many have not. However, even within those who have changed, change is not uniform, nor at a level indicative of full implementation. With a recognition of this unevenness, there are some areas where progress can be reported.

At the elementary and middle grades, teachers report use of cooperative groups, an increased use of manipulatives and computers, and there is some evidence of discussion and interaction in the classroom. The greatest areas of strength at the secondary level include mathematics as reasoning, cooperative group work, and the use of calculators.

WEAKNESSES

When looking at the frequency with which most any strategy is used, it is difficult to feel complacent about the data in any given area. Clearly, there remains a lot of work to be done before we can say teachers are actually implementing the *Standards.*

While problem-solving is reportedly done by all teachers, the evidence does not support the use of problem-solving as a global approach to mathematics or as a pervading theme. Nonstandard and project-type problems are infrequently used. The driving force in the classroom remains the textbook.

The area of assessment is perhaps least reflective of the *Standards* than any other area. There is little evidence of alternative forms of assessment, portfolios, or journals. Teachers made almost no distinctions between the use of assessment for diagnostic purposes and for grading. Traditional end-of-chapter and standardized tests remain the most common forms of assessment.

At the elementary level, calculators are used less frequently than desired and evidence would suggest that the curriculum at that level remains dominated by computational skills. While calculators are common at the upper grades and secondary school, there is an inadequate use of computer technology and of graphing calculators. It is not clear whether this is due to lack of availability or teacher reluctance or curricular support.

AIDS AND OBSTACLES

There are two factors that appear to be correlated with a movement toward a *Standards*-like classroom: (1) The support of the administration, especially at the principal level. (2) The initiative of individual teachers to take advantage of opportunities and to be self-starters. In the case of the latter, it is not clear what causes these personal characteristics.

Other factors that influence implementation of change are time (for planning, for inservice and professional growth opportunities), the pressures of standardized testing, quality inservice (or lack of same), and the availability of resources (especially in the area of technology). Teachers at the upper levels note the difficulties of working with students of low abilities as a significant obstacle.

IMPLICATIONS

In many ways, the study did not uncover any major surprises. On the whole, the findings are in agreement with those of the NCTM pilot study. Nor are the findings a surprise to the mathematics supervisors in the MERC school divisions or to the investigators. At the same time, the study does provide data to corroborate the viewpoint that much work

needs to be done and allows us to focus attention on specific areas that deserve attention.

The comments that follow are, of course, based on the independent interpretation of the investigators. However, we believe that they accurately reflect the differences between the findings of the study and the major directions recommended by the NCTM *Standards*.

CURRICULUM AND INSTRUCTIONAL PROCEDURES

Elementary Level

1. The entire area of computation at the elementary level should be looked at. The data suggest that most teachers spend the majority of their time on pencil-and-paper computational skills while spending little time on mental computation and computational estimation. It is fairly clear that the current emphasis is a function of textbooks, standardized testing, and long-standing traditions, each of which have consistently stressed pencil algorithms as the backbone of the elementary mathematics curriculum. The *Standards* calls for a de-emphasis on these outdated skills with an increased emphasis on more flexible and more frequently used mental methods. Teachers will need inservice and support from curriculum materials to make this change.

2. While teachers report addressing the area of problem-solving, it is not clear that the full curriculum is being approached in a problem-solving manner. The first theme standard is mathematics *as* problem-solving. To implement this theme requires teachers to have a more complete understanding of the full intent and philosophy of the *Standards*. Teachers still seem to see mathematics as a rule-driven curriculum rather than one in which students are involved in the discovery and invention of mathematical ideas through problem-solving methods.

3. The data suggest that calculators are only used infrequently in the elementary school. Based on the focus group interviews and on informal observations, it is

most likely that very few teachers require students to have calculators or have them readily available at all times. The *Standards* calls for calculators to be available at all times and to be used in all areas of mathematics including assessment. There are a number of ways to get inexpensive calculators into the hands of every elementary child, including making them required material for school. The daily or regular use of calculators must begin with availability and be followed with ideas for using them.

4. The areas of geometry, probability and statistics should be given significantly more visibility in the required curriculum. The evidence suggests that geometry receives only minimal attention and that probability and statistics are rarely taught. Once again, textbooks, testing programs, and lack of a tradition of teaching in these areas are the targets that need to be addressed.

5. While primary grade teachers are comfortable at least with the idea of using manipulative materials, upper-grade teachers are facing unfamiliar challenges. They lack experience with managing manipulatives in the classroom. They do not have experiences with making materials nor do they have adequate commercial supplies to support a manipulative approach. They also need help with ways to use manipulatives with older students.

Middle School Level

1. As at the elementary level, computation and number sense appear to receive the most attention in the middle-grades curriculum. Although it may appear from the data that teachers include number sense in their instruction, it is not clear that the term *number sense* is clearly understood in the same sense as is meant by the *Standards*. At this level, mental computation and computational estimation are clearly a component of number sense as is a connection of number concepts with real word referents. In these areas, teachers are not reporting strong instructional emphasis. More attention should be given to a broad view of number sense while

simultaneously deemphasizing pencil-and-paper computation. Textbooks, testing, and teacher knowledge of the curriculum must all be addressed in order to promote change.

2. Middle school teachers seem to be considerably more textbook bound than their counterparts at the elementary level. They need more assistance in how to teach mathematics through open-ended explorations, projects, and group work. A problem-solving approach and the use of manipulatives in middle grades is rarely seen. A more exploratory, discussion-oriented approach is recommended by the *Standards*.

3. The middle school teachers tend to use calculators more than at the elementary level but not on a daily or even regular basis by any means. The use of computers is actually weaker than at the elementary level. In fact, due to some of the more recently available computer software, the teacher of the middle grades has more reason to use computers now than ever and the calculator should be an ever-present tool at the disposal of the middle-grades student. In fact, in the 1992 NCTM Yearbook on calculators in mathematics, a strong case is made for the use of graphing calculators at the middle grade level.

4. The curricular areas of patterns, measurement, statistics and probability are all in need of increased emphasis in the middle grades if the *Standards* are to be addressed.

Secondary Level

1. The notion of a core-curriculum at the secondary level is one of the main themes of the NCTM Standards. The core-curriculum concept envisions all students having access to significant mathematics with no one being denied access due to lack of computational skills. The differentiation between college-intending and noncollege-intending students is determined by the depth of study, not what is

studied. Thus, all students should have access to algebra, geometry, probability and statistics, and discrete math topics.

The current study was not designed to determine specifically if a core curriculum was in place. However, there was little evidence that suggested the existence of a core curriculum. For example, there remains a lot of traditional instruction in skill areas for lower-level students. No discussion of addressing a variety of mathematical topics for all students was noted. To move toward a core curriculum is a major step for any school division and requires significant changes in the total curricular offerings for the four years of secondary schools. While the study itself did not uncover such changes, it is noted that at least two of the MERC school divisions have begun implementation of some form of a core-curriculum concept.

2. The secondary teachers in the study report using calculators fairly regularly. However, it is clear from the focus groups that graphing calculators are far from a standard tool. It is more likely that only one or two teachers are using graphing calculators or have taken the time to learn how to use them. For under $70 each, these calculators are essentially small computers that can be programmed, used for investigating graphs, working with statistics, computing matrices, and much more. Students in college-bound programs should be encouraged to purchase their own graphing calculators, schools should have them available for use, and most importantly, nearly every secondary school course should take advantage of them. This will require some training or at the very least some support in terms of curricular materials.

3. Computer usage is also weak and spotty. In the opinion of the teachers, much of the problem is hardware and software compatibility. Simply purchasing computers and/or software is not sufficient Teachers must be afforded time and support to learn about the software and computers must be installed in usable configurations and be compatible with the desired software.

4. Secondary teachers could improve their problem-solving approach to instruction including the use of cooperative learning groups, project problems, and more student writing.

ASSESSMENT

Of the areas investigated, assessment strategies and procedures was the area where teachers have made the least amount of change in the direction of the *Standards*. This is true at all grade levels and little is gained by separating the three levels in this discussion.

The predominant mode of assessment is the chapter test and related quizzes. While teachers report that they assess concepts as well as procedures, an examination of the typical chapter test will indicate that the conceptual understanding required is minimal. Most teachers are concerned about standardized testing, reporting numeric grades backed up by test averages and the performance of routine procedures. While these are not bad objectives, they represent an incomplete approach to assessment.

In their reporting, teachers made almost no distinction between the use of any assessment procedure for grading purposes versus instructional feedback or diagnosis. One interpretation that may be made is that they really do not make this distinction at all. It is unlikely that they do as much assessment for diagnosis as for grading as is suggested by the data.

The *Standards* calls for assessment to be much less distinct from instruction than has traditionally been the case. By broadening an assessment plan to include observations, checklists, portfolios of work, group projects, and performance tasks, the things that students do in class as part of their learning experiences can also be included in an assessment plan. Furthermore, the *Standards* calls for alignment of all assessment, not just with objectives of the course but also with the methods of instruction. If calculators

and/or manipulative materials are used in the instructional program perhaps they should also be used in the assessments.

With the possible exception of some observations and group work being used at the elementary level and calculators permitted in most secondary class testing situations, it is safe to say that teachers are still using the same assessment procedures that they always have.

The researchers' experiences with teachers taking courses suggest that learning to implement and use effectively a broader, performance-based plan of assessment that is integral to instruction, is a very difficult task. It requires considerable instruction in assessment strategies and having the opportunity to try them out in the classroom. Teachers must begin small and find one or two new ideas that suit their personal style and agenda. From this beginning they can gain confidence and add additional strategies later.

Teachers who do adopt a variety of alternative assessment procedures tend to be very positive about the results – except for the hard work that is almost always involved. If school divisions want to help teachers look more broadly at student achievement and report more accurately to parents what students are able to do (instead of what they cannot do), schools must do more than provide one-shot inservice. They must develop a plan that will guide and support teachers, offer them choices, and show them the benefits of the additional work involved. This is easily one of the most difficult areas of the *Standards* to implement.

AIDS TO IMPLEMENTATION

The data, especially the focus group interviews, provide useful information concerning the types of things that can influence (or hinder) change and general implementation of the *Standards*. Some of these things must involve division change or division implementation. We might call these structural changes - changes that are beyond the control of the

individual teacher or principal. Other factors influencing change are more local. These factors are under the control of the building principal or department chair, or can be dealt with through inservice and other avenues of professional growth. Local factors are still influenced at the division level. For example, providing quality, focused inservice is listed here as a nonstructural aid. However, to follow up on that inservice or to implement the suggestions remain in the control of the teachers and principal. Implementation of a core curriculum at the secondary level is clearly structural, requiring division implementation.

Structural Initiatives

1. The development of a clear policy relative to the NCTM *Standards*, coupled with information and appropriate modifications in the curriculum, would help teachers and principals have a sense of direction that is sometimes lacking. Teachers, even those who are well aware of the *Standards*, are not clear about what they themselves should be doing in the classroom. Conflicting messages concerning objective lists, SOL's, ITBS and other mandates are not always in sync with the message of the *Standards.* It is not reasonable for teachers to be expected to make change with only a simple admonition that we support the *Standards*. Information about the *Standards* and how the division views implementation is important for all concerned.

2. Testing policies should be examined to be in keeping with the *Standards*. It is, of course, important to be aware of test scores as a measure of how well a school or division is doing. However, it is now very important to take a careful look at the items that are included in those tests. The current version of the ITBS is heavily weighted toward procedural or algorithmic knowledge with very little emphasis given to concepts and problem-solving skills. Textbooks also have chapter-end tests that tend to focus on the lowest level skills of the chapter.

3. Examine policies relative to textbook adoption and be certain that they are in keeping with the spirit of the *Standards*. When textbooks are not in keeping with pronounced directions, either because they are out of date or because they were selected with out-dated criteria, they are of no real help to teachers.

Local Initiatives

1. Promote and support the lead teacher concept. Many teachers talked of the value of having a lead teacher in the school – someone they could count on to have current information or a good idea to solve a problem. Lead teachers are present in many divisions but require the constant support of principals since no moneys are available for mathematics specialists. At the secondary level, the department chairs should be encouraged to be instructional leaders in the same way as the lead teacher is at the elementary and middle school level.

2. Make opportunities for teachers to observe one another within the buildings and encourage teachers to share ideas and problems about teaching mathematics. Teachers truly value ideas that come from their colleagues.

3. Provide quality inservice that is focused on specific classroom issues in the teaching of mathematics. Teachers react negatively to inservice that is not specifically useful to them or is so general in nature that significant implementation problems make using the information nearly impossible. Relevance of inservice is very important. If the inservice is good, support should be available to follow up on it. That support should come in the form of sharing, materials, encouragement, and time to work on implementation.

4. Principals need to be knowledgeable about the NCTM *Standards*. While a relatively high number report awareness of the *Standards,* there is also evidence that a principal who is truly involved in making the *Standards* a reality in the school is somewhat of an anomaly. As teachers spend extra time and effort at

implementation of new ideas and request support for materials, manuals, software, calculators, and help from others, these efforts and requests must not fall on deaf ears. Teachers cannot implement the *Standards* without support.

5. Be very sure that teachers are aware of opportunities for professional growth. Professional journals and books from NCTM could be made available. Opportunities to attend conferences at the local, state, regional and even national level should at the very least be well publicized and discussed. When possible, funds, such as Eisenhower money, should be made available to get teachers to these meetings. Teachers should be encouraged to attend special training courses, take workshops and even university courses. When teachers do make these efforts, their efforts should be rewarded - at the very least with recognition and praise if not with more tangible means of support for work in the classroom.

6. Examine issues and concerns around technology. Simple calculators should be available to every child at all times. Teachers should not have to go to a central place to get the "grade-level" set. Where reasonable, school policy could permit students be required to bring a simple calculator to school. For more expensive technologies, similar policies should be made in cooperation with the teachers. Care should be taken to see that computers that are available are in good repair, that there is reasonable software to use on the computers. All teachers at all levels need help in how to use technologies in their courses. It is not reasonable to expect them to use a new tool without assistance.

CONCLUSION

The NCTM *Standards* document is now four years old and the *Professional Teaching Standards* are two years old. These recommendations, while universally accepted across the nation, are not likely to be easily implemented in their entirety. NCTM itself recognizes that true implementation is a long-term endeavor that will extend into the next century. The findings of this survey are generally consistent with these expectations. There is

some movement in a positive direction as more and more teachers are at least aware of an agenda for change. Actual significant change on any global basis, however, is very difficult to find. Teachers are in serious need of support as well as education concerning what the *Standards* are actually saying.

Glenda Lappan, Chair of the Commission on Teaching Standards for School Mathematics, writes:

> *The kinds of change called for by the vision in the standards documents are so fundamental and pervasive that they seep into every aspect of our society. The current curriculum, expectations, and teaching practices are failing with so many of our students in mathematics that we have a responsibility to rethink what we are about. To accomplish change on a large scale, all the stakeholders - students, teachers, parents, school administrators, business, industry, professional mathematicians, politicians, and others - need to understand the issues and the direction of reform and give their support to the effort.*
> Arithmetic Teacher, May, 1993, p. 526.

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APPENDIX A

TEACHER SURVEY

APPENDIX A: TEACHER SURVEY METHODOLOGY

SUBJECTS

Responses were received from 1,892 teachers (1473 elementary, 221 middle, and 198 secondary teachers) for an overall response rate of 55%. The majority (92%) of the respondents are female with a median age of approximately 40 years. Overall, the respondents are an experienced group. About two thirds of the teachers completed their teacher training before 1980 and 48% have had additional training in mathematics beyond their initial certification. Half of the teachers have 15 or more years of experience teaching. The middle and secondary teachers are relatively active in professional organizations with 55% reporting that they are past or present members of GRCTM; 29% are or have been members of VCTM or NCTM. Less than 8% of elementary teachers are members of any mathematics professional association. (See Tables 1-3 in Appendix D for the raw data on which this summary is based.)

SURVEY DESIGN

Item selection

Items were chosen to reflect teachers' awareness of the *Standards*, their classroom practices with one of the mathematics classes they are currently teaching (specified as the first mathematics they taught the week they filled out the survey), and their perceptions of aids and obstacles to implementing the *Standards* in their classrooms and in their schools or divisions. Thus, the survey is organized into four major sections (item counts are for the final version of the survey):

SECTION 1: identifying data (13 items);

SECTION 2: awareness of *Standards*/preparedness to teach accordingly (21 items);

SECTION 3: classroom practices (90 items);

SECTION 4: aids and obstacles to *Standards* implementation (32 items).

Most items were developed for the survey based on the recommendations of the *Standards*, published articles on implementing the *Standards*, and the suggestions of mathematics coordinators in the MERC school divisions, who collaborated in the design of the survey. Approximately one-third of the items were identical to items on the NCTM (1992) pilot study on mathematics education to allow for comparisons with a national sample. Item content and selection for each section is discussed in more detail below.

Section 1 contains items reflecting teacher age, gender, training, and teaching experience, as well as the grade level, size, and ability level of the mathematics class the teacher will be describing on the remainder of the survey.

Section 2 contains items reflecting teachers' level of awareness of (a) the *Curriculum and Evaluation Standards*, and (b) the *Professional Standards for Teaching Mathematics*. Teachers who report that they are well aware of the *Curriculum and Evaluation Standards* are asked to respond to 8 items reflecting the extent of this awareness, their perceptions of the level of awareness of other teachers in their school, and their own and other teachers' efforts to make changes in their classroom practices based on the recommendations of the *Standards*. Another 9 items, taken from the NCTM pilot study, reflected teachers' preparedness to teach according to the *Standards*. Two items assessed the extent to which teachers have access to a copy of the *Standards*, or to materials reflecting the recommendations of the *Standards*.

Section 3 contains 30 items, taken from the NCTM pilot study, reflecting the content of mathematics instruction. Because these items are keyed to teacher grade level (separate questions for elementary, middle, and secondary teachers), each teacher responded to only about 10 items in this subsection. Another 11 items, also taken from the NCTM pilot study, reflect the frequency with which students in the mathematics class perform a variety of classroom activities. These activities are rather broadly defined (e.g., "do mathematics problems from textbooks," " use calculators"), and include activities whose

frequency should be decreased in a typical mathematics class, according to the *Standards*, as well as activities whose frequency would ideally be increased.

Section 3 also contains 26 items reflecting more fine-grained "teaching strategies." These items also describe classroom activities (e.g., "work on nonroutine problems," "report to the class on the results of mathematical investigations") and ask teachers to report the frequency with which their students engage in these activities. All activities in this subsection are recommended in the *Standards*, and items are grouped in accordance with the instructional goals advocated by the *Standards*: problem-solving, communication, reasoning, and connections.

Lastly, Section 3 contains a 23-item subsection on "assessment strategies." Teachers are asked to indicate the degree of emphasis they give to 7 different assessment modalities, either for (a) grading purposes, or for (b) diagnosis or instructional planning purposes. Another 6 items reflect "aims of assessment," and a final 3 items reflect the frequency with which manipulatives, calculators, and computers, respectively, are used by students in the context of assessment.

Section 4 includes 23 items enumerating various aids to *Standards* implementation. These items were derived from descriptions by the MERC mathematics coordinators of the initiatives taken by local schools and school divisions, as well as suggestions from the literature on implementation. They are grouped into three categories: "teacher training"; "policies and practices"; and "informal changes in school 'culture'." For each item, teachers indicated both (a) whether or not their school or school division had attempted such an intervention, and (b) whether or not it was (would be) helpful. The final 9 items in this section list potential obstacles to implementation, again derived both from suggestions by mathematics coordinators and from the literature. Teachers are asked to identify the extent to which each of these items is an obstacle in their attempts to implement *Standards*-congruent changes in their mathematics classes.

The final two pages of the survey included a space for written comments, as well as an invitation to volunteer to be one of the focus group discussants. Teachers who offered to participate in the focus groups were asked to give their names and telephone numbers.

Pilot Survey

Following the initial selection of items, the survey was piloted in one small school division. The pilot version of the survey was distributed to 58 mathematics teachers in the three schools in this division. Responses were received from 51 (88%) of these teachers, including 37 elementary, 9 middle, and 5 secondary teachers.

Teachers in the pilot division were asked to respond to the survey itself and also to fill out a "comment form" indicating the time taken to complete the survey and enumerating any items that were unclear or otherwise difficult to answer. These comments formed the basis for a modest revision of the survey, in which problematic items were deleted or reworded for greater clarity. In addition, pilot teachers' survey responses were used to assess both convergent and discriminant validity of survey items.

Patterns of responding on related items indicated that teachers' responses were consistent on the different sections of the survey (i.e., they were not responding randomly or otherwise haphazardly due to the survey's length). There appeared to be meaningful differences in classroom practices and teaching strategies between teachers who reported being "well aware" of the *Standards* and those who were not well aware. Patterns of responses on similar but not identical items were assessed in an effort to ascertain whether teachers were discriminating between them. Several apparently redundant items were deleted or reworded in an effort to make the intended distinctions more obvious.

These deletions and revisions resulted in the 156-item survey described in the previous section.

SURVEY DISTRIBUTION

The final version of the survey was distributed to teachers in six MERC school divisions via these divisions' internal mail services. Teachers received a copy of the survey, a blank answer sheet, and a memo from their superintendent's office explaining the purpose of the survey and assuring them of the confidentiality of their responses. Except for those teachers volunteering to participate in a focus group, responses were given anonymously. Completed surveys were returned to the school principal's office, then sent back to the district central office for pick-up by the survey team.

Although the school divisions were given the same prototype for the explanatory letter to teachers, administrators were permitted to make minor modifications in this letter as they saw fit. As a result, teachers in different divisions received different levels of encouragement to participate in the survey. At the extremes, one district's letter emphasized the small amount of time required to complete the survey, and the value to the district of teachers' responses; another district emphasized the voluntary nature of the survey, and stated that teachers should not respond if they felt they did not have the time. These differences in presentation may account, in part, for the variability in response rates between divisions. A substantial proportion of the teachers in each district did respond to the survey, however: Three smaller divisions had response rates of 64%, 82%, and 82%; three larger divisions had response rates of 39%, 47%, and 73%. Responses from all divisions were combined in all analyses.

DATA ANALYSIS

Missing data

Because instructional conditions vary according to the grade level taught, teachers were grouped according to grade level for all analyses. These groupings followed the designations of the vast majority of MERC schools (elementary: K-5; middle: 6-8; secondary: 9-12), rather than the groupings used in the *Standards* (K-4; 5-8; 9-12). For teachers who failed to indicate the grade level of students in their mathematics class, or who indicated more than one grade level, an attempt was made to assign these teachers

to one of the three categories based on their responses to the items in Section 3 that were split by grade level. If no determination could be made, the protocol was excluded from analyses (21 protocols excluded).

Because awareness of the *Standards* was of primary interest, and because teachers' awareness of the *Standards* (or lack thereof) was a criterion for dividing respondents into groups for comparison purposes, teachers who failed to answer the item reflecting their awareness of the *Standards* were also excluded from the analysis (23 protocols excluded).

Analyses

As noted above, responses were analyzed within grade levels. Frequency of responses were examined for demographic items, items reflecting awareness of the *Standards*, and items reflecting course content, in order to assess the distribution of responses in each grade level taken as a whole.

Other items in Sections 2 and 3, as well as items reflecting aids to implementation (Section 4), were analyzed by comparing the response frequencies among two groups of teachers: the "Changed" group (teachers who were aware of the *Standards* and reported having changed what and how they teach based on this awareness) and the "Unchanged" group (all other teachers). To index items on which Changed and Unchanged teachers responded differently, chi square statistics were computed comparing response distributions between the two groups. Due to relatively small sample sizes at the middle and secondary levels, and to the large number of chi square statistics computed (approximately 90 tests at each grade level), no attempt was made to establish the statistical significance of these tests. Rather, they were used to identify items on which patterns of responding differed between the Changed and Unchanged groups, and the practical significance of these differences was discussed by examining these frequency distributions.

FINDINGS

AWARENESS OF THE *STANDARDS*

Awareness of the *Standards* is somewhat better at the middle and secondary school levels than at the elementary level. Most middle and secondary teachers are aware of the *Standards*, and report access in their school to either a copy of the *Standards* or materials describing *Standards*-like curriculum and assessment practices. In addition, slightly less than half own their own copy of the *Curriculum and Evaluation Standards*. While 87% of the elementary teachers reported access to either a copy of the *Standards* or materials describing *Standards*-like curriculum and assessment practices, and one third say they own a copy of them, only 44% described themselves as "well aware" of the NCTM *Curriculum and Evaluation Standards*. Awareness of the *Professional Standards for Teaching Mathematics* is not quite as good, with slightly less than half of middle and secondary teachers and about one third of elementary teachers aware of this document.

Of the teachers who are aware of the *Curriculum and Evaluation Standards*, over 75% of middle and secondary teachers and 65% of elementary teachers consider themselves well informed about and in agreement with the *Standards*. Yet, less than 40% of the middle and secondary teachers and 23% of elementary teachers feel prepared to explain the NCTM *Standards* to their colleagues. Although about 70% of teachers at each level would like to make changes in their classrooms in accordance with the recommendations of the *Standards*, only about half at the middle and secondary levels, and about one-fifth at the elementary level, report having done so.

Of the three grade levels, middle school teachers were most likely to report that their district has made *Standards*-based changes in the mathematics curriculum, followed by secondary and elementary teachers (68%, 50% and 38% respectively). Less than half of the teachers at any level think that most other teachers are well informed about the *Standards* and fewer than a third report that other teachers have made changes in what and how they teach based on the *Standards*.

Conclusions

The mathematics teachers in the MERC Consortium are well aware of the NCTM *Standards*, about two times as many teachers as were aware of them in a pilot study reported by NCTM (1992). However, of the MERC teachers who are aware of the *Standards*, many fewer are prepared to explain them to colleagues than in the NCTM national sample. This suggests that the word about the *Standards* is getting out, but much work remains to help teachers feel comfortable with the changes in teaching and assessment that the *Standards* require. See Appendix D, Tables 4-9 for the raw data on which this summary is based.

PREPAREDNESS TO TEACH ACCORDING TO THE *STANDARDS*

These items, adapted from the NCTM (1992) pilot study, indicate how well prepared teachers feel to perform activities recommended in the *Standards* documents. Overall, teachers at all three levels feel well prepared to use more open ended questions, treat the textbook as a resource, manage manipulatives, teach heterogeneous groups, use cooperative learning, incorporate calculators and computers as integral parts of instruction, use a variety of alternative assessment strategies, and involve parents in the mathematics education of their children. At least 20% at all three grade levels, however, reported being unprepared to use computers and alternative assessment strategies. In addition, at least 20% of middle school teachers reported being unprepared to teach heterogeneous groups; at least 20% of elementary teachers say they are unprepared to use the text as a resource and to use calculators; at least 20% of secondary teachers are unprepared to use the text as a resource, to teach heterogeneous groups, or to involve parents.

Conclusions

Helping MERC Consortium teachers teach according to the *Standards* should be facilitated somewhat because they do feel well prepared to carry out a number of classroom activities that are recommended in the *Standards* documents. This, too, is consistent with the NCTM (1992) pilot data. Particular areas of weakness for all three

grade levels would be the use of computers and of alternative assessment activities. See Appendix D, Tables 10-12 for the raw data on which this summary is based.

CONSISTENCY OF CLASSROOM PRACTICES WITH *STANDARDS* 1-4

Our goal is to provide a snapshot that characterizes the extent to which the majority of mathematics teachers teach in ways that are consistent with the NCTM *Standards*. Because curriculum and instruction can be expected to vary according to the type of course and the ability level of students, this section of the survey asked teachers to focus on a particular mathematics class; those who teach more than one mathematics class each day were asked to focus on the first mathematics class of the week. Teachers were asked to describe the general content of that class and the ability level of the students.

Within each content area, we first summarize the survey results for all teachers. Then, we address ways in which the responses of Changed and Unchanged teachers differ for this content area.

Elementary School

The grades K through 5 were evenly represented in the sample. Most of the classes at these grade levels consisted of 21 or more students of mixed or average ability.

Curriculum

These questions asked teachers to indicate the level of emphasis that they give to curriculum areas recommended in the *Standards* documents. Nearly 70% of elementary teachers report giving heavy emphasis in their instruction to number sense and numeration, concepts of whole number operations, and whole number computation. Over 70% give moderate emphasis to estimation, and patterns and relationships and little to moderate emphasis to geometry and spatial sense, measurement, and fractions and decimals. Over 70% give little or no emphasis to statistics and probability. The evidence suggests that teachers who report changes in their teaching based on the *Standards* give

a bit more emphasis to estimation, geometry and spatial sense, statistics and probability, and patterns and relationships than teachers who are not aware of the *Standards*.

Conclusions. The instructional emphases in the MERC elementary classrooms closely parallels the NCTM (1992) national pilot data. The curricular areas given the most emphasis in each sample are whole number computation, number sense and numeration, and concepts of whole number operations. The least emphasis in each sample is given to statistics and probability. See Appendix D, Tables 13a and 13b for the raw data on which this summary is based.

Class Activities

If you walked into a randomly chosen elementary school mathematics class, you would still find a rather traditional looking mathematics class with some indications that things are changing. Most teachers still rely on the mathematics textbook and problems from it. Children rarely use calculators. In fact, elementary students apparently use computers more often than calculators. However, signs of implementation appear in over 60% of elementary classrooms where children would be asked to explain their reasoning about how to solve a problem and would use manipulative materials at least twice a week. You would also find that in about half of the classrooms, students rarely listen and take notes.

Furthermore, in over 60% of classrooms of teachers who say they have changed their teaching, you would find students engaged with cooperative groups, using manipulatives, and learning mathematics through real-life applications. In addition, students would more often be asked to make conjectures and explore possible methods to solve a mathematical problem, work on mathematics projects, and use calculators.

Conclusions. These data closely parallel the NCTM (1992) pilot survey data. The two class activities recommended in the NCTM *Standards* documents that are frequently used in a substantial number of elementary mathematics classes are having students explain their reasoning and using manipulatives. The heavy reliance on textbooks, however,

suggests that a major shift in thinking about mathematics teaching still needs to occur. Weaknesses in classroom activities include the very low use of calculators and work on mathematics projects. The low use of calculators is corroborated by the data reported in a previous section which suggests that a substantial number of elementary teachers do not feel prepared to use calculators. See Appendix D, Tables 16a and 16b for the raw data on which this summary is based.

Teaching Strategies

Teachers were asked to respond to a variety of teaching strategies based on recommendations in the NCTM standards (See Appendix D, Tables 19a and 19b for the complete set of items and raw data). While it is clear that students in most elementary mathematics classes have the opportunity to engage in these behaviors occasionally, few do so on a regular basis. None of the strategies is used more than once a week by even 40% of the teachers. The strategies experienced two to four times a month by students in at least 60% of the elementary classrooms are:

* cooperative problem-solving, both in small groups and as a class;
* discussion to reflect on and clarify their thinking about mathematical ideas;
* discussion to relate models, pictures, or diagrams to mathematical ideas;
* justify their answers to mathematical problems;
* experience a climate of openness and inquiry;
* respond to questions designed to focus their attention on their own reasoning processes;
* use a variety of different representations of the same mathematical concept or procedure.

In addition to the above strategies, at least 60% of the teachers who report that they have changed their teaching also report engaging in the following strategies at least twice a month:

* develop and apply strategies that can be used to solve a wide variety of mathematical problems
* describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties
* explore applications of mathematical ideas in their lives
* appreciate the role of mathematics in our culture and society

* make meaningful connections between different areas of the mathematics curriculum
* see, use and apply mathematics in other content areas, such as literature, sciences, social studies, and art.

Those strategies that students in over 70% of elementary classrooms experience rarely or not at all are:

* "project" problems
* writing about mathematical ideas with journals or portfolios,
* making and discussing mathematical conjectures.

In contrast, the evidence suggests that elementary teachers who report change are beginning to use these strategies at least occasionally. In addition, they more often have students report to the class on the results of mathematical investigations and formulate definitions and/or express generalizations of mathematical principles.

Conclusions. Of the 26 strategies described in the survey, at least 60% of the teachers reported using eight of them two to four times a month. Three of those eight had to do with the reasoning theme of the *Standards*, two with the problem-solving theme, two with the communications theme, and one with mathematical connections. The teachers who report having changed their teaching used another six strategies on an occasional basis (one problem-solving, one communications, and four connections strategies). While it seems that the connections and reasoning themes appear to be the easiest to implement at the elementary level, we must remember that the number of items representing each theme varied, and teachers may not fully understand the ramifications of them.

Middle School

The first mathematics class of the day for the middle school teachers typically was an average or mixed ability class with 26 or more students.

Curriculum

In describing their curriculum, over 80% of middle school teachers indicated moderate or heavy emphasis on number and number relationships, number system and number theory, computation, estimation, and geometry. Over 70% indicated little to moderate emphasis on patterns, measurement, statistics, and probability. The teachers who are aware of the *Standards* and reported making changes in accordance with them also were more likely to report heavy emphasis (as opposed to moderate emphasis) on number and number relationships, and number system and number theory. In addition, they emphasize patterns, statistics, probability, algebra, and geometry a bit more than other teachers. They were less likely to give heavy emphasis to computation.

Conclusions. The instructional emphases in MERC middle school classrooms closely parallel the NCTM (1992) pilot data with two exceptions. MERC classrooms seem to emphasize geometry more and measurement less than the national sample. In each case, computation is overemphasized. Statistics, probability and functions are least emphasized in middle school classrooms. See Appendix D, Tables 14a and 14b for the raw data on which this summary is based.

Class Activities

None of the 11 activities described in the survey is experienced on a daily basis in the middle school classrooms (See Appendix D, Tables 17a and 17b for the raw data on which this summary is based). The data suggest that in contrast to *Standards* recommendations, the students in the typical middle school mathematics class would do mathematics problems from textbooks two or more times a week. They also would do mathematics problems from worksheets and listen and take notes during a teacher presentation at least once a week. Evidence that the *Standards* are beginning to be implemented in middle school mathematics classes is that the majority of students would be asked to explain their reasoning two to three times a week, and work in small cooperative groups, make conjectures and explore possible methods to solve a mathematical problem, and learn about mathematics though real-life applications at least

once a week. Class activities recommended in the *Standards* documents that are used least often are mathematical projects and computers.

In the classrooms of teachers who report that they have changed their teaching, students more frequently explain their reasoning about how to solve problems, work on mathematics projects, make conjectures and explore possible methods to solve a mathematical problem, use calculators and manipulatives. These changes are not big ones, but they are obvious shifts in teaching.

Conclusions. The use of *Standards* recommended class activities in MERC middle school classrooms is somewhat similar to the NCTM (1992) pilot data. MERC classrooms show a lower frequency of mathematics worksheets, mathematics projects, use of computers and calculators. However, in contrast to *Standards* recommendations, MERC classrooms had a higher frequency of listening and taking notes from a teacher presentation.

Teaching Strategies

In another vein, teachers were asked to respond to various teaching strategies based on the NCTM *Standards*. While it is clear that students in most middle school mathematics classes engage in these behaviors occasionally, few do so on a regular basis. Few of the strategies are used more than once a week by even 25% of the teachers. The strategies experienced two to four times a month by students in at least 60% of the middle school classrooms are:

* use discussion in order to reflect or clarify their thinking about mathematical ideas or situations
* justify their answers to mathematical problems
* experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration
* respond to questions designed to focus their attention on their own reasoning processes.

In addition to the above, strategies that at least 60% of the middle school teachers who report change cite as using at least two to four times a month are:

* verify and interpret the results of their work with respect to the original problem
* engage in cooperative group problem-solving either as a class, or in small groups
* use discussion to relate models, pictures, or diagrams to mathematical ideas
* use a variety of different representations of the same mathematical concept or procedure
* explore applications of mathematical ideas in their daily lives
* appreciate the role of mathematics in our culture and society.

Finally, a number of strategies are used rarely or not at all by over 60% of the middle school teachers. They are:

* use computer software to facilitate the development of problem-solving activities
* work on "project problems"
* write about mathematical ideas
* make and develop mathematical conjectures
* report to the class on mathematical investigations

Conclusions. Of the 26 teaching strategies described in the survey, at least 60% of the middle school teachers reported using four of them two to four times a month (two dealt with the communications theme and two with the reasoning theme of the *Standards*). Teachers who report having changed their teaching cite another six strategies (two problem-solving based strategies and four connections based strategies). See Tables 20a and 20b in Appendix D for the raw data on which this summary is based.

Secondary School

The first class of the day for the secondary teachers generally had 21 or more students. These classes were well distributed with respect to student ability levels and subject areas.

Class Activities

As with the other grade levels, the majority of secondary mathematics classes still look fairly traditional with students doing mathematics problems from textbooks at least twice a week, and doing mathematics problems on worksheets, and listening and taking notes during a teacher presentation at least once a week. More consistent with the *Standards*, students work on mathematics projects, use calculators, and explain their reasoning about how to solve a problem at least twice a week. At least once a week, students also learn about mathematics through real-life applications, and make conjectures and explore possible methods to solve a mathematical problem. Although recommended in the *Standards*, it is unusual to find secondary students working on mathematics projects, using computers, or manipulatives on a regular basis.

Teachers who report having changed their teaching in accordance with the *Standards* are somewhat more likely to engage students in working on mathematics projects, making conjectures and exploring possible methods to solve mathematics problems, learning about mathematics through real-life applications, explaining their reasoning about how to solve a problem, and using calculators, computers, and manipulatives.

Conclusions. Mathematics teaching at the secondary level appears to be very traditional, with the majority of classrooms relying on textbook problems and teacher presentations. Nevertheless, three activities recommended in the *Standards* documents are used by at least half of secondary mathematics teachers: using calculators, explaining reasoning, and making conjectures and exploring possible methods of solving mathematical problems on a regular basis. The use of mathematics projects, computers, and manipulatives are the most noticeable weaknesses. See Tables 18a and 18b in Appendix D for the raw data on which this summary is based.

Teaching Strategies

Teachers were also asked to respond to various teaching strategies based on the NCTM *Standards* (See Appendix D, Tables 21a and 21b for the raw data on which this summary

is based). While it is clear that students in most of these classes engage in these behaviors occasionally, few do so on a regular basis. Three strategies recommended in the *Standards* documents are reportedly used by at least 50% of the teachers at least once a week. Students are expected to:

* justify their answers to mathematical problems
* experience a climate of openness and inquiry in mathematics where both students' and teachers' statements are open to question, reaction, and elaboration
* respond to questions designed to focus their attention on their own reasoning processes.

Other strategies students in at least 50% of the classes were experienced two to four times a month:

* verify and interpret the results of their work with respect to the original problem
* cooperative group problem-solving, both as a class, and in small groups
* discussion in order to reflect on or clarify their thinking about mathematical ideas
* describe orally how they reached a solution, including difficulties encountered and methods for overcoming them.

Furthermore, the one item that was reported as used not at all by at least 50% of secondary teachers is writing about mathematical ideas.

At least half of the secondary teachers who reported that they had changed their teaching based on the *Standards* used all of the above strategies as well as a few others two to four times a month. Their students were also asked to:

* develop and apply strategies that can be used to solve a wide variety of mathematical problems
* use discussion to relate models, pictures, or diagrams to mathematical ideas
* use a variety of different representations of the same concept or procedure.

Conclusions. Of the 26 teaching strategies described in the survey, three were used on a once a week basis by at least half of the teachers. Each of these was designed to

promote mathematical reasoning. In addition, six strategies were used two to four times a month by at least half of the secondary teachers: three problem-solving strategies, two communications strategies, and one connections strategy. At least half of the teachers who reported having changed their teaching cite three additional strategies that they use two to four times a month: one each from problem-solving, communication and connections.

It appears that the secondary teachers already do a lot with mathematical reasoning since all three of the strategies in the survey occur with weekly frequency in half of the classrooms. The other themes appear about equally difficult to implement at the secondary level.

"TO WHAT EXTENT DO ASSESSMENT PRACTICES SUPPORT THE IMPLEMENTATION OF *STANDARDS* 1-4?"

The *Standards* documents emphasize that multiple sources of information are important for assessment. Teachers were asked to indicate which sources of information they use for two purposes: grading, and instructional feedback and diagnosis.

Elementary School

Over 70% of teachers report giving moderate to heavy emphasis in grading to written quizzes and tests, and checklists or observations. For diagnosis and instructional feedback purposes, over half of elementary teachers report giving moderate to heavy emphasis to quizzes and tests, homework, and checklists and observations. Practices recommended in the *Standards* that are not used in over half of classrooms for either grading or diagnostic purposes are portfolios, journals, and projects.

Teachers who report that they have changed their teaching, also report that they use journals and projects more frequently both for grading and for diagnosis purposes, although even they don't give either much emphasis.

Over 60% of elementary teachers report that the focus of their assessment is largely on students' understanding of the concepts and their ability to perform mathematical procedures. Fewer than half are concerned with students' understanding of how/why the procedures work, problem-solving processes, and reasoning skills. Teachers who report change also report being somewhat more concerned with the assessment of the problem-solving processes than do other teachers.

In contrast to recommendations in the *Standards*, teachers rarely allow students to use calculators and computers during assessment activities. Teachers who report changing their teaching, however, are moving in the direction of allowing students to use calculators at least occasionally during assessment.

Conclusions

Elementary teachers appear to make little distinction between assessment for grading purposes and assessment for diagnosis and instructional feedback. In addition, most teachers have not brought their assessment practices in line with *Standards* recommendations. For grading purposes, opportunities for students to be graded on written communication of their understanding mathematical ideas as well as the application of learning to new contexts are minimal. Although teachers who report that they have changed are somewhat more likely to use these techniques, the data suggest that they have made few changes in their assessment practices. For instructional feedback purposes, they do not use written presentations, projects or cooperative group work as often as they might.

The *Standards* documents recommend that assessment of student's learning should include knowledge about their ability to apply their knowledge to solve problems, communicate mathematical ideas in mathematical language, reason and analyze, understand concepts and procedures. Most teachers, however, emphasize an understanding of concepts and computation, an aspect of mathematical knowledge deemphasized in the *Standards* documents. The more complex purposes of assessment

such as reasoning, problem-solving and understanding how the procedures work are not adopted, consistent with the assessment activities chosen.

Although the *Standards* documents recommend using manipulatives, calculators and computers in assessment, teachers rarely allow the use of calculators and computers. Surprisingly, computers are in use even more than the cheaper, more accessible calculator. While teachers who report change are slightly more likely to assess problem-solving and allow the use of calculators, the data still suggest that few changes have been made in assessment activities. Tables 22a and 22b, 25a and 25b, and 28a and 28b in Appendix D present the data on which this summary is based.

Middle School

The majority of middle school teachers report giving heavy emphasis to quizzes and tests in grading students. In addition, homework, checklists/observations, cooperative group products, and projects receive little to moderate emphasis. With regard to diagnosis and instructional feedback purposes, quizzes, tests, and homework receive moderate to heavy emphasis. Cooperative group products, and projects receive little to moderate emphasis. The majority of teachers give no emphasis to portfolios or student journals for either grading or diagnosis purposes. Teachers who report having changed, however, were slightly more likely to use journals and student projects for both grading and diagnosis purposes.

The major focus of assessment for middle school teachers is students' understanding of the concepts you teach and their ability to perform mathematical procedures. Teachers who reported change were more likely to systematically gather information about problem-solving processes and reasoning skills as a major focus of their assessment.

In contrast to elementary teachers, calculators were used in assessment on a regular basis in middle school classrooms. Computers, however are rarely, if ever, used.

Manipulatives are used in assessment at least occasionally by at about half of the teachers, most of whom are teachers who report that they have changed their teaching.

Conclusions

As with the elementary teachers, middle school teachers do not seem to distinguish between assessment for grading and assessment for diagnosis and instructional feedback. They also have made few adjustments in assessment practices consistent with the recommendations in the *Standards* for student learning. For example, middle school teachers rarely assess students' ability to communicate mathematical ideas or the application of learning to new contexts as you would find with portfolios, projects, and journals. Information about problem-solving processes and reasoning skills is not a major focus of their assessment.

While computers are rarely if ever used in assessment at the middle school level, it is good to see that calculators are used on a regular basis. Furthermore, manipulatives are used on an occasional basis by teachers who report having changed their teaching. Tables 23a and 23b, 26a and 26b, and 29a and 29b Appendix D present the data on which this summary is based.

Secondary School

As with teachers at the other levels, secondary teachers indicate that they give heavy emphasis to tests and quizzes in grading as well as for diagnosis and instructional feedback. In addition, homework and products of cooperative groups and projects receive little to moderate emphasis by over 50% of the teachers for grading. Homework and products of cooperative group work receive little to moderate emphasis by the majority of teachers. Portfolios and journals are not used by most teachers. Teachers who report that they have changed their teaching use checklists or direct observations and individual projects more often than other teachers for diagnosis purposes. Individual projects also figure somewhat more prominently in their grading.

Over 60% of the teachers reported that a primary focus of their assessment was to systematically gather evidence about students' understanding of the concepts that were taught and their ability to perform mathematical procedures. About half of the changed teachers also reported a primary emphasis on understanding how/why the procedures work, problem-solving processes, and reasoning skills. The changed teachers also reported less emphasis on the ability to perform procedures.

Again, calculators were frequently used in assessment by secondary teachers. Manipulatives and computers were rarely, if ever used in assessment by over 70% of the teachers. Those who did use manipulatives or computers in assessment were more likely be teachers who reported change.

Conclusions

Secondary teachers appear to use the least number of information sources in assessing students, with a greater reliance on quizzes and tests for grading, diagnosis and instructional feedback. Portfolios, journals and projects are least used at the secondary level. Although many teachers report focusing their assessment on reasoning and problem-solving, the strategies best suited to assess them and the ability to communicate mathematical ideas are not used. Consistent with recommendations in the *Standards* documents, calculators are frequently used in assessment at the secondary level. However, computers and manipulatives are not. Tables 24a and 24b, 27a and 27b, and 30a and 30b in Appendix D present the data on which this summary is based.

WHAT SCHOOL PROCESSES SUPPORT IMPLEMENTATION OF THE *STANDARDS*?

In this section we look at teacher's reactions to potential aids and obstacles to implementation of the *Standards*. These practices were identified from the literature as well as materials received from the various participating school divisions. When interpreting this data it is important to understand that teachers were asked to skip a question on the Aids to Implementation section if they were not sure if the item was available in their school division. Although it varied by item, approximately one half of the

elementary teachers and 30% of middle and secondary teachers indicated that they were in fact unsure of the availability of any given aid. Responses reflect the opinions only of the teachers who were knowledgeable of the availability of the aid.

Elementary School

Aids to implementation identified by over half of the teachers as being available and helpful in descending order (from 64% to 50%) are:

* notifying teachers of opportunities to attend workshops not on school time
* teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change
* administrators observe mathematics classes in progress
* encouraging teachers to attend regional and state mathematics conferences which emphasize the *Standards*
* offering specific training events for "lead teachers"
* school maintains library of instructional materials related to the *Standards*

Teachers who report that they have changed their teaching were more likely to indicate the following as available and helpful, again in descending order (from 70% to 51%):

* offering specific training events for "lead teachers"
* encouraging teachers to attend regional and state mathematics conferences which emphasize the *Standards*
* offering in-service workshops designed to increase teachers' awareness of and incorporation of the *Standards*
* school maintains a library of instructional materials related to the *Standards*
* unofficially recognized "school leader" acts as a catalyst for new instructional practices
* school- or district-wide policy statements articulating a vision of curriculum reform
* awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms
* designating certain teachers as "lead teachers," who will take the initiative in educating themselves and their colleagues regarding the *Standards*
* revision of criteria for mathematics textbook selection.

Other ideas were not available to over half of the teachers, but were considered potentially helpful by them. They are:

* mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the *Standards*
* teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools
* teachers observe one another's mathematics classes

Many other aids were viewed as helpful, but were available to some teachers and not others; still other suggested aids were in process in the schools of many teachers, and so difficult to evaluate. District-level analyses may be more important in interpreting these data.

The survey data didn't clearly identify any major obstacles to implementation of the *Standards* by elementary teachers. Factors that were considered a major or minor obstacle by 60% or more of the teachers are:

* pressure to have students succeed on "standardized tests"
* teachers lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area
* teacher's own lack of knowledge of the changes advocated in the *Standards*
* lack of resources (computers, calculators, manipulatives, etc.)

Teachers who report having changed their teaching, however, were less likely to view low level of student ability, their own lack of knowledge of the *Standards*, and their own lack of training in methods for incorporating these changes into the curriculum as obstacles to implementation. See Appendix D, Tables 31a and 31b and 34a and 34b for the data on which this summary is based.

A final question to ask about aids and obstacles is whether the teachers who are aware of the *Standards*, but have not changed their teaching perceive aids and obstacles differently than unaware teachers. At the elementary level few differences are evident

between unaware teachers and those who are aware but have not changed. The only differences are that the aware/unchanged are less likely to view their own lack of knowledge as a major obstacle. There is no evidence that they are especially resistant to the message of the *Standards*.

Conclusions

A number of ideas have been identified as available and helpful in the implementation process. Perhaps the ones to concentrate on, however, would be those identified more frequently by the Changed group. Three ideas that are relatively "cost free" are disseminating school- or district-wide policy statements articulating a vision of curriculum reform, and revision of criteria for textbook selection.

The "lead teacher" idea is endorsed by those who have changed, perhaps because many of these respondents are themselves lead teachers. Nevertheless, designating lead teachers to take the initiative in educating themselves and their colleagues, and offering specific training events for lead teachers, were identified as available and helpful by teachers who have changed. In addition, the presence of "unofficially recognized" school leaders was also considered available and helpful by those in the Changed group.

Finally, resources that would be available to all teachers were considered available and helpful by many changed teachers: grant money, inservice workshops, and library of instructional materials within each school, and encouraging teachers to attend regional and state mathematics conferences which emphasize the *Standards*.

Supports that teachers would like to see that are not currently available are support groups, opportunities to observe other teachers, and meetings with teachers from other grade levels to coordinate implementation.

These aids are most likely to address two obstacles to implementation mentioned by a majority of teachers: their own lack of knowledge about the *Standards* and training in

methods for incorporating them. The library of materials should help to address the lack of resources mentioned by many teachers as an obstacle. The one obstacle most frequently mentioned is standardized tests. This will need to be addressed through district policy changes.

Middle School

Aids to Implementation that were identified as available and helpful by over half of the teachers are listed below in descending order of frequency (from 73% to 50%). Those items that were endorsed more often by teachers who have changed are noted by two asterisks.

** Notifying teachers of opportunities to attend workshops not on school time
* Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum reform
** encouraging teachers to attend regional and state mathematics conferences which emphasize the *Standards*
** revision of criteria for mathematics textbook selection
* school maintains a library of instructional materials related to the *Standards*
** offering in-service workshops designed to increase teachers' awareness of and incorporation of the *Standards*
* fostering a collaborative climate among mathematics (and other) teachers
* Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms.
** Administrators observe mathematics classes in progress
** encouraging teachers to make their own decisions regarding curriculum and professional development

Three ideas were not available to over half of the teachers but they were considered potentially helpful:

* teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools
* mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the *Standards*.
* Teachers observe one another's mathematics classes.

Only one factor was identified as a major obstacle to implementation of the NCTM *Standards* by over half of the middle school teachers, and that was the pressure to succeed on standardized tests. Other factors identified as either major or minor obstacles by at least half of the teachers are:

* student attitudes about mathematics
* low level of student ability
* teachers own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area
* lack of resources
* lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the *Standards*
* parent attitudes about mathematics education.

Factors clearly identified as not an obstacle to implementation are:

* administration attitudes
* your own lack of knowledge of the changes advocated in the *Standards*.

Teachers who reported making changes in their teaching were much less likely to identify their own lack of training and knowledge about the *Standards* as an obstacle.

A final question to ask about aids and obstacles is whether the teachers who are aware of the *Standards*, but have not changed their teaching perceive aids and obstacles differently than unaware teachers. At the middle level the aware/unchanged teachers do not appear to be resistant to the *Standards*. As with the elementary teachers, they are less likely to view their own lack of knowledge as a major obstacle. They are also more likely to view several aids as "in process." They appear to be at the beginning of the learning curve--they know about the *Standards*, know that things are happening in their school or district, but have not acted as of yet.

Conclusions

Middle school teachers who have changed their teaching consistent with the *Standards* more often view staff development opportunities as available and helpful: Notifying

teachers to attend workshops, encouraging teachers to attend regional and state mathematics conferences, and inservice workshops. In addition, the teachers overall seemed to welcome collaboration and encouragement of professional judgement. For example, teachers taking interest in each other's classrooms, providing support and suggestions, creating a collaborative climate, and making their own decisions about curriculum and professional development were endorsed as helpful.

District level aides that were endorsed are: revision of criteria for textbook selection, grant money.

Finally, two ideas considered as unavailable but potentially helpful were support groups, opportunities to observe other teachers, and discussions with teachers at other levels to coordinate efforts at implementation.

Middle school teachers seem to see more potential obstacles to implementation than elementary teachers. Standardized testing is viewed as a major obstacle. This, of course, needs to be addressed in district policy statements. In addition lack of resources may need to be addressed at the district level.

Two factors mentioned as either a major or minor obstacle are student ability and attitudes. While the district cannot directly change either of these factors, it can help change teachers' attitudes toward these factors. The teachers in the focus groups seemed to feel that students liked mathematics more and did better when they attempted to implement the *Standards*. Perhaps these could be addressed through inservice efforts. Similarly, concerns about lack of training can be addressed through inservice.

It should also be mentioned that middle school teachers perceive their colleagues as being unenthusiastic about the *Standards*. In addition, they are aware that parent attitudes may be an obstacle. The literature suggests that as parents are educated about the goals of mathematics, and as they observe what their children are now able to do,

they can become convinced that a *Standards*-oriented curriculum is the way to go. See Appendix D, Tables 32a and 32b and 35a and 35b for the data on which this summary is based.

Secondary School

Aids to the implementation of the NCTM *Standards* identified as available and helpful by at least half of the teachers in descending order (from 73% to 50%) are:

* teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum reform
* notifying teachers of opportunities to attend workshops not on school time
* encouraging teachers to attend regional and state mathematics conferences which emphasize the *Standards*.

Teachers who reported changing their teaching consistent with the *Standards* identified the above as available and helpful at a higher rate than other teachers. In addition, over half identified the following as available and helpful:

* offering in-service workshops designed to increase teachers' awareness of and incorporation of the *Standards*
* awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms.

Suggestions identified as unavailable but potentially helpful by at least 50% of the teachers were:

* teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools
* mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the *Standards*
* designating certain teachers as "lead teachers," who will take the initiative in educating themselves and their colleagues regarding the *Standards*
* offering specific training events for "lead teachers"

Factors identified as a major obstacle by at least half of the teachers are:

* student attitudes about mathematics
* pressure to have students succeed on standardized tests.

Factors identified as either a minor or major obstacle by at least half of the teachers are:

* teacher's own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area
* lack of resources
* low level of student ability
* lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted in the *Standards*
* parent attitudes about mathematics.

Factors clearly identified as not an obstacle are

* administration attitudes
* teacher's own lack of knowledge of the changes advocated by the *Standards*.

Teachers who had indicated changing their teaching, however, were more likely to view student attitudes as a minor, rather than a major obstacle. Further they were much less likely than other teachers to view their own knowledge or training as a potential obstacle to implementation.

A final question to ask about aids and obstacles is whether the teachers who are aware of the *Standards*, but have not changed their teaching perceive aids and obstacles differently than unaware teachers. At the secondary level the aware/unchanged teachers also are less likely to view their own lack of knowledge as an obstacle to implementation. However, they do rate many aids as unavailable in their school or district:

* Inservice workshops designed to increase mathematics teachers' awareness of and incorporation of the NCTM *Standards*
* Encouragement to attend regional and state mathematics conferences which emphasize the NCTM *Standards*
* Specific training events for lead teachers
* School-wide plans for mathematics curriculum reform
* Revision of criteria for mathematics textbook selection
* Revision of criteria for mathematics curriculum design
* Fostering collaboration among mathematics teaches and teachers of other subjects
* School maintains a library of instructional materials related to the NCTM *Standards*.

In summary, the secondary teachers who are aware but have not made changes seem to report less district/school support in the availability of aids rather than resistance to the *Standards*.

Conclusions

Considerably fewer aids to implementation were identified in the secondary level data. Two ideas are relatively easy to accomplish: to notify teachers of workshops, and encourage teachers to attend regional and state mathematics conferences. Teachers who had made changes were more aware of inservice workshops and the availability of grant money. As at the middle and elementary levels, secondary teachers would like to see support groups and meetings with mathematics teachers at different levels to coordinate efforts at reform. In addition, designation of "lead teachers" and training for them were viewed as potentially helpful.

The secondary teachers were most aware of obstacles to implementation. These obstacles can either be addressed through district policy statements or inservice. Student attitudes was considered a major obstacle by a majority of teachers, however, teachers who indicated that they had changed their teaching were less likely to view student attitudes as an obstacle. Inservice could address this concern. In addition inservice could address concerns about lack of training, student ability, and parent attitudes.

At the district level, pressure to succeed on standardized tests, which was identified as a major obstacle, needs to be addressed, as does lack of resources. See Appendix D, Tables 33a and 33b and 36a and 36b for the data on which this summary is based.

TEACHER COMMENTS

Listed below are the major categories of comments made by the teachers. The majority elaborate on obstacles to change. Selected comments are listed under many categories.

Obstacles/Needs

1. lack of time (30)

"I am more than willing to learn new things and try different approaches. However, I teach between 6 and 7 subjects per day and only have 3(45 min.) planning periods per week. I like doing new things but it is humanly impossible to do the planning, executing, and evaluating necessary for all of the subjects. Help!"

"Lack of time is also a primary obstacle in implementing the standards. There is not enough instructional time to get through the subject curriculum with all the embellishments required in the standards. In addition to lack of resources, there is little planning time to use what is available. Training in methods may help here. I do believe we should be using more of the elements required, but it is difficult at this point."

"You have not mentioned the enormous amount of extra time this program will take for already overburdened teachers who have been given major curriculum changes each year with little training! This program will only succeed if adequate time, training and materials are provided during the teacher's contract time."

"Teaching has so many demands on your time, and it does take a lot of time to change teaching strategies and learn to use new technology."

"Time! It is very difficult to find the time to research information and have discourse with colleagues, locate or create materials, and contemplate and execute lessons. Summer seminars (paid please!) might be helpful. The current textbook adoption becomes incredibly important, doesn't it?!?"

"Time is the major resource in which we are lacking. We do not have planning time available to check out and plan how to use these new teaching strategies, computers, manipulatives, etc."

"Teachers are being inundated with new curriculum changes and assessment procedures. In the elementary school, we have little or no planning time. It takes time to gather new materials, assess new curriculum guides, & restructure your classroom environment. This is my major stumbling block to change."

"Time restraints have prevented me from sitting down and reviewing over the NCTM Standards. Although I consider national standards to be very important, I feel they need to be brought to us, explained & possibly demonstrated. It's hard for me to study in depth one curriculum in particular when I teach 5 subjects a day."

2. Inservice (31)

"If time were provided for real ongoing training then you would see the changes you desire. By simply sending information and asking for volunteer time you undermine your efforts. Research and development must be part of the job of teaching, part of their paid time. Otherwise it is regarded as unimportant which it must be if the school systems are not prepared to provide technology and training."

"I would like to have more help from VCU in the form of workshops given in our district showing how better to implement the standards."

"My primary obstacle in implementation of the NCTM Standards is lack of training in methods for incorporating these changes into the curriculum. We have had many inservices describing the standards but few/none on implementation!"

"Most of the teachers know very little about NCTM Standards. More in-service and education needed plus sufficient technological equipment and manipulatives."

3. Materials, resources, technology (25)

"In this age of technology, why aren't computers in every classroom??"

"Computers are not accessible, but once a week. One set of calculators for the entire school. Most of the manipulatives I use have been purchased or made by me."

"I agree that students learn best by doing and experimenting on their own but I also see a need for teacher's manuals and worksheets."

"By providing calculators and other manipulatives to each classroom, reliance on textbooks would be reduced and student involvement increased. Money is the key issue- not textbook/kit adoptions."

"Schools should be given money to help buy manipulatives. Teachers should not have to use their own money."

"Technology (computers) is lacking- the only computer software available in the school is games for low- average ability learners."

4. Standardized testing (8)

"If we ever could do away with the standardized testing, we would be able to do much more 'hands-on' activities. Our curriculum is not based on 'life skills' but should be!"

"While our system has spent monies on manipulatives and computers, teachers are greatly pressured to improve test scores. As our standardized tests emphasize product, not process, we similarly must follow suit."

"Literacy testing puts great pressure on 6th grade teachers for computational skills."

5. Leadership (2)

6. Grading requirements (9)

"There is no need for math portfolios. Time element and large class size are major problems with this concept."

7. textbook (3)

8. classes too large (6)

"Class sizes of 30 or more children make it difficult to use manipulative materials and make useful and lengthy teacher observations."

9. lead teachers (3)

"Successful implementation will only be possible when 'lead' teachers are allowed time out of the regular classrooms to share information through workshops, school observations, assessment options and parent training."

"Concerned that not all schools have a lead teacher. There is a need for a math coordinator in each school to help implement the standards and serve as a resource for all teachers."

III. District Issues

"Attempts to educate teachers are being made but not enough support (paid instruction, truly qualified instructional leaders, released planning time) is being given. The teachers that have received some instruction and materials are being given the responsibility of teaching colleagues before they feel comfortable and with little compensation in preparation time or extra benefits. Efforts are being made but not enough."

"We have 39 math objectives to complete by the end of the year. Some of them are not developmentally appropriate. I try to stick with students' understanding of mathematical patterns and concepts, however, the time schedule of fitting all 39 objectives does not always allow me the time necessary to do that. A revision of the math objectives would fall on teachers to do during their own time without extra pay. Therefore, it is not high on anyone's list of things to reform."

"The NCTM Standards need to be "sold" to teachers. Many teachers see these standards as the newest fad that will run its course and die out. Other teachers (I'm one of these) see many possible positive outcomes, but also see areas of the standards with which they strongly disagree. Decisions "from above" to implement the standards have caused a lot of resentment and resistance."

"I would like to see the county adopt the everyday mathematics program from the University of Chicago. I went to a workshop and fell in love with the program. It supports the NCTM Standards along with critical thinking, cooperative learning and interdisciplinary curriculum. It is frustrating to know that the county is looking at another "text" to adopt instead of UCM's program."

"I feel that math specialists should present at least one or two lessons weekly in the elementary level (just like P.E., art, music, etc). Math is specialized! Not all teachers have the natural ability in this area for in depth reasoning."

"Teachers seem to be educating themselves without benefit of direct instruction from Central Office."

"We plan our lessons using SOL's given by the State Dept"

"The state needs to move quickly on instituting the common core and new assessment measures. The SOLs need to be formally replaced as soon as possible."

"Try to implement the changes slowly so teachers stay positive. Try not to make the portfolios include too many things."

"I feel I meet my county's standards in my classroom. I also feel that the administrative staff is up to date to see that our standards meet the NCTM even though each teacher does not have individual copies. As a kindergarten teacher, I feel our program is developmentally appropriate."

"The mathematics department in my county needs to form a good committee to rewrite the curriculum for high school (and middle school) following the NCTM Standards. I am not really interested in the "looking into it" concept on the back of this sheet, but I am interested in a committee to make changes."

"The county needs to take a public stand supporting the Standards."

V. Other (16)

"Some of the standards have been in use for years! I feel that the only real changes are related to technology or assessment. Some standards (eg. cooperative learning) have a very slow and deliberate implementation time frame with much training necessary.

"Other grade levels should see how JK uses manipulatives and teacher observation every day."

"NCTM focus is of critical importance to keep math instruction of the highest quality."

"There is some resentment to the situation in which one group namely NCTM, is dictating- right or wrong- the direction of mathematics education in this country!"

"In order to effectively monitor the progress children make daily, it would be very helpful to have a paraprofessional to assist the children and teacher."

"I would like to see a statewide math program in place in VA. The math program should emphasize the "hands-on" approach. There needs to be a different type of "hands-on" activity for each day."

"The survey continues the fallacious assumptions that instruction can be improved by merely altering curriculum, methods, etc. No improvement will occur unless and until those "leading" education are willing to look at societal (inc. parental) real lack of interest and a willingness on their part to

supervise learning at home; be proper role models for youth and value education over immediate gratification (jobs, cars, etc.)."

"Be careful. Students need a basic understanding of concepts and a degree of competence in mathematics computation before they can philosophize about number theory. Manipulatives should be used to explain why mathematics operations work, but after a time of explanation, then move to computation competence and then to application in problem-solving. Base your decisions for math curricula in the future on past performance scores of children over decades of learning and testing. In other words, go with what works, not with a new, good-sounding idea.

"My school uses CSMP and traditional text H-M so we have a strong, balanced approach to concepts, computation and problem-solving with these two programs."

APPENDIX B

FOCUS GROUP INTERVIEWS

APPENDIX B: FOCUS GROUP INTERVIEWS METHODOLOGY

SELECTION OF PARTICIPANTS

Teachers who had volunteered to participate in focus group discussions were ranked according to the degree to which they reported teaching and assessment practices congruent with the recommendations of the *Standards*. Only teachers who reported being well aware of the *Standards* were considered for participation in these groups. Ranking was based on responses to a subset of 9 critical items thought to differentiate between "*Standards* practice" and "non-*Standards* practice" classrooms. Item numbers and contents are as follows:

- Item 14. Awareness of *Standards*
- Item 22. Change in teaching practice based on the *Standards*
- Item 24. Preparedness to abandon textbook as "primary instructional tool"
- Item 30. Preparedness to use a variety of alternative assessment strategies
- Item 67. Frequency with which students work in small cooperative groups
- Item 89. Frequency with which students write about mathematical ideas in class
- Item 90. Frequency with which students make and argue for mathematical conjectures
- Item 111. Use of student journals for diagnosis or instructional planning purposes
- Item 155. Extent to which "own lack of training" is perceived as an obstacle to *Standards* implementation

Responses indicating attitudes or practices compatible with the recommendations of the *Standards* received positive scores, and responses indicating incompatible attitudes or practices received negative scores. A composite score on this index was computed for each teacher in the volunteer pool, by taking the sum of scores on the nine critical items.

Critical index scores can vary from a minimum of 0 (least indicative of *Standards* practice) to a maximum of 18 (most indicative of *Standards* practice).

The volunteer pool was then split by grade level into an elementary pool (61 grade K-5 teachers) and a middle/secondary school pool (40 grade 6-12 teachers). Middle and secondary school teachers were combined for the focus groups because each grade level taken alone contained too few teachers to guarantee adequate differentiation between practice and nonpractice groups.

Participants were recruited for two focus groups from each of these pools, one group at the high end of the composite index (the "*Standards* practice" group) and one at the low end of the index (the "non*Standards* practice") group. Thus, four focus groups were formed: elementary *Standards* practice (ES), elementary non*Standards* practice (EN), secondary *Standards* practice (SS), and secondary non*Standards* practice (SN).

Either 7 or 8 teachers were invited and agreed to attend each focus group. Teachers scoring at the extremes of the critical index were contacted first, with other, less extreme scorers invited as necessary due to schedule conflicts or in an effort to maintain diversity of grade levels and school divisions within each group. Invitations were made initially by telephone, with a follow-up reminder by mail. Each participating teacher received a $22 honorarium.

Although focus groups did not include the most extreme scorers within each volunteer pool, they did differ significantly in their mean scores on the critical index; $\underline{M}_{ES} = 13.7$, $\underline{M}_{EN} = 3.5$, $\underline{t} = 6.43$, $\underline{p} < .0001$; $\underline{M}_{SS} = 12.7$, $\underline{M}_{SN} = 3.8$, $\underline{t} = 12.17$, $\underline{p} < .0001$. In addition, the highest score in the non*Standards* practice group was always at least two standard deviations below the lowest score in the *Standards* practice group, for teachers of comparable grade level (elementary, middle, or secondary).

INTERVIEW FORMAT

All four interviews were held in small room in Cabell Library on the VCU campus and lasted for 60 to 70 minutes. Participants sat around a large table. Two microphones on the table picked up the discussion and the entire interview was audio-recorded. Dr. Cauley conducted the interviews using a planned set of questions and follow-ups agreed upon in advance by the investigators. Dr. Van de Walle and Mr. Hoyt sat in as observers and took notes but did not participate. See Appendix E for the Interview Guide. It should be noted that the discussion was very informal and did not rigidly follow the guide. It is fair to say that all areas on the guide were addressed with each group. At the start of each interview, Dr. Cauley stressed the confidentiality of the group's responses and comments. No individual or individual's school division is identified in this report.

FINDINGS

In the sections that follow, a summary of each group's responses is provided. The final section provides an overall summary. It should be noted that these groups represent very small samples of teachers who were not randomly selected for participation. While we believe that the comments provide interesting information that is generally substantiated by the survey data, generalizations from these focus groups should be made with caution.

Throughout all four focus groups, the teachers tended to shift freely from comments about themselves and their own classrooms to comments about their school, other teachers and the school division. Especially for the "High Implementation" groups, there was a significant difference between how teachers viewed mathematics within their own classrooms and how they viewed mathematics in their schools among peers, or in their school divisions.

GROUP 1: K-5 HIGH IMPLEMENTATION (K-5,H)

Seven teachers representing grades K, 1, 2, 3, 5 (3 teachers) participated in this interview.

Comments Concerning Changes and Direction

The most common sentiment in this group dealt with a perceived move away from the routine approaches of the text and toward a more open, student-centered approach to mathematics. One teacher noted an emphasis on critical thinking that was being stressed not only in mathematics but across all disciplines. Another noted that there is beginning to be a realization that "mathematics is not just what comes from a book." These teachers all talked about a greater emphasis on problem-solving and thinking. An example was provided of doing estimations before doing the pencil-and-paper computation. The group identified a standard textbook-driven lesson as the old way and a nontextbook approach as the new way.

This group placed a clear value on student discussions, cooperative learning, the use of journals, student-student interactions, and the use of student explanations. One teacher of the upper grades said that "It just was not working. Something had to change." When the children began to use calculators and they got something wrong, they were more interested in finding out why. "They feel more worth -- 'You mean you really want me to tell you what I know? You want my opinion.'" There is a sense of value in looking at what students really understand instead of what score they receive on a test or how many problems are done correctly.

Two other areas of observed change were the use of manipulatives, especially above the second grade, and a greater emphasis on calculators. "Up until now, no one has realized that you don't stop using manipulative in the second grade." There is a consistent feeling that not a lot of the upper grade teachers even know about how to use manipulatives or place any value on them. But these teachers all sensed a value in manipulatives at all grade levels.

Not only are these teachers comfortable with calculator usage, they did not seem to be dependent on the division making calculators available. On the other hand, there is

clearly a desire that calculators be made available by the divisions and where that has been done, these teachers are appreciative.

Comments Concerning Factors That Have Helped in Making Changes

"Time" was seen as a big factor. When pressed on this, some talked of time to observe other teachers - even in other schools. Others talked about time to research new ideas or time to create and develop new activities or make materials.

Sharing of ideas among teachers was another value. The group universally placed a high value on the good ideas they get from other teachers. There seems to be a sense that the new directions of the *Standards* has helped teachers to be more open and willing to share with their peers.

Several of the teachers were lead teachers in their schools. All who had contact with lead teachers placed a large value on that person being able to share ideas, to be sure that appropriate materials were being purchased, etc. Inservice, either from lead teachers or offered by the division, was seen as a value when it was practical and addressed real classroom needs. "Showing how" rather than "telling how" seemed to be emphasized. Inservice on broader themes was not valued and was actually seen as an obstacle.

Several teachers mentioned helpful principals while others groaned with envy. A supportive administrator was clearly valued while one who was not well informed about the *Standards* or about current directions was seen to be an obstacle.

A general characterization that could be made of this group especially is that they seemed to be "self-starters." They took advantage of opportunities available to them such as professional conferences (GRCTM or VCTM), courses at VCU, professional literature made available to them in their schools, opportunities to observe other teachers, interest in trying new ideas. When talking about teachers in general, it becomes clear that they realize not all teachers take advantage of these opportunities. This seems to

be a function of individual motivation rather than of external pressures. The point is worth making since it was a major contrast with those teachers in the second elementary group.

Comments Concerning Obstacles to Change

The most over-riding sources of obstacles are testing and lists of objectives that are perceived (accurately) as not leading them in the same direction as the *Standards*. On the one hand are the State objectives and ITBS pressures coupled with lists of objectives from the local division or pressure to give the chapter-end tests. On the other hand are the *Standards* that talk about observations, use of manipulatives, portfolios and journals, problem-solving, and a high degree of interaction. These teachers who have some sense of a *Standards*-oriented direction feel pulled in at least two if not three directions. Coupled with this is the belief that parents like those test scores. [One teacher talked of having a parent session in which the same hands-on activities that the kids were doing the parents did. Then, when the activity was over, she handed out a traditional worksheet on the same topic and noted "Now this is how you probably were taught this." The parents were reported to be very impressed with the value of the hands-on approach.]

As time is a value, time (or lack of it) is also a major obstacle. "It takes a lot of time to coordinate all of these materials."

Other obstacles that were not necessarily common to the full group included administrators that were not knowledgeable of the *Standards* or even in agreement with them, lack of training in college (New teachers are perceived as being better informed.), parents feeling that books and worksheets are necessary. They expressed a general need to educate parents, and for the availability of manipulatives and computers.

The teachers believed that their peers who do not appear to be moving toward the *Standards*, also do not perceive the value in going to all of the extra work of making manipulatives and planning interesting activities. This seems to be especially true at the upper grades. These teachers have sensed a personal reward in the achievement and

interest level of their students and this tends to keep them working. Others have not had that affective feedback and do not value new and difficult ways. "Some teachers are not going to change until they all change."

Comments Concerning Assessment

These teachers collectively report using such evaluation techniques as observations, journal writing or "mathematics notebooks." There is a general emphasis on having children explain their reasoning. Each teacher still felt compelled to give chapter tests or to give most of the school division tests that assess the prescribed objectives. There was no mention of performance assessment with the exception of one teacher who had taken a class from Dr. Gross on mathematics assessment. This teacher talked about designing a rubric for an activity. She felt that this allowed her to be "more focused" and comfortable with what she was doing. The teachers mentioned using journal writing and observations to help them with remediation and planning.

It was noted that it is sometimes difficult to reconcile observation and journal data with test scores when talking with parents. That parents' need to see scores on tests in a traditional way appears to be a drawback to doing alternative forms of assessment.

When discussing other teachers, there is a sense that journals and alternative assessment is just one too many burden, especially after just learning to do these things in language arts. Some expressed a belief that eventually this would all get easier as children got used to writing year after year and teachers became more comfortable with new approaches. Even with this group, however, new assessment methods did not seem to be a hallmark of their individual change.

GROUP 2: K-5 LOW IMPLEMENTATION (K-5, L)

Six teachers representing grades 2 and 4 (5 teachers) participated in this interview.

Comments Concerning Changes and Direction

As indicated by their responses on the survey, this group showed very little evidence of making changes in their classrooms. They all seem to have some sense of a direction of change that is suggested by the *Standards* but would probably have a hard time articulating what that is. Using manipulatives is the strongest hallmark of the new directions according to these teachers. "In our school everyone's teaching the way they have for 20 years." This same teacher commented that for many teachers, mathematics is sort of "tucked away" as they focus on other things and let the attention to mathematics slip.

These teachers all sense that whatever change is happening is happening slowly and the primary reason is lack of leadership and direction.

Comments Concerning Factors that Have Helped in Making Change

There were some teachers in the group who had a lead teacher in their building and acknowledged the value of this person. Another teacher stood out in her praise of the leadership provided by her principal in helping inform her staff about the *Standards* and supporting their needs for implementing change. (It was not at all clear, however that this teacher could be called a *Standards*-oriented teacher as a result.) Others in the group expressed real envy of this leadership.

A difference between this group and the K-5, H group can be noted in their total lack of comments concerning cooperative groups and student discussions. These are things that many teachers have taken on willingly and which require only personal effort rather than materials, curriculum or training. Higher order thinking and student interaction was a common thread among the K-5, H group.

Comments Concerning Obstacles to Change

The difference between this group and the K-5, H group was overwhelming and can be generally summarized in terms of the way this K-5, L group tended to see everything as

an obstacle. While they noted and acknowledged the need for change, however poorly articulated, not one of these teachers saw themselves as change agents or as being in control of change.

The most prevalent theme throughout this session was the repeated expressed need for leadership and support. There is a strong sense that there will likely be very little change from these teachers until someone, probably at the school level but with the support of their school division, shows them exactly what is expected of them, provides the materials (manipulatives, calculators, computers), conducts adequate training, and then offers them time. "There are too many new things - a hands-on science program, a new social studies, program, but it takes an overwhelming amount of time to plan and pull the materials." These teachers believe that the classroom teacher is overwhelmed as it is and they see that attempts to implement change without explicit direction to be beyond them.

With respect to manipulatives, one teacher noted that she saw the push to use them, "but I'm not going to go out and get them. The County needs to give us manipulatives." In a discussion of computers, there was general agreement that the equipment was not adequate, there was no help in using them, even wiring in the school was a problem in one case. In the case of computers, it was not clear that the teachers sensed a real value in using them. Without a value system, the desire to overcome problems is not strong. Perhaps this is true across the board.

These teachers see accountability to both the school division ("checking off objectives") and to parents (report cards and homework) as further obstacles.

In discussing curriculum materials and the use of nontext activities, the problem of children making up missed work or reviewing was noted. A similar problem was noted with science and there was little interest in creating the same problem in mathematics. Most of these teachers wanted the direction and guidance of a text or of some similar

framework. The *Standards* do not provide the details or structure that these teachers currently see in programs such as their whole language curriculum or their science program.

The bottom line is a constant expression of the need for guidance, leadership, provision of materials and curriculum, and time. Of these, it is interesting to note that it is only time that the K-5, H group expressed as a concern and in that case it was less an obstacle as it was a wish. Perhaps the difference is a lack of understanding of mathematics in general and the specific directions of the *Standards* in particular. Without this knowledge, there is a lack of desire to overcome difficulty. Consequently, these teachers are waiting for some other force to make change easier.

Comments Concerning Assessment

There was a realization in this group that checking off an objective by virtue of a short-term test was not the same as true mastery of an objective or any sort of long-term understanding. However, while given this realization, there was no sense in the discussion that these teachers were searching for other means of assessment or were making any efforts to use alternative or performance tasks. One teacher discussed alternative assessment techniques in language and expressed a positive belief that it could be done in mathematics as well - but had not yet done anything. Again, these teachers are waiting for someone to show them how and to be very specific in guiding them.

The cry for leadership and support was constant throughout this discussion. If this group is typical of those teachers who have not yet made *Standards*-oriented changes, then expecting them to be self-starters, to initiate their own change, or to seek out their own information is not a reasonable expectation.

GROUP 3: 6-12 HIGH IMPLEMENTATION (6-12, H)

Six teachers representing grades 6 (4 teachers) and senior high (2 teaching various classes) participated in this interview.

Comments Concerning Changes and Direction

It was difficult to determine from the comments of this group exactly what sorts of changes they had made. At the very end of the session, two teachers volunteered that they would "never go back to teaching the old way. This is too much fun." They commented on the involvement level of the children, the lack of discipline and the interest generated in the students. Apparently what these and the others were talking about was less of an emphasis on isolated skills and rote drills that they had come to feel they were freed from by the *Standards*. At the same time, there was a pervading sense that the *Standards* were something else to do rather than a change; an extra - "We still have to teach certain skills."

The emphasis on skills is heightened at the middle grades level by the Literacy Passport Test and at the secondary school level by succession of courses and a feeling of needing to cover the work for the next course. This undercurrent of skill development was much stronger with this group than with the K-5, H group and it is probably safe to say that testing and skill-oriented curriculum concerns are a larger negative factor at the upper grades.

There is some movement toward the use of calculators, manipulatives and cooperative learning, especially in the middle grades. It was difficult to get a sense from this group that they understood why these things were important other than the fact that the kids seemed to enjoy mathematics class and were having fun. A sense of the nature or spirit of mathematics as an investigation activity was really missing.

In talking about other teachers in their buildings, there was a sense that not many teachers were putting the *Standards* into practice and that they were somewhat alone.

"A couple of us are trying to do a few things but most people are doing things the way they always have." There was general agreement with this statement. While there is awareness, it seems difficult to change old ideas.

Comments Concerning Factors that Have Helped in Making Change

There were very few comments from this group suggesting that school division or building-level efforts were in any way responsible for the changes these teachers had made. The exception came from those who believed that either the principal or the school division had helped them acquire necessary technology. Others saw lack of access to technology as an obstacle in their situations.

What was mentioned as helpful was taking classes or in some instances being responsible for teaching classes or conducting inservices. This type of activity, they explained, forced them to come to grips with new ideas directly. These teachers talked about the need for others to come to new ideas with an open mind. When ideas were presented by a teacher who had actually used the ideas in his or her own classroom, it carried a lot more weight and was more likely to be received in a positive way. In the same vein, the concept of teaming with other teachers and sharing ideas was valued highly by the entire group. Not all teachers benefitted from this as they saw no opportunity to share or to work with others. Department meetings were seen as not helpful for teaching ideas but were rather concerned with administrative functions. One teacher simply took it upon herself to periodically busy her class and drop in on other mathematics teachers on her hall.

One teacher mentioned that her own personal growth was largely through professional organizations and explicitly said that her school division was not responsible for her changes.

Comments Concerning Obstacles to Change

In contrast with the K-5 high implementation group, this group was quite vocal about obstacles. However, for each obstacle noted, it was reasonable to believe that removal of the difficulty would, in fact bring change. In some instances one or more teachers were not experiencing the same difficulty as others and the effects were positive.

Tests and the pressure of tests were the first and most obvious hinderance. At the middle school level especially, the Literacy Passport Test is seen as a major problem, especially for the "other" teachers. "When assessment changes then there will be changes." The pressure of the Literacy Test causes teachers to teach to the traditional atomized skills and promotes a drill and practice, rote approach. Even the teachers in this group feel a pressure for their students to succeed on tests while they realize at the same time that the tests are focused on rote skills. They do talk about blending skills in their own classes with larger investigations.

Time and training are concerns for this group as with the others. At the secondary school level, teachers talk about the large number of extra responsibilities such as club sponsorship. In one school represented it was noted that 1/3 to 1/2 of the mathematics teachers were coaches. All teachers talk about the heavy time burden to learn about new methods, to plan interesting activities, and to prepare materials that they simply do not have. It is worth noting that teachers at the 6-12 level are facing a much larger methodology change than the elementary teacher who has always understood that a manipulative approach was expected. These teachers are more apt to describe a *Standards* approach as being "extra" or "more" than the usual curriculum and thus time to implement and learn about new ideas is a larger hurdle. Time is also a factor in professional development for the same reason. These teachers do not evidence as clear an understanding of what the *Standards* are saying and that may be because a larger need for in-depth training is required. They recognize that there are many things they do not know and they do not see the time and opportunity to learn.

Lack of adequate equipment, especially in the area of technology was another constant theme. When discussing computers, there were problems with lack of uniformity, sufficient software, computers that were matched with software and made available and time and help to learn how to use technology when it was available. The use of graphing calculators was also discussed. These teachers express the view that the schools should provide these calculators and that only minimal sets of these exist. One teacher even commented that he was glad he was one of only two who used them because otherwise there would not be enough to go around. It should be noted that as a group, these teachers did not articulate well an understanding of why they wanted technology. They know it should be used and that they are encouraged to use computers and calculators but it is not clear that they see this as an integral component that allows them to change both what and how they teach mathematics. A few had taken classes on their own but clearly this is not universal. In the area of simple manipulatives, the teachers express the belief that it is the elementary teachers who get the money for these things and they would have to spend their own money if they wanted materials.

Lack of knowledge about what they really should be doing seems to be another obstacle that colored the general discussion. "I need someone to help me use real life problems to give to students. We are in a vacuum. Teachers are isolated." This secondary school teacher was expressing his personal inadequacies and his frustration at finding information, even from his peers.

Comments Concerning Assessment

"What I really like about the NCTM *Standards* is being able to keep a mathematics journal and portfolios." This teacher and others saw journals and portfolios as a value in finding out what the children really know. There was a recognition that communication is important, especially among the middle grade teachers. "It's just fantastic to have to have the students talk about an idea." (Notice that in each of these quotations that there is a sense of permission to do the unusual rather than a challenge. Perhaps not much

weight should be given to the "being able to" and "to have to have" but it is an interesting expression of values.)

There was not much follow-up to the few comments about assessment and there was little evidence of any real move toward alternative forms of assessment. The two secondary school teachers were especially silent on this issue.

GROUP 4: 6-12 LOW IMPLEMENTATION (6-12, L)

Five teachers representing grades 7 and secondary (4 teachers) participated in this interview

Comments Concerning Changes and Direction

As we listened to this group it was difficult to get a real sense that they had a true understanding of what the *Standards* are all about. "We've just been handed a memo, basically." Another teacher said that she had only heard about the *Standards* through a class she had taken and a conference that she had attended. Toward the end of the interview, another teacher expressed a wish that there could be a more careful understanding and consensus about what the *Standards* were saying. She believed that they were "becoming and excuse for 'Oh, well, let's not worry about the long division because calculators are what we are going to use' or 'Let's not worry about proofs because the *Standards* say don't do proofs," and that's not what they say." This teacher was expressing a view that perhaps was characteristic of the group: Old fashioned basic skills are just as important today as ever and new approaches, manipulatives, cooperative learning, projects, etc. were extras that were nice. Unfortunately, time and other constraints - especially constraints of the curriculum - prevent these teachers from seeing these "extras" as a priority.

The group expresses a tremendous willingness to make changes. Some noted their use of graphing calculators and another saw practical applications of mathematics as important. But the changes discussed were not deep rooted but perhaps superficial.

The use of calculators is a case in point. "Once they have shown that they can add, subtract, multiply, and divide whole numbers, decimals and fractions, then everything else we use calculators for." Another teacher actually took calculators away from her Algebra I and Geometry students because she saw the calculators being used for simple basic facts and she firmly believed the calculator "replaces understanding of fundamentals."

There was some evidence of encouraging student discussion - students sharing proofs on the overhead and discussing them, peer teaching, etc. but for the most part, these were vehicles for getting the traditional program covered. The process of mathematics as a goal in itself was never evident. While these teachers talk of valuing understanding and concepts, there is a relatively constant undercurrent of old fashioned skill mastery. There was the traditional upper-grade teacher complaint that the elementary and middle grade teachers should do a better job in forcing kids to master the basics.

Comments Concerning Factors that Have Helped in Making Change

It was not obvious that these teachers felt that they were receiving much help to implement the *Standards* or to make changes. The Mathematics and Science Center was noted as offering good information on graphing calculators and two of the teachers mentioned following up on what they had learned. Another got ideas from the VCU summer mathematics Colloquium.

One school division received "points" for offering a lot of training on cooperative learning. However, this same teacher noted limited success with this approach. This got into a discussion of how honors-level and advanced students were "terrified" of making a mistake - a point that was agreed with by a few others. Notice that within an "answer-oriented" curriculum, students develop a great deal of resistance to open-ended approaches. Within this group, however, there was little value or effort given to helping these answer-driven students see a broader view of mathematics. One teacher had a

bad experience with cooperative learning and some special education students and said she would never try it again.

"Good textbooks" were seen as essential. Most of these teachers apparently use their textbooks as a basic anchor for their curriculum. "If you have a book and the problems are fine in the book, why do something else?" It is fair to say that virtually all comments during the interview reflected a problem-answer, skill-oriented view of what mathematics is.

Comments Concerning Obstacles to Change

As with the K-5, L group, this group saw lots of difficulties. Perhaps these were more in the spirit of problems they wished would go away rather than impediments to change.

The lack of instructional time caused essentially by the perceived pressures of the curriculum was reflected in many of the comments. Several teachers returned more than once to the fact that students come to them with less than adequate skills that therefore need to be remediated. Kids "really don't understand that they have a responsibility for retention" (of basic procedures and facts). Others felt that the curriculum simply had too many things to cover. Another felt hampered by large classes that made it impossible for her to do interesting projects or investigations.

Time for teachers to learn was brought out by this group as by each of the other three groups. "We have the Geometer's Sketchpad in our school but I don't have time to learn it. I don't have a Mac and home and I don't have time to work on it in school."

Among the few references to technology, several teachers mentioned inadequate, out of date, and miss-matched equipment - a lament voiced in other groups as well.

Most of these teachers seem to have a wish list of things that they would like to have that they believe would help:

- expert input from specialists in the school division;
- administrators and school division support in educating parents about the values of "competency" instead of simple grades;
- a computer room with up to date equipment and software that was accessible.

Comments Concerning Assessment

For all of these teachers, assessment is synonymous with techniques for assigning grades. "All of my grades are based on some sort of product." None of the discussion of assessment related to diagnosis or providing opportunities for students to show knowledge that other evaluation forms might not show. There was some evidence of using projects and student presentations in the grading schemes. A common belief was that students who get good grades on the usual tests are the same ones who get good grades on projects.

Lack of time to deal with a portfolio approach was expressed by several teachers.
One teacher was experimenting with a competency based approach to moving students through a unit with skills being checked off as they were "mastered." The group's positive interest in this teacher's idea was perhaps characteristic of the general skill-orientation that was noted throughout the interview.

SUMMARY

The comments in this section are highly subjective and reflect the interpretation of the investigators. While caution should be taken in generalizing to the entire population, the comments of these groups are reflective of the data gathered on the survey and also reflect the experiences of the investigators in working with teachers.

Group Characterizations and Contrasts

The K-5, H group evidenced the best understanding of the *Standards* in terms of the nature of mathematics. They valued more highly than any of the other groups, the use of student discussions and interaction, and an emphasis on problem-solving and higher-order thinking. This understanding cannot be developed in any simple way. The other characterization of these teachers is that they tended to be "self-starters." They took advantage of opportunities to learn and invested in that learning whether it was through course work, talking and sharing ideas with other teachers, attending professional meetings, or reading professional literature. It is perhaps the summative effect of their initiatives that caused them to develop a different view of mathematics from the other groups.

In contrast, the K-5, L group could not really be said to understand the nature of mathematics as described by the *Standards.* Their changes were superficial or characterized by actions in the classroom (e.g., calculators, manipulatives) rather than adoption of a new set of goals or expectations for their students. In fact, that understanding of mathematics as a process was not evident in any of the groups except the K-5, H group. The determining factor is very likely the quantity and quality of professional input each teacher had taken advantage of.

The K-5, L group was basically waiting for leadership and direction while the K-5, H group found their own direction.

At the middle-secondary school level, the two groups were more alike than different. Some evidence did exist to suggest that perhaps the 6-12, H teachers valued discussion and interaction more than the 6-12, L. Similarly there was limited evidence to support the notion of self-initiative to learn which was the hallmark of the K-5, H group. But a real change in the goals of mathematics instruction and curriculum was lacking in both of the 6-12 groups. These teachers seem typical of upper-grade teachers in that they are significantly pre-occupied with test scores and skills. They have a greater resistance to

abandon familiar curriculum. While both of the 6-12 groups were concerned with skills, especially those that supposedly are taught in lower grades, the reasons for their concerns may be different. The 6-12, H group felt pressured by the effect that skill acquisition had on testing (especially the Literacy Passport Test) and on preparation for the next course that might be taken. The 6-12, L group expressed a deeper sense of value attached to basic skills. It was not so much a matter of the tests but the importance of skills as requisite knowledge.

Common Concerns

Time, or rather the lack of it, was a factor mentioned in every group - both time within the classroom with students and time outside of class to learn and develop new ideas. While this is not a startling revelation, these teachers all seem to understand that they must learn more than what they know and that greater expectations are being placed on their students. While teachers have always cried for more time, it is reasonable to expect that the usual inservice approaches will not be adequate to help teachers become *Standards*-oriented. Long-term and in-depth inservice or coursework seems to be essential in helping teachers come to a true understanding of the *Standards*' message and also in helping them deal with in-class time issues. Several secondary school teachers in a VCU *Standards* class (not participants in these interviews) sounded initially much like some of these teachers. Late in the semester, each agreed that much to their surprise, they were much further along in their curriculum than they would have been in their more traditional approaches. They had accomplished more in less time and had done many good and interesting things along the way. This sort of understanding does not come quickly, especially at the upper grades.

Curriculum Interference

There is a uniform belief that local curriculums need to change; that the current objectives (State, local, textbook) are not in sync with the *Standards*. This seems to be less of an obstacle for the K-5 group than the 6-12 group, a difference that is quite reasonable. The curriculum tends to cause confusion and frustration. Teachers feel pulled in different

directions by tests and objective checklists that ask for one thing and the *Standards* and a constant pressure to do projects and investigations that clash with the time to needed to attend to the large menu of the curriculum.

Changes in Practice vs. Changes in Curriculum

With the possible exception of the K-5, H group, there was a frustration in listening to the reported changes made in reaction to the *Standards*. Teachers must reconceptualize the very nature of mathematics. They must come to understand what the *Standards* means when it says, "To know mathematics is to do mathematics," or what Lynn Steen in *Everybody Counts* refers to when he says, "Mathematics is the science of pattern and order." What these teachers report are changes in practice rather than a change in curriculum or curricular goals. They talk about the use of calculators or manipulatives or cooperative groups - ways of doing things. These are the overt hallmarks of doing something different. However, if teachers come to believe that the *Standards* are about the superficial acts of instruction, then they may adapt these approaches and never really move in the true direction of the *Standards*. Most disturbing is that they may never know the difference.

By way of example, in the K-5, H group, one teacher of the fourth grade expressed a real value in the Touch Math system. "If that gets the answer, what's wrong with it?" This same teacher had touted the values of nontext approaches, the use of manipulatives and estimation. But it is difficult to believe that anyone who truly understood the *Standards* could also view Touch Math as an acceptable method of dealing with basic facts.

On a different side of the coin was a teacher in the 6-12, L group who was known to one of the investigators as being active in professional organizations, one who attends conferences, has taken summer courses, and is even a frequent speaker at state-level meetings. Why did her survey data suggest that she was a low-implementation teacher? Listening to this teacher in the interview suggested that she had a some understanding of the *Standards* and therefore her self-appraisal of how well she had implemented them

was perhaps more brutally accurate than some of the teachers in the 6-12, H group. It was also true, that the pressures of time, class size and availability of technology were real obstacles for this teacher.

It is at least as important to help teachers reconceptualize the nature of the mathematics they are teaching as it is to help them change the instructional methods they use in their classrooms. The two are not necessarily correlated.

APPENDIX C

PRINCIPAL SURVEY

APPENDIX C: PRINCIPAL SURVEY METHODOLOGY

SUBJECTS

Of the 183 surveys distributed, 110 were returned; a 60% response rate (70 elementary, 18 middle, 20 secondary, 2 unknown). The group included roughly equal numbers of men and women, although men were more prevalent at the secondary level (62%) than at the elementary level (49%). The respondents represented a broad spectrum of experience as a principal with about 36% having 5 years of experience or less, 32% having 6-15 years of experience, and 33% having more than 16 years of experience.

SURVEY DESIGN

Item Selection

Survey items were drawn from the final version of the Teacher Survey, and were adapted to be directed at school principals. A brief description of these 47 items, along with the sections in which they appear in the Teacher Survey, is given below.

Demographics:	Items reflecting principal gender, years of experience as a school principal, and school grade level (4 items).
Awareness:	Items reflecting awareness of the *Standards*, teachers' access to the *Standards*, and perceptions of teacher attitudes and teacher and school changes in response to the *Standards* (11 items adapted from section 2 of the Teacher Survey).
Aids and Obstacles:	Most items from the Teacher Survey reflecting aids and obstacles to *Standards* implementation, plus an additional two obstacles specific to principals (32 items, total).

Due to the relatively small number of school principals in the geographical area of interest, no attempt was made to pilot the principal survey. However, all but the last two

items had been included, either identically or with minor alterations, on the pilot version of the Teacher Survey.

Survey Distribution

Principal Surveys were distributed via district internal mail services along with the Teacher Surveys. Principals were directed to complete the survey and to mail it back to the research team in the stamped envelope provided. They were assured that their responses would be confidential, and were not asked to indicate their name or school name on the survey form.

DATA ANALYSIS

Principals' responses were grouped by grade level for purposes of analysis. Responses from middle and secondary school principals were combined due to low sample sizes in each of these categories, so that frequency analyses are for elementary and secondary grade levels. When no differences between elementary and secondary principals are evident, item percentages are reported for all grades taken as a whole.

FINDINGS

AWARENESS OF THE *STANDARDS*

The majority of school principals at all grade levels reported being aware of the *Standards*, although the degree of awareness appeared to differ as a function of grade level. Fully 63% of elementary principals reported that they had read the *Standards*, whereas only 29% of secondary principals had done so. About 4% overall reported no knowledge of the *Standards*. More than half of the principals at each grade level reported that they were well aware of the Teaching *Standards*, but in this case the number of principals reporting no knowledge was somewhat higher--about 25% of elementary principals and 10% of secondary principals.

Like the teachers who are aware of the *Standards*, over three fourths of the principals consider themselves well informed about and in agreement with the *Standards*. Slightly

more than half feel prepared to discuss them with teachers in their schools. Principals appear to be fairly accurate in their perceptions of teachers' awareness of the *Standards*. About 80% of the secondary principals, and 40% of the elementary principals, report that most of the mathematics teachers at their schools are aware of the *Standards*. Over 90% of principals report that teachers have access to a copy of the *Standards*, or to *Standards*-like materials, at their schools; this is also in agreement with data from the teacher survey.

It is clear that awareness does not necessarily mean change. Less than half report significant changes in the teaching of mathematics in their schools, or in their own observation and evaluation of mathematics teaching, as a result of the *Standards*.

AIDS TO IMPLEMENTATION OF THE *STANDARDS*

All of the activities identified as available and helpful by a majority of teachers on a corresponding survey were listed as either available or in process by three quarters or more of the principals. Aids that at least 75% of the principals reported as available in their school are:

* Support to teachers who take responsibility for planning and/or implementing mathematics curricular reforms
* Notification of teachers of opportunities to attend workshops not on school time
* Encouragement for teachers to attend regional and state mathematics conferences which emphasize the *Standards*
* Specific support for mathematics "lead teachers"/department chairpersons
* Fostering a collaborative climate among mathematics and other teachers.

Other aids were reported as either "available" or "in process" by at least 75% of the principals:

* School- or district-wide policy statements articulating a vision of mathematics curriculum reform
* District-wide plans for reform
* Revision of criteria for mathematics curriculum design
* Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the *Standards*

* School maintains a library of instructional materials related to the *Standards*
* Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at mathematics curriculum change.
* Teachers use a portion of the time at department or staff meetings to engage in mathematics activities and to discuss the usefulness of these activities as classroom activities.

In addition, there was general agreement with the teachers on potential aids that were not yet in place in the schools. Two initiatives were described as not available or in process by at least half of the principals:

* Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate the approaches emphasized in the *Standards*
* Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools.

A second category of responses on the Teacher Survey included items that were more frequently endorsed as being available and helpful by teachers who indicated that they had changed their teaching practices in accordance with the *Standards*. Four of the ten items were also endorsed by a majority of principals as available in their schools. They include:

* Encouragement for teachers to attend regional and state mathematics conferences which emphasize the *Standards* (79%)
* Designating certain teachers as "lead teachers" (69%)
* Maintaining library of *Standards*-related instructional materials (58%)
* Unofficially recognized "school leader" acts as a catalyst for new instructional practices (62%).

Three of the items endorsed by "Changed" teachers were not directly comparable on the two surveys. Thus, although 90% of the principals reported "support" for teachers acting as catalysts for curriculum reform, it was not clear to what extent this support took the form of awards of grant money, which were perceived as helpful by teachers who had made changes. Likewise, although some form of support was available for lead teachers or department chairpersons was offered in 90% of the schools, the prevalence of specific

training events for lead teachers cannot be determined from this data. A final item concerning revision of criteria for textbook selection, also perceived as disproportionately available by teachers making changes, was omitted from the Principal Survey. It is difficult to discern the availability of aids to implementation valued by "changed" teachers. It appears that at least three of them are not widely available in the schools: inservice, notification of workshops not on school time, and school or district wide policy statements regarding implementation.

A few differences were noted between elementary and secondary principals. Secondary principals were more likely to report the existence of school-wide plans for curriculum reform as well as requirements for teachers to formulate individual staff-development plans. (It should be noted that a significant proportion of teachers deemed the latter strategy "unhelpful.") It appears that the prevalence of both types of plans is increasing, with 20 to 40% of principals at all grade levels reporting that such changes are in process in their schools. Secondary principals were also more likely to report that teachers interacted with one another inside and outside the classroom in an effort to promote curriculum reform. These interactions could take the form of observing one another's classes, exchanging suggestions on curriculum development, coordinating with teachers from other program levels, or using time at department or staff meetings for exchange of ideas and teaching strategies.

Elementary teachers were more likely to report the existence of unofficially recognized "school leaders" in mathematics reform, as well as officially designated "lead teachers" in mathematics. The prevalence of lead teachers in secondary schools is increasing, however, with almost 20% of principals reporting that this initiative was in process.

OBSTACLES TO IMPLEMENTATION OF THE *STANDARDS*

Like elementary teachers, elementary principals tended to perceive pressure on teachers (and on themselves) to have students perform well on standardized tests as at least a minor obstacle to implementing the *Standards*, with more than 20% designating this as

a major or primary obstacle. Other situations that over 60% of elementary principals classify as at least a minor obstacle include lack of time and resources for inservice training and lack of material resources such as calculators, computers and manipulatives.

Secondary principals also identified pressure based on standardized test scores as an important obstacle, as did the teachers at these grade levels. Lack of both training and technology resources was also a commonly identified obstacle by these principals. Finally, unlike elementary principals, secondary principals indicated widespread agreement that both student attitudes and low level of student ability constituted obstacles to *Standards* implementation at their schools. These factors were also mentioned as obstacles by middle and secondary school teachers (but not by elementary school teachers).

PRINCIPAL COMMENTS

District Issues

-- Much, Much, Much staff development will be needed for less dependency on texts, use of strategies, assessing student achievement (5)

-- District mathematics objectives need to be revised (2)

-- State and local curriculum specialists need to further correlate the NCTM Standards with local expectations and give in-service to teachers including help with record keeping and report cards. This would free teachers from the pressures of standardized test performance and allow them to teach the newer strategies and techniques.

-- Attitudinal change for teachers and parents will be a key factor in determining success or failure of the implementation process. Some teachers will implement standards, at least partially,on their own, but it will require an edict from Central office to change others, if then.

-- A Math Lead Teacher is needed at <u>each</u> elementary school. These teachers should function exclusively as building level Math Coordinators.

-- The math programs currently used allow for implementation of many of the NCTM standards. A possible approach for our county is to show which areas we have been emphasizing, and where we need to grow. Calculators are being used more than in the past for computational skills needed in the process of solving a problem. As the number of computers grows for classroom use, so too will the use of teachers to show mathematical procedures to be carried out in the reasoning of a problem.

-- With our organization being so large, decisions of this nature and major changes need to come from the top down. That has not happened as of this date.

-- clearly defined system-wide plans for application of NCTM standards have not been shared.

-- An <u>elementary math</u> supervisor is needed to provide division leadership

Principal/School Issues

-- The math department in my school is doing a terrific of implementing the standards. A new course is being developed based on the standards.

-- The implementation of the NCTM Standards is proceeding as a result of the leadership of our math specialist and building principals

-- We have just recently received materials on the NCTM through our math lead teachers. They meet with the Math Specialist for the county who gives them information and informs them of conferences. This has just started this year. We are also in the process of new adoptions which I'm sure will have some impact for our future direction. Though I am familiar with the Standards, I have not read about them in-depth. I have been emphasizing greater use of manipulatives the past several years as well as problem-solving skills. The math specialist did some training with my teachers. My KG and first grade teachers use no workbooks but manipulatives and a fifth grade teacher does a terrific job at teaching reasoning skills, problem-solving, etc. We're on the way but not there yet.

-- Our faculty is currently involved deeply in implementing the NCTM Standards. Every classroom teacher has a copy of the Standards and we are meeting each week with Educ. Specialist, math Coordinator, Key Math teacher, and principal. We are reviewing Standards, sharing activities and lessons, and generating ideas about how to have Standards fully implemented by fall. We are already in to "everyday" math but want a structured format to make sure it all happens for students. We are excited about our summer work of planning!

-- Our mathematics department is discussing and implementing the changes in the standards. We are making more progress in some areas than others. We plan some in-service activities in the future to help implement the applications of the new standards in our curriculum.

-- I see the need to avail myself to learning more about the NCTM Standards. Participating in this survey has been beneficial to me. I will work with the Mathematics teachers regarding implementation procedure.

Teacher Issues

-- Our teachers have not had the standards long enough to have implemented many of the standards

-- Teachers feel pressure to make change without regard to their input---after all, they are the ones "in the trenches" and are the ones "blamed" for pupils' successes or lack of successes.

-- Teachers are receptive to new teaching strategies and manipulatives to best insure students maximize learning from curricula taught. An obstacle for our teachers seems to be the fact that many facets of public education are changing quickly and simultaneously, therefore, adequate transition and training is not being provided. Teachers feel overwhelmed and often revert back to previously reliable methods and material.

General Comments on Standards

-- This survey presupposes that those surveyed favor the NCTM Standards and/or feel that they - or any set of standards- will result in an overall improvement in the mathematical competency of American students unless there is a substantive change in American culture.

Standards - whether old or new - must be implemented and adhered to. As long as parents expect that their children will get good grades for minimum effort - and as long as we administrators, due to lack of support from school boards, do not feel we can support higher teacher expectations, all the NCTM *Standards* in the world will not help.

-- Talking <u>about</u> NCTM *Standards* and defining changes needed and goals to be set are different. We need more than <u>talking about</u> the "*Standards*". No one has the time to read that NCTM volume.

APPENDIX D

TEACHER SURVEY DATA TABLES

APPENDIX D: TEACHER SURVEY DATA TABLES

TEACHER SURVEY RESPONSES

This Appendix contains response profiles of elementary, middle, and secondary school teachers to all items on the Teacher Survey. Related items are grouped into tables, and table entries indicate the percent of respondents selecting each response ("a" tables) or the percent of both "Unchanged" and "Changed" teachers selecting each response ("b" tables).

Teachers were placed into the Changed group if they indicated that they were well aware of the *Standards* (response of A or B to item 14) and also agreed that they had changed their teaching practices based on this awareness (response of A or B to item 22). All teachers not meeting both these criteria were assigned to the Unchanged group in these analyses.

For the "a" tables, cell entries are percentages of the total respondents to each item (teachers who omitted a given item are not included in the total for that item). For most items, only a few teachers failed to respond, so that these percentages very closely reflect the opinions of all teachers who returned the survey. But for the "Aids to Implementation" items, teachers who were not sure about the availability of any of the items in their school or district were asked to omit that item. A high proportion of elementary teachers chose not to respond to these items (average number of responses to these items = 712; total elementary teachers surveyed = 1473; mean percent of survey respondents who omitted these items = 52%). Thus the percentages in Table 31a reflect the opinions of only those teachers who knew whether the item in question was available or not.

In addition, the response rates for the "Aids to Implementation" were disproportionate for the Changed and Unchanged teachers at the elementary and middle school levels (but not at the secondary level). Among elementary teachers, 44% of Unchanged teachers, as compared with 64% of Changed teachers, on average, knew whether a given aid to implementation was available or not. Among middle school teachers, 61% of Unchanged

teachers, as compared with 78% of Changed teachers, knew whether the average item was available. Thus, Tables 31a and 32a disproportionately reflect the opinions of the teachers in the Changed, as opposed to Unchanged, groups at these grade levels.

These anomalies in the pattern of responding also affect the interpretation of the percentages given in Tables 31b and 32b, which contrast responses of the Unchanged and Changed teachers on each of the aids to implementation items. As noted above, slightly more than half of the elementary teacher omitted a typical item in this section. In addition, teachers who had changed in response to the *Standards* were less likely to omit these items (i.e., more likely to be sure whether the aids to implementation were available in their schools or divisions) than were unchanged teacher, at both the elementary and middle school levels. Thus, the percentages for the Changed group will be more representative than those of the Unchanged group in these two tables.

Tables

Table 1a: Elementary Teachers: Self-Description and Class Characteristics (Total Frequencies)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
1. Age	≤25 6%	25 to 34 25%	35 to 44 34%	45 to 54 28%	55+ 7%
2. Gender	Male 4%	Female 96%			
3. Year in which you completed your initial teacher training	Prior to 1960 6%	1960 to 69 24%	1970 to 79 37%	1980 to 89 24%	1990+ 10%
4. Number of years you have taught in grades K-12	≤5 18%	5 to 14 35%	15 to 24 35%	25 to 34 12%	35+ 1%
5. Extent of your formal college training in teaching of mathematics (math ed. courses)	None at all 2%	Only my initial training 55%	Additional coursework 41%	Additional graduate degree 2%	
6. Membership in GRCTM	Yes, current 7%	Not now but yes in past 6%	Never 87%		
7. Membership in VCTM	Yes, current 4%	Not now but yes in past 5%	Never 91%		
8. Membership in NCTM	Yes, current 3%	Not now but yes in past 5%	Never 91%		
9. Student grade level	K 18%	1 20%	2 18%	3 17%	4 14%
10. Student grade level	5 13%				
11. (HS teachers only)					
12. Number of students in class	≤=10 1%	11 to 15 3%	16 to 20 16%	21 to 25 59%	26+ 21%
13. Student ability level	Low 9%	Average 46%	High 8%	Mixed 36%	

Note: This table summarizes responses from all 1473 elementary (K-5) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 2a: Middle School Teachers: Self-Description and Class Characteristics (Total Frequencies)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
1. Age	≤25 5%	25 to 34 15%	35 to 44 36%	45 to 54 40%	55+ 5%
2. Gender	Male 10%	Female 90%			
3. Year in which you completed your initial teacher training	Prior to 1960 3%	1960 to 69 32%	1970 to 79 40%	1980 to 89 18%	1990+ 7%
4. Number of years you have taught in grades K-12	≤5 12%	5 to 14 31%	15 to 24 44%	25 to 34 13%	35+ 0%
5. Extent of your formal college training in teaching of mathematics (math ed. courses)	None at all 4%	Only my initial training 33%	Additional coursework 55%	Additional graduate degree 8%	
6. Membership in GRCTM	Yes, current 54%	Not now but yes in past 20%	Never 26%		
7. Membership in VCTM	Yes, current 28%	Not now but yes in past 26%	Never 46%		
8. Membership in NCTM	Yes, current 27%	Not now but yes in past 21%	Never 51%		
9. (Elementary only)					
10. Student grade level	5 0%	6 39%	7 32%	8 29%	
11. (HS teachers only)					
12. Number of students in class	<=10 1%	11 to 15 5%	16 to 20 6%	21 to 25 33%	26+ 56%
13. Student ability level	Low 21%	Average 34%	High 19%	Mixed 25%	

Note: This table summarizes responses from all 221 Middle (6-8) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 3a: Secondary Teachers: Self-Description and Class Characteristics (Total Frequencies)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
1. Age	≤25 3%	25 to 34 17%	35 to 44 40%	45 to 54 33%	55+ 8%
2. Gender	Male 34%	Female 66%			
3. Year in which you completed your initial teacher training	Prior to 1960 5%	1960 to 69 29%	1970 to 79 43%	1980 to 89 18%	1990+ 6%
4. Number of years you have taught in grades K-12	≤5 10%	5 to 14 24%	15 to 24 51%	25 to 34 15%	35+ 1%
5. Extent of your formal college training in teaching of mathematics (math ed. courses)	None at all 9%	Only my initial training 18%	Additional coursework 51%	Additional graduate degree 22%	
6. Membership in GRCTM	Yes, current 56%	Not now but yes in past 25%	Never 19%		
7. Membership in VCTM	Yes, current 31%	Not now but yes in past 33%	Never 36%		
8. Membership in NCTM	Yes, current 31%	Not now but yes in past 39%	Never 29%		
9. Student grade level (Elementary only)					
10. Student grade level (E/M only)					
11. Principal subject matter (HS teachers only)	Basic math 12%	Algebra I 30%	Geometry 20%	Algebra II 22%	Advanced 15%
12. Number of students in class	<=10 3%	11 to 15 7%	16 to 20 15%	21 to 25 40%	26+ 35%
13. Student ability level	Low 24%	Average 29%	High 21%	Mixed 26%	

Note: This table summarizes responses from all 198 secondary (9-12) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 4a: Elementary Teachers: Awareness of and Access to the Standards (Total Frequencies)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read 29%	Aware; have not read 15%	Heard of; don't know much about 33%	Not aware 18%	Not sure 5%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school 69%	No copy, but related materials available 18%	School has no copy or related materials 13%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy 32%	No, I do not own a copy 65%			
34. Awareness of Professional Standards	Aware; have read 14%	Aware; have not read 16%	Heard of; don't know much about 27%	Not aware 32%	Not sure 11%

Note: This table summarizes responses from all 1473 elementary (K-5) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 4b: Elementary Teachers: Awareness of and Access to the Standards (Unchanged vs. Changed)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	15% 76%	14% 20%	42% 3%	22% 1%	7% 0%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school	No copy, but related materials available	School has no copy or related materials		
	66% 78%	19% 16%	15% 6%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy	No, I do not own a copy			
	29% 45%	70% 51%			
34. Awareness of Professional Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	7% 39%	13% 30%	30% 18%	38% 10%	13% 3%

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual n's vary.

Only teachers who reported that they were "well aware" of the Standards on item 14 were asked to respond to item 22, which was used to identify the Changed group.

Table 5a: **Middle School Teachers: Awareness of and Access to the Standards (Total Frequencies)**

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read 72%	Aware; have not read 10%	Heard of; don't know much about 13%	Not aware 4%	Not sure 2%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school 85%	No copy, but related materials available 12%	School has no copy or related materials 3%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy 54%	No, I do not own a copy 46%			
34. Awareness of Professional Standards	Aware; have read 33%	Aware; have not read 27%	Heard of; don't know much about 18%	Not aware 18%	Not sure 5%

Note: This table summarizes responses from all 221 Middle (6-8) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 5b: Middle School Teachers: Awareness of and Access to the Standards (Unchanged vs. Changed)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	50% 92%	12% 8%	28% 0%	7% 1%	4% 0%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school	No copy, but related materials available	School has no copy or related materials		
	81% 89%	14% 9%	5% 1%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy	No, I do not own a copy			
	48% 58%	50% 42%			
34. Awareness of Professional Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	15% 47%	30% 25%	24% 12%	25% 11%	7% 4%

Note: This table summarizes responses from 221 middle school (6 - 8) teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Only teachers who reported that they were "well aware" of the Standards on item 14 were asked to respond to item 22, which was used to identify the Changed group.

Table 6a: Secondary Teachers: Awareness of and Access to the Standards (Total Frequencies)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read 67%	Aware; have not read 16%	Heard of; don't know much about 15%	Not aware 1%	Not sure 2%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school 79%	No copy, but related materials available 16%	School has no copy or related materials 5%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy 41%	No, I do not own a copy 56%			
34. Awareness of Professional Standards	Aware; have read 33%	Aware; have not read 25%	Heard of; don't know much about 22%	Not aware 17%	Not sure 3%

Note: This table summarizes responses from all 198 secondary (9-12) school teachers responding to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 6b: Secondary Teachers: Awareness of and Access to the Standards (Unchanged vs. Changed)

Item # and Description:	(A)	(B)	(C)	(D)	(E)
14. Awareness of the Curriculum and Evaluation Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	44% 88%	19% 12%	31% 0%	2% 0%	3% 0%
32. Access to Curriculum and Evaluation Standards at school	Copy of Standards available at school	No copy, but related materials available	School has no copy or related materials		
	73% 84%	20% 12%	7% 3%		
33. Ownership of Curriculum and Evaluation Standards	Yes, I own a copy	No, I do not own a copy			
	37% 45%	60% 52%			
34. Awareness of Professional Standards	Aware; have read	Aware; have not read	Heard of; don't know much about	Not aware	Not sure
	19% 45%	22% 28%	33% 12%	23% 12%	3% 3%

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual n's vary.

Only teachers who reported that they were "well aware" of the Standards on item 14 were asked to respond to item 22, which was used to identify the Changed group.

Table 7a: Elementary Teachers: Attitudes Toward the Standards (Total Frequencies)

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
15. I am well informed about the NCTM Standards for the grades I teach.	16	49	12	20	2
16. I am in agreement with the instructional philosophy of the NCTM Standards, as I understand them.	21	49	26	3	0
17. I am prepared to explain the NCTM Standards to my colleagues.	5	18	29	33	15
18. Our district has made changes in the mathematics curriculum based on the NCTM Standards.	5	31	46	15	4
19. Most of the mathematics teachers in my school are well informed about the NCTM Standards.	4	28	39	24	6
20. Mathematics teachers in my school have changed what and how they teach based on the NCTM Standards.	1	18	56	19	5
21. I would be happy if my own mathematics classes incorporated more of the ideas and activities recommended in the NCTM Standards	20	46	30	4	1
22. I have changed what and how I teach based on the NCTM Standards	7	43	28	19	2

Note: This table summarizes responses from approximately 750 elementary (K - 5) school teachers. Only those teachers (n = 646) who described themselves as "well aware" of the NCTM Standards were asked to respond to these items, but approximately 100 additional teachers responded voluntarily.

Cell entries represent the percent of teachers answering the item who selected each response choice. Actual n's vary.

Table 8a: **"Well Aware" Middle School Teachers: Attitudes Toward the Standards (Total Frequencies)**

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
15. I am well informed about the NCTM Standards for the grades I teach.	32	51	8	9	0
16. I am in agreement with the instructional philosophy of the NCTM Standards, as I understand them.	24	59	15	2	1
17. I am prepared to explain the NCTM Standards to my colleagues.	9	37	20	26	8
18. Our district has made changes in the mathematics curriculum based on the NCTM Standards.	13	55	21	7	4
19. Most of the mathematics teachers in my school are well informed about the NCTM Standards.	5	42	32	20	1
20. Mathematics teachers in my school have changed what and how they teach based on the NCTM Standards.	2	27	46	24	2
21. I would be happy if my own mathematics classes incorporated more of the ideas and activities recommended in the NCTM Standards	18	61	19	2	0
22. I have changed what and how I teach based on the NCTM Standards	11	54	16	18	1

Note: This table summarizes responses from 187 middle (6-8) school teachers who described themselves as "well aware" of the NCTM Standards. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 9a: **"Well Aware" Secondary Teachers: Attitudes Toward the Standards (Total Frequencies)**

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
15. I am well informed about the NCTM Standards for the grades I teach.	28	50	6	17	0
16. I am in agreement with the instructional philosophy of the NCTM Standards, as I understand them.	18	56	18	7	0
17. I am prepared to explain the NCTM Standards to my colleagues.	9	31	28	22	11
18. Our district has made changes in the mathematics curriculum based on the NCTM Standards.	9	42	28	19	2
19. Most of the mathematics teachers in my school are well informed about the NCTM Standards.	8	38	21	29	4
20. Mathematics teachers in my school have changed what and how they teach based on the NCTM Standards.	4	30	38	24	5
21. I would be happy if my own mathematics classes incorporated more of the ideas and activities recommended in the NCTM Standards	15	60	21	4	1
22. I have changed what and how I teach based on the NCTM Standards	11	54	21	18	3

Note: This table summarizes responses from 164 high (9 - 12) school teachers who described themselves as "well aware" of the NCTM Standards. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 10a: Preparedness of Elementary Teachers to Teach in Accordance with the Standards (Total Frequencies)

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
23. I feel well prepared to phrase questions to encourage more open-ended investigations.	15	61	11	12	1
24. I feel well prepared to use the textbook as a resource rather than as the primary instructional tool.	27	45	7	20	1
25. I feel well prepared to manage a class of students who are using manipulatives.	39	51	5	6	0
26. I feel well prepared to teach heterogeneous groups.	34	55	5	6	0
27. I feel well prepared to use cooperative learning groups in mathematics instruction.	35	52	6	7	0
28. I feel well prepared to use calculators as an integral part of mathematics instruction.	17	45	18	18	2
29. I feel well prepared to use computers as an integral part of mathematics instruction.	19	50	11	17	3
30. I feel well prepared to use a variety of alternative assessment strategies.	17	48	15	19	2
31. I feel well prepared to involve parents in the mathematics education of their children.	22	52	14	11	1

Note: This table summarizes responses from all 1473 elementary school (K - 5) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 11a: Preparedness of Middle School Teachers to Teach in Accordance with the Standards (Total Frequencies)

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
23. I feel well prepared to phrase questions to encourage more open-ended investigations.	20	56	11	13	0
24. I feel well prepared to use the textbook as a resource rather than as the primary instructional tool.	25	50	9	15	1
25. I feel well prepared to manage a class of students who are using manipulatives.	26	54	9	10	1
26. I feel well prepared to teach heterogeneous groups.	21	50	7	18	5
27. I feel well prepared to use cooperative learning groups in mathematics instruction.	26	55	8	11	1
28. I feel well prepared to use calculators as an integral part of mathematics instruction.	29	56	9	6	0
29. I feel well prepared to use computers as an integral part of mathematics instruction.	18	45	11	22	4
30. I feel well prepared to use a variety of alternative assessment strategies.	16	44	18	19	2
31. I feel well prepared to involve parents in the mathematics education of their children.	15	50	18	17	0

Note: This table summarizes responses from all 221 middle school (6 - 8) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 12a: Preparedness of Secondary Teachers to Teach in Accordance with the Standards (Total Frequencies)

Item # and Description:	(A) Strongly Agree	(B) Agree	(C) No opinion	(D) Disagree	(E) Strongly Disagree
23. I feel well prepared to phrase questions to encourage more open-ended investigations.	19	61	7	13	1
24. I feel well prepared to use the textbook as a resource rather than as the primary instructional tool.	23	45	7	24	1
25. I feel well prepared to manage a class of students who are using manipulatives.	16	53	13	17	2
26. I feel well prepared to teach heterogeneous groups.	20	45	12	18	5
27. I feel well prepared to use cooperative learning groups in mathematics instruction.	22	54	9	47	1
28. I feel well prepared to use calculators as an integral part of mathematics instruction.	35	53	4	8	1
29. I feel well prepared to use computers as an integral part of mathematics instruction.	21	43	9	22	4
30. I feel well prepared to use a variety of alternative assessment strategies.	15	39	20	23	3
31. I feel well prepared to involve parents in the mathematics education of their children.	16	42	19	21	2

Note: This table summarizes responses from all 198 secondary (9 - 12) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 13a: Grade K-4 Teachers: Topical Emphasis (Total Frequencies)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
35. Estimation	3	26	51	20
36. Number sense and numeration	1	3	26	70
37. Concepts of whole number operations	2	4	21	73
38. Whole number computation	3	7	20	70
39. Geometry and spatial sense	4	32	49	15
40. Measurement	3	21	58	18
41. Statistics and probability	29	47	19	5
42. Fractions and decimals	14	41	34	11
43. Patterns and relationships	2	17	38	43

Note: This table summarizes responses from 1268 teachers in grades K - 4 who responded to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 13b: K-4 Teachers: Topical Emphasis (Changed vs. Unchanged)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
35. Estimation	4 2	28 20	52 48	17 30
36. Number sense and numeration	1 1	3 1	27 24	69 73
37. Concepts of whole number operations	2 1	5 2	21 19	72 78
38. Whole number computation	3 3	7 5	19 24	71 69
39. Geometry and spatial sense	4 3	35 22	49 50	13 26
40. Measurement	3 3	22 16	59 56	16 26
41. Statistics and probability	33 18	47 44	16 30	4 8
42. Fractions and decimals	16 11	41 40	33 38	11 12
43. Patterns and relationships	3 0	19 12	39 34	40 54

Note: This table summarizes responses from 1277 K - 4 school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1002), and lower entries indicate the percent of Changed teachers (n = 275) selecting each response. Actual n's vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 14a: Grade 5-8 Teachers: Topical Emphasis (Total Frequencies)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
44. Number and number relationships	0	8	49	43
45. Number system and number theory	2	15	51	32
46. Computation	0	8	31	61
47. Estimation	1	8	50	41
48. Patterns	2	23	55	21
49. Functions	13	24	42	22
50. Algebra	21	36	26	17
51. Statistics	24	41	28	8
52. Probability	11	47	35	6
53. Geometry	4	16	56	25
54. Measurement	4	19	51	26

Note: This table summarizes responses from 414 teachers in grades 5 - 8 who responded to the survey. This number includes 193 grade 5 teachers and 221 teachers in grades 6 through 8. Thus, all grade levels are not equally represented in these data.

Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 14b: 5-8 Teachers: Topical Emphasis (Changed vs. Unchanged)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
44. Number and number relationships	0 0	9 7	53 43	38 50
45. Number system and number theory	3 0	17 10	52 49	27 40
46. Computation	0 0	5 13	25 41	70 46
47. Estimation	1 1	7 9	50 49	41 42
48. Patterns	3 0	26 18	57 49	14 33
49. Functions	13 12	24 24	40 44	23 20
50. Algebra	30 12	41 27	18 38	11 29
51. Statistics	31 12	43 38	23 36	3 15
52. Probability	13 8	51 41	32 40	4 10
53. Geometry	5 2	17 13	57 53	20 33
54. Measurement	5 3	19 19	51 51	25 27

Note: This table summarizes responses from 407 teachers in grades 5 - 8. This number includes 186 grade 5 teachers (150 Unchanged; 43 Changed) and 221 teachers in grades 6 through 8 (104 Unchanged; 117 Changed). Thus, all grade levels are not equally represented in these data.

Upper entries in each cell represent the percent of Unchanged teachers giving that response; lower entries represent responses of Changed teachers. Actual *n*'s vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 15a: 9-12 Teachers: Topical Emphasis (Total Frequencies)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
55. Algebra	4	5	19	73
56. Functions	20	25	31	23
57. Geometry from a synthetic perspective	34	30	21	16
58. Geometry from an algebraic perspective	13	30	29	28
59. Trigonometry	54	22	11	13
60. Statistics	55	29	13	3
61. Probability	54	30	13	3
62. Discrete mathematics	63	23	12	2
63. Conceptual underpinning of calculus	70	12	10	9
64. Mathematical structure	27	29	26	18

Note: This table summarizes responses from 198 teachers in grades 9 - 12 who responded to the survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 15b: 9-12 Teachers: Topical Emphasis (Changed vs. Unchanged)

Item # and Description:	(A) No emphasis	(B) Little emphasis	(C) Moderate emphasis	(D) Heavy emphasis
55. Algebra	8 0	3 6	15 23	73 71
56. Functions	21 20	31 20	32 31	17 29
57. Geometry from a synthetic perspective	40 29	28 31	16 25	16 15
58. Geometry from an algebraic perspective	17 10	33 28	25 33	26 30
59. Trigonometry	60 49	17 26	11 11	11 14
60. Statistics	65 47	25 33	8 17	2 3
61. Probability	65 45	25 35	8 17	2 3
62. Discrete mathematics	76 52	13 31	10 14	1 3
63. Conceptual underpinning of calculus	78 63	7 15	9 11	6 12
64. Mathematical structure	33 22	27 31	26 25	14 21

Note: This table summarizes responses from 198 teachers in grades 9 - 12. Upper entries in each cell indicate the percent of Unchanged teachers ($n = 93$) giving that response; lower entries indicate the responses of Changed teachers ($n = 105$). Actual *n*'s vary.

Occasional responses of "E" are counted as "D" in this analysis.

Table 16a: Elementary Teachers: Classroom Activities (Total Frequencies)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	17	5	7	34	36
66. Do mathematics problems on worksheets	6	24	24	34	13
67. Work in small cooperative groups	2	17	30	36	15
68. Work in class on mathematics projects	24	44	18	10	4
69. Listen and take notes during presentation by teacher	71	13	7	6	3
70. Make conjectures and explore possible methods to solve a mathematical problem	9	26	25	30	9
71. Learn about mathematics through real-life applications	2	15	31	36	16
72. Explain their reasoning about how to solve a problem	2	12	22	41	22
73. Use calculators	46	35	12	6	2
74. Use computers	10	19	38	17	16
75. Use manipulative materials	1	18	20	29	32

Note: This table summarizes responses from all 1473 elementary (K - 5) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 16b: Elementary Teachers: Classroom Activities (Unchanged vs. Changed)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	17 17	5 7	7 9	32 41	39 27
66. Do mathematics problems on worksheets	5 8	23 26	24 25	34 32	14 9
67. Work in small cooperative groups	2 1	20 7	31 26	34 47	14 20
68. Work in class on mathematics projects	27 12	45 41	15 29	9 14	4 5
69. Listen and take notes during presentation by teacher	71 69	13 13	7 8	5 9	4 1
70. Make conjectures and explore possible methods to solve a mathematical problem	10 7	28 16	26 22	27 44	9 12
71. Learn about mathematics through real-life applications	2 2	17 9	32 28	34 41	15 21
72. Explain their reasoning about how to solve a problem	2 1	13 10	23 19	42 41	20 30
73. Use calculators	50 33	34 39	11 16	5 10	1 3
74. Use computers	11 7	19 19	38 36	16 21	16 17
75. Use manipulative materials	1 0	20 11	21 18	28 34	30 37

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 1142$), and lower entries indicate the percent of Changed teachers ($n = 316$) selecting each response. Actual n's vary.

Table 17a: Middle School Teachers: Classroom Activities (Total Frequencies)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	1	6	7	49	37
66. Do mathematics problems on worksheets	3	24	36	34	4
67. Work in small cooperative groups	4	29	30	33	6
68. Work in class on mathematics projects	23	64	10	3	0
69. Listen and take notes during presentation by teacher	8	16	17	42	17
70. Make conjectures and explore possible methods to solve a mathematical problem	3	20	28	38	10
71. Learn about mathematics through real-life applications	0	10	20	48	23
72. Explain their reasoning about how to solve a problem	8	39	20	19	14
73. Use calculators	8	39	20	19	14
74. Use computers	30	40	17	6	6
75. Use manipulative materials	9	58	23	8	1

Note: This table summarizes responses from all 221 middle school (6 - 8) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 17b: Middle School Teachers: Classroom Activities (Unchanged vs. Changed)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	1 1	7 5	7 8	51 47	35 39
66. Do mathematics problems on worksheets	3 3	21 27	36 35	37 32	4 3
67. Work in small cooperative groups	5 1	34 25	26 33	31 35	4 7
68. Work in class on mathematics projects	30 17	58 68	8 11	3 3	0 0
69. Listen and take notes during presentation by teacher	10 6	17 15	15 19	46 39	14 21
70. Make conjectures and explore possible methods to solve a mathematical problem	4 3	26 16	31 26	33 43	6 13
71. Learn about mathematics through real-life applications	0 0	32 21	31 31	31 35	7 13
72. Explain their reasoning about how to solve a problem	0 0	17 4	21 18	46 50	17 28
73. Use calculators	13 4	48 32	19 20	12 26	9 18
74. Use computers	33 28	37 44	21 14	4 8	5 7
75. Use manipulative materials	14 5	60 57	17 29	9 8	1 1

Note: This table summarizes responses from 221 middle (6 - 8) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Table 18a: Secondary Teachers: Classroom Activities (Total Frequencies)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	1	2	4	38	56
66. Do mathematics problems on worksheets	3	24	39	31	3
67. Work in small cooperative groups	2	32	33	26	7
68. Work in class on mathematics projects	48	43	8	2	0
69. Listen and take notes during presentation by teacher	1	4	7	49	39
70. Make conjectures and explore possible methods to solve a mathematical problem	7	20	20	34	18
71. Learn about mathematics through real-life applications	2	31	35	24	7
72. Explain their reasoning about how to solve a problem	2	9	21	43	25
73. Use calculators	6	12	11	21	50
74. Use computers	40	44	8	7	1
75. Use manipulative materials	29	50	16	5	1

Note: This table summarizes responses from all 198 secondary school (9 - 12) teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 18b: Secondary Teachers: Classroom Activities (Unchanged vs. Changed)

Item # and Description:	(A) Never	(B) < once per wk.	(C) About once per wk.	(D) 2 to 3 times per wk.	(E) 4 or more times per wk.
65. Do mathematics problems from textbooks	0 1	2 3	2 5	34 41	62 51
66. Do mathematics problems on worksheets	2 4	22 27	40 38	32 30	4 2
67. Work in small cooperative groups	2 2	37 28	30 35	22 31	9 5
68. Work in class on mathematics projects	53 43	40 46	5 10	1 2	0 0
69. Listen and take notes during presentation by teacher	2 0	5 3	4 9	52 47	36 42
70. Make conjectures and explore possible methods to solve a mathematical problem	12 2	23 18	20 20	31 37	13 23
71. Learn about mathematics through real-life applications	2 3	37 27	38 32	16 31	7 8
72. Explain their reasoning about how to solve a problem	2 1	11 7	24 19	45 42	19 31
73. Use calculators	8 5	16 8	13 10	21 22	42 56
74. Use computers	46 35	47 41	4 11	2 11	1 1
75. Use manipulative materials	34 25	54 46	9 22	3 7	0 1

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual n's vary.

Table 19a: Elementary Teachers: Teaching Strategies (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
76. Formulate their own problems, based on everyday situations	11	25	34	20	9
77. Formulate their own problems based on mathematical situations	12	26	36	20	7
78. Develop and apply strategies (e.g., guess and check, make a table, look for patterns) that can be used to solve a wide variety of mathematical problems	5	12	30	35	18
79. Verify and interpret the results of their work with respect to original problem	11	20	24	28	18
80. Use computer software to facilitate their development of problem solving strategies	19	16	21	26	18
81. Develop new concepts or skills through a problem solving approach	9	19	32	28	11
82. Work on "project" problems (complex or open-ended problems whose solution may require one or more days of class time)	42	30	17	8	3
83. Discover how to generalize problem solutions or strategies to new situations	12	24	36	21	7
84. Engage in cooperative problem solving, working together as a class	2	8	18	37	34
85. Engage in cooperative problem solving, working in small groups	4	8	23	34	31
86. Work on nonroutine problems	10	24	34	22	10
87. Use discussion in order to reflect or clarify their thinking about mathematical ideas and situations	3	9	20	32	36
88. Use discussions to relate models, pictures, or diagrams to mathematical ideas	3	11	23	34	29
89. Write about mathematical ideas (e.g., journals or portfolios describing what they are learning in class, written descriptions of the process by which they have solved a given problem, etc.)	43	25	18	9	6

(Table continues.)

Table 19a (continued)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
90. Make and discuss mathematical conjectures and attempt to construct convincing arguments in support of these conjectures	48	26	16	7	3
91. Report to class on the results of mathematical investigations (either individual or group)	36	27	21	11	4
92. Formulate definitions and/or express generalizations of mathematical principles	23	23	29	17	9
93. Describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties	10	13	24	30	24
94. Justify their answers to mathematical problems	4	9	19	33	35
95. Experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration	3	9	19	31	38
96. Respond to questions designed to focus their attention on their own reasoning processes (e.g., "Why do you think that is a good answer?" "Do you think you'd get the same answer if ...?"	3	8	23	31	34
97. Use a variety of different representations (manipulatives, graphs, drawings, charts, equations) of the same mathematical concept or procedure	1	7	19	34	39
98. Explore applications of mathematical ideas in their daily lives	2	7	30	35	25
99. Appreciate the role of mathematics in our culture and society	3	11	31	33	22
100. Make meaningful connections between different areas of the mathematics curriculum	3	10	32	32	22
101. See, use, and apply mathematics in other content areas, such as art, literature, sciences, social studies	3	8	29	32	28

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 20a: Middle School Teachers: Teaching Strategies (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
76. Formulate their own problems, based on everyday situations	8	36	37	16	3
77. Formulate their own problems based on mathematical situations	7	36	38	15	4
78. Develop and apply strategies (e.g., guess and check, make a table, look for patterns) that can be used to solve a wide variety of mathematical problems	3	14	38	31	14
79. Verify and interpret the results of their work with respect to original problem	3	8	32	35	21
80. Use computer software to facilitate their development of problem solving strategies	34	28	20	12	6
81. Develop new concepts or skills through a problem solving approach	8	17	41	25	9
82. Work on "project" problems (complex or open-ended problems whose solution may require one or more days of class time)	28	42	20	8	2
83. Discover how to generalize problem solutions or strategies to new situations	5	26	37	25	7
84. Engage in cooperative problem solving, working together as a class	3	11	27	35	24
85. Engage in cooperative problem solving, working in small groups	3	8	31	35	23
86. Work on nonroutine problems	6	21	41	19	13
87. Use discussion in order to reflect or clarify their thinking about mathematical ideas and situations	2	11	16	33	39
88. Use discussions to relate models, pictures, or diagrams to mathematical ideas	3	14	27	31	26
89. Write about mathematical ideas (e.g., journals or portfolios describing what they are learning in class, written descriptions of the process by which they have solved a given problem, etc.)	33	31	19	11	6

(Table continues.)

Table 20a (continued)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
90. Make and discuss mathematical conjectures and attempt to construct convincing arguments in support of these conjectures	32	32	24	9	3
91. Report to class on the results of mathematical investigations (either individual or group)	37	38	15	8	3
92. Formulate definitions and/or express generalizations of mathematical principles	7	24	33	28	8
93. Describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties	4	12	28	28	28
94. Justify their answers to mathematical problems	1	6	17	32	43
95. Experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration	1	4	20	27	48
96. Respond to questions designed to focus their attention on their own reasoning processes (e.g., "Why do you think that is a good answer?" "Do you think you'd get the same answer if ...?"	2	7	22	35	34
97. Use a variety of different representations (manipulatives, graphs, drawings, charts, equations) of the same mathematical concept or procedure	3	13	27	36	22
98. Explore applications of mathematical ideas in their daily lives	3	10	28	42	17
99. Appreciate the role of mathematics in our culture and society	3	11	31	37	17
100. Make meaningful connections between different areas of the mathematics curriculum	2	6	37	37	18
101. See, use, and apply mathematics in other content areas, such as art, literature, sciences, social studies	4	20	36	26	13

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 20b: Middle School Teachers: Teaching Strategies (Changed vs. Unchanged)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
76. Formulate their own problems, based on everyday situations	12 4	40 32	37 38	11 21	1 5
77. Formulate their own problems based on mathematical situations	13 3	37 35	35 41	14 16	1 6
78. Develop and apply strategies (e.g., guess and check, make a table, look for patterns) that can be used to solve a wide variety of mathematical problems	4 2	19 10	44 33	24 38	10 18
79. Verify and interpret the results of their work with respect to original problem	5 2	13 4	35 30	32 37	15 27
80. Use computer software to facilitate their development of problem solving strategies	36 32	27 28	19 21	13 11	5 8
81. Develop new concepts or skills through a problem solving approach	9 7	22 13	41 41	18 31	10 9
82. Work on "project" problems (complex or open-ended problems whose solution may require one or more days of class time)	37 21	39 44	15 24	8 9	2 3
83. Discover how to generalize problem solutions or strategies to new situations	6 4	36 17	37 37	18 32	4 10
84. Engage in cooperative problem solving, working together as a class	6 1	12 10	33 22	29 41	21 28
85. Engage in cooperative problem solving, working in small groups	6 1	10 6	33 29	37 33	15 31
86. Work on nonroutine problems	8 4	23 18	48 36	10 28	12 15
87. Use discussion in order to reflect or clarify their thinking about mathematical ideas and situations	2 2	18 4	14 18	33 32	34 44
88. Use discussions to relate models, pictures, or diagrams to mathematical ideas	3 3	18 10	33 21	25 36	20 30
89. Write about mathematical ideas (e.g., journals or portfolios describing what they are learning in class, written descriptions of the process by which they have solved a given problem, etc.)	42 25	32 29	19 18	5 17	2 10

(Table continues.)

Table 20b (continued)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
90. Make and discuss mathematical conjectures and attempt to construct convincing arguments in support of these conjectures	40 25	36 28	20 28	1 16	3 3
91. Report to class on the results of mathematical investigations (either individual or group)	41 34	40 36	15 15	4 10	0 5
92. Formulate definitions and/or express generalizations of mathematical principles	8 6	30 19	31 35	27 28	4 12
93. Describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties	6 3	10 14	33 23	27 29	24 31
94. Justify their answers to mathematical problems	1 1	9 4	25 10	27 37	39 48
95. Experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration	2 1	5 3	25 17	26 28	42 52
96. Respond to questions designed to focus their attention on their own reasoning processes (e.g., "Why do you think that is a good answer?" "Do you think you'd get the same answer if ...?"	3 2	11 4	27 18	34 36	26 41
97. Use a variety of different representations (manipulatives, graphs, drawings, charts, equations) of the same mathematical concept or procedure	5 2	17 9	27 26	30 41	21 22
98. Explore applications of math ideas in their daily lives	4 3	12 9	34 22	37 46	14 21
99. Appreciate the role of mathematics in our culture and society	5 0	13 11	35 27	29 44	19 18
100. Make meaningful connections between different areas of the mathematics curriculum	4 1	10 4	38 34	33 41	16 18
101. See, use, and apply mathematics in other content areas, such as art, literature, sciences, social studies	5 3	24 17	36 37	23 29	13 13

Note: This table summarizes responses from 221 middle (6 - 8) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Table 21a: Secondary Teachers: Teaching Strategies (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
76. Formulate their own problems, based on everyday situations	32	41	21	5	2
77. Formulate their own problems based on mathematical situations	24	43	22	9	3
78. Develop and apply strategies (e.g., guess and check, make a table, look for patterns) that can be used to solve a wide variety of mathematical problems	5	20	32	29	13
79. Verify and interpret the results of their work with respect to original problem	3	11	18	40	28
80. Use computer software to facilitate their development of problem solving strategies	42	31	14	6	8
81. Develop new concepts or skills through a problem solving approach	6	24	32	22	16
82. Work on "project" problems (complex or open-ended problems whose solution may require one or more days of class time)	36	38	17	8	2
83. Discover how to generalize problem solutions or strategies to new situations	6	19	34	31	10
84. Engage in cooperative problem solving, working together as a class	4	14	24	30	29
85. Engage in cooperative problem solving, working in small groups	3	13	32	27	24
86. Work on nonroutine problems	10	31	36	13	10
87. Use discussion in order to reflect or clarify their thinking about mathematical ideas and situations	2	10	20	30	38
88. Use discussions to relate models, pictures, or diagrams to mathematical ideas	4	18	29	25	24
89. Write about mathematical ideas (e.g., journals or portfolios describing what they are learning in class, written descriptions of the process by which they have solved a given problem, etc.)	50	23	17	7	2

(Table continues.)

Table 21a (continued)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
90. Make and discuss mathematical conjectures and attempt to construct convincing arguments in support of these conjectures	24	30	22	17	6
91. Report to class on the results of mathematical investigations (either individual or group)	40	34	15	9	2
92. Formulate definitions and/or express generalizations of mathematical principles	12	19	0	23	15
93. Describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties	6	11	23	31	29
94. Justify their answers to mathematical problems	2	2	15	25	56
95. Experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration	2	5	11	27	55
96. Respond to questions designed to focus their attention on their own reasoning processes (e.g., "Why do you think that is a good answer?" "Do you think you'd get the same answer if ...?")	0	6	14	30	50
97. Use a variety of different representations (manipulatives, graphs, drawings, charts, equations) of the same mathematical concept or procedure	4	16	31	30	19
98. Explore applications of mathematical ideas in their daily lives	2	23	36	22	17
99. Appreciate the role of mathematics in our culture and society	2	21	38	23	16
100. Make meaningful connections between different areas of the mathematics curriculum	4	16	27	27	26
101. See, use, and apply mathematics in other content areas, such as art, literature, sciences, social studies	10	31	34	18	7

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 21b: Secondary Teachers: Teaching Strategies (Changed vs. Unchanged)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
76. Formulate their own problems, based on everyday situations	38 27	40 41	20 22	1 9	1 2
77. Formulate their own problems based on mathematical situations	29 18	44 43	20 24	4 13	3 2
78. Develop and apply strategies (e.g., guess and check, make a table, look for patterns) that can be used to solve a wide variety of mathematical problems	9 2	27 13	30 34	24 34	10 16
79. Verify and interpret the results of their work with respect to original problem	3 3	17 5	20 17	38 41	22 34
80. Use computer software to facilitate their development of problem solving strategies	44 40	42 24	7 21	7 5	1 13
81. Develop new concepts or skills through a problem solving approach	8 5	31 18	33 31	22 23	8 23
82. Work on "project" problems (complex or open-ended problems whose solution may require one or more days of class time)	49 24	36 40	11 22	2 13	2 1
83. Discover how to generalize problem solutions or strategies to new situations	9 3	28 12	34 33	22 39	8 12
84. Engage in cooperative problem solving, working together as a class	5 3	16 11	27 21	27 31	24 33
85. Engage in cooperative problem solving, working in small groups	4 2	15 11	32 33	27 28	22 26
86. Work on nonroutine problems	17 4	28 24	28 43	11 16	5 14
87. Use discussion in order to reflect or clarify their thinking about mathematical ideas and situations	5 0	12 8	26 15	23 36	34 41
88. Use discussions to relate models, pictures, or diagrams to mathematical ideas	5 2	29 8	27 31	17 31	21 28
89. Write about mathematical ideas (e.g., journals or portfolios describing what they are learning in class, written descriptions of the process by which they have solved a given problem, etc.)	62 40	22 24	8 26	5 9	3 2

(Table continues.)

Table 21b (continued)

Item # and Description:	(A) Not at all	(B) Rarely 1 or 2 times/ semester	(C) Occas. >=Once per mo.	(D) Frequently 2 to 4 times/mo.	(E) Very freq. >=Once per wk.
90. Make and discuss mathematical conjectures and attempt to construct convincing arguments in support of these conjectures	31 19	33 27	22 23	9 25	6 7
91. Report to class on the results of mathematical investigations (either individual or group)	52 30	34 35	9 21	4 12	1 2
92. Formulate definitions and/or express generalizations of mathematical principles	16 9	28 11	25 34	17 29	13 17
93. Describe orally how they reached a solution, including difficulties encountered and methods for overcoming these difficulties	11 2	15 8	25 21	28 33	21 37
94. Justify their answers to mathematical problems	3 1	4 1	17 12	25 25	50 61
95. Experience a climate of openness and inquiry in mathematics, where both students' and teachers' statements are open to question, reaction, and elaboration	3 0	8 3	20 4	21 32	49 61
96. Respond to questions designed to focus their attention on their own reasoning processes (e.g., "Why do you think that is a good answer?" "Do you think you'd get the same answer if ...?"	0 0	10 2	17 11	30 30	42 57
97. Use a variety of different representations (manipulatives, graphs, drawings, charts, equations) of the same mathematical concept or procedure	6 3	23 11	39 25	21 37	12 25
98. Explore applications of math ideas in their daily lives	2 1	29 18	36 37	20 24	13 20
99. Appreciate the role of mathematics in our culture and society	3 1	27 15	38 38	19 28	13 18
100. Make meaningful connections between different areas of the mathematics curriculum	9 0	19 14	31 24	24 30	18 32
101. See, use, and apply mathematics in other content areas, such as art, literature, sciences, social studies	13 7	34 29	37 32	10 25	7 8

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual n's vary.

Table 22a: Elementary Teachers: Assessment Strategies (Total Frequencies)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	14	2	10	38	35
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	14	4	15	39	28
104. Homework assignments (grading purposes)	40	23	22	12	3
105. Homework assignments (diagnosis and instructional feedback purposes)	23	10	17	30	20
106. Teacher checklists or direct observations (grading purposes)	15	11	21	31	23
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	8	5	14	39	34
108. Portfolios of students' work (grading purposes)	44	14	14	20	9
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	42	11	15	20	13
110. Student journals (grading purposes)	70	16	8	4	1
111. Student journals (diagnosis and instructional feedback purposes)	68	14	10	5	3
112. Products of cooperative group work (grading purposes)	26	25	27	19	3
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	14	12	27	36	11
114. Individual projects (grading purposes)	38	15	23	18	6
115. Individual projects (diagnosis and instructional feedback purposes)	35	14	23	20	8

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 22b: Elementary Teachers: Assessment Strategies (Unchanged vs. Changed)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	15 13	2 3	10 14	37 44	37 27
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	15 12	3 5	14 19	39 40	29 26
104. Homework assignments (grading purposes)	40 40	23 22	23 21	11 13	3 4
105. Homework assignments (diagnosis and instructional feedback purposes)	23 24	11 8	16 21	30 31	21 16
106. Teacher checklists or direct observations (grading purposes)	16 10	11 10	21 20	30 36	22 25
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	9 7	6 2	14 13	38 44	34 34
108. Portfolios of students' work (grading purposes)	44 42	14 14	14 14	19 23	9 8
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	43 38	10 12	14 18	20 20	13 13
110. Student journals (grading purposes)	74 58	15 20	7 14	4 6	1 3
111. Student journals (diagnosis and instructional feedback purposes)	71 55	14 14	9 15	4 9	2 6
112. Products of cooperative group work (grading purposes)	29 19	26 21	26 30	17 27	3 4
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	16 9	12 10	27 26	35 39	10 16
114. Individual projects (grading purposes)	40 28	16 13	23 24	16 28	5 7
115. Individual projects (diagnosis and instructional feedback purposes)	38 26	15 13	24 21	18 29	7 12

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual n's vary.

Table 23a: Middle School Teachers: Assessment Strategies (Total Frequencies)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	1	1	4	42	54
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	3	1	12	42	41
104. Homework assignments (grading purposes)	10	14	34	28	13
105. Homework assignments (diagnosis and instructional feedback purposes)	3	5	12	37	43
106. Teacher checklists or direct observations (grading purposes)	18	14	30	31	7
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	16	10	21	32	21
108. Portfolios of students' work (grading purposes)	47	12	16	18	6
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	43	13	16	17	10
110. Student journals (grading purposes)	59	16	19	4	2
111. Student journals (diagnosis and instructional feedback purposes)	57	14	16	8	6
112. Products of cooperative group work (grading purposes)	12	15	45	26	2
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	12	6	35	37	10
114. Individual projects (grading purposes)	20	10	34	31	6
115. Individual projects (diagnosis and instructional feedback purposes)	24	17	34	20	6

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 23b: Middle School Teachers: Assessment Strategies (Unchanged vs. Changed)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	1 1	1 1	6 3	37 47	56 47
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	3 3	2 1	14 11	39 45	42 40
104. Homework assignments (grading purposes)	9 12	14 16	37 32	28 28	14 13
105. Homework assignments (diagnosis and instructional feedback purposes)	3 3	6 4	13 12	37 37	42 44
106. Teacher checklists or direct observations (grading purposes)	17 19	19 10	26 34	30 31	8 6
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	14 17	13 9	20 22	30 34	24 19
108. Portfolios of students' work (grading purposes)	52 43	13 12	14 19	14 22	8 4
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	48 39	13 14	14 19	14 19	12 10
110. Student journals (grading purposes)	62 57	20 12	14 22	3 5	1 3
111. Student journals (diagnosis and instructional feedback purposes)	62 53	17 10	10 22	6 10	6 5
112. Products of cooperative group work (grading purposes)	14 10	15 15	46 44	23 29	1 3
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	18 7	6 5	37 34	35 40	5 15
114. Individual projects (grading purposes)	26 14	12 9	31 36	24 37	8 4
115. Individual projects (diagnosis and instructional feedback purposes)	31 18	18 16	31 36	14 24	6 6

Note: This table summarizes responses from 221 middle (6 - 8) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Table 24a: Secondary Teachers: Assessment Strategies (Total Frequencies)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	0	0	2	29	38
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	7	2	17	40	33
104. Homework assignments (grading purposes)	4	9	32	41	15
105. Homework assignments (diagnosis and instructional feedback purposes)	3	2	13	35	47
106. Teacher checklists or direct observations (grading purposes)	25	12	26	32	5
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	22	8	21	32	16
108. Portfolios of students' work (grading purposes)	57	15	16	10	3
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	57	13	16	11	3
110. Student journals (grading purposes)	74	10	10	5	2
111. Student journals (diagnosis and instructional feedback purposes)	74	9	9	7	1
112. Products of cooperative group work (grading purposes)	14	17	43	25	1
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	13	12	38	31	7
114. Individual projects (grading purposes)	31	10	34	20	6
115. Individual projects (diagnosis and instructional feedback purposes)	41	18	25	13	3

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 24b: Secondary Teachers: Assessment Strategies (Unchanged vs. Changed)

Item # and Description:	(A) Do not use	(B) No emphasis	(C) Little emphasis	(D) Moderate emphasis	(E) Heavy emphasis
102. Written quizzes/tests (grading purposes)	0 0	0 0	4 1	25 32	71 67
103. Written quizzes/tests (diagnosis and instructional feedback purposes)	9 6	3 2	17 17	40 40	30 35
104. Homework assignments (grading purposes)	7 2	5 11	34 30	37 44	17 13
105. Homework assignments (diagnosis and instructional feedback purposes)	2 4	3 0	14 13	33 38	48 46
106. Teacher checklists or direct observations (grading purposes)	32 20	13 11	23 29	32 32	1 8
107. Teacher checklists or direct observations (diagnosis and instructional feedback purposes)	29 15	7 10	23 20	28 36	13 19
108. Portfolios of students' work (grading purposes)	54 59	14 15	19 13	10 10	3 3
109. Portfolios of students' work (diagnosis and instructional feedback purposes)	57 57	11 15	19 14	9 12	5 1
110. Student journals (grading purposes)	79 70	7 12	11 10	2 7	1 2
111. Student journals (diagnosis and instructional feedback purposes)	79 70	7 11	9 10	3 10	2 0
112. Products of cooperative group work (grading purposes)	20 10	16 17	41 44	22 29	1 1
113. Products of cooperative group work (diagnosis and instructional feedback purposes)	16 10	15 10	36 39	26 34	7 8
114. Individual projects (grading purposes)	39 23	8 11	35 33	14 26	4 7
115. Individual projects (diagnosis and instructional feedback purposes)	50 32	13 22	22 29	12 14	3 3

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 91), and lower entries indicate the percent of Changed teachers (n = 105) selecting each response. Actual n's vary.

Table 25a: Elementary Teachers: Aims of Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	1	2	18	70	11
117. Ability to perform mathematical procedures	1	2	23	65	9
118. Understanding of how/why the procedures work	2	9	36	45	8
119. Problem-solving processes	2	9	36	45	8
120. Reasoning skills	2	14	40	37	7
121. Attitudes or dispositions (likes, dislikes, beliefs)	25	25	31	17	2

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual n's vary.

Table 25b: Elementary Teachers: Aims of Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	1 1	2 0	18 19	69 68	10 12
117. Ability to perform mathematical procedures	1 0	3 1	21 29	66 61	9 10
118. Understanding of how/why the procedures work	2 1	9 9	37 30	44 51	8 9
119. Problem-solving processes	3 0	9 8	38 30	44 52	7 11
120. Reasoning skills	2 2	15 11	41 35	36 43	6 10
121. Attitudes or dispositions (likes, dislikes, beliefs)	26 20	26 22	29 37	17 18	2 3

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual n's vary.

Table 26a: Middle School Teachers: Aims of Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	0	1	22	67	11
117. Ability to perform mathematical procedures	0	1	28	60	10
118. Understanding of how/why the procedures work	1	9	36	46	9
119. Problem-solving processes	0	6	40	44	10
120. Reasoning skills	1	12	39	41	7
121. Attitudes or dispositions (likes, dislikes, beliefs)	23	29	27	18	2

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 26b: Middle School Teachers: Aims of Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	0 0	1 0	21 22	67 66	10 11
117. Ability to perform mathematical procedures	0 0	2 1	27 28	61 60	10 10
118. Understanding of how/why the procedures work	0 1	12 7	36 35	44 47	7 10
119. Problem-solving processes	0 0	7 4	46 35	39 49	8 12
120. Reasoning skills	2 0	13 10	43 35	35 47	6 9
121. Attitudes or dispositions (likes, dislikes, beliefs)	25 22	32 28	28 27	14 22	2 3

Note: This table summarizes responses from 221 middle school (6 - 8) teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual *n*'s vary.

Table 27a: Secondary Teachers: Aims of Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	1	3	24	62	10
117. Ability to perform mathematical procedures	0	1	28	62	9
118. Understanding of how/why the procedures work	2	6	41	45	6
119. Problem-solving processes	1	6	38	48	7
120. Reasoning skills	1	10	39	42	8
121. Attitudes or dispositions (likes, dislikes, beliefs)	26	31	28	13	1

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 27b: Secondary Teachers: Aims of Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) To a small extent (minor focus)	(C) To a moderate extent	(D) To a large extent (major focus)	(E) ---
116. Understanding of the concepts that you teach	0 1	2 3	26 23	61 64	11 9
117. Ability to perform mathematical procedures	0 0	0 2	21 35	68 57	11 7
118. Understanding of how/why the procedures work	1 2	7 6	50 34	37 52	6 7
119. Problem-solving processes	1 0	7 6	42 35	41 54	9 6
120. Reasoning skills	1 1	17 5	39 39	37 46	7 9
121. Attitudes or dispositions (likes, dislikes, beliefs)	30 23	33 29	22 34	14 12	0 2

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual *n*'s vary.

Table 28a: Elementary Teachers: Technology in Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	12	16	29	40	3
123. Calculators	60	17	17	6	1
124. Computers	47	15	21	16	2

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 28b: Elementary Teachers: Technology in Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	13 9	17 11	30 27	38 48	3 5
123. Calculators	64 46	17 17	15 24	4 12	0 1
124. Computers	48 43	15 15	20 23	16 14	2 4

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual *n*'s vary.

Table 29a: Middle School Teachers: Technology in Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	26	27	38	8	1
123. Calculators	14	20	34	29	4
124. Computers	50	22	18	10	0

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 29b: Middle School Teachers: Technology in Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	34	28	28	8	2
	18	27	46	8	1
123. Calculators	20	30	29	18	3
	9	12	39	36	4
124. Computers	56	15	22	7	0
	45	28	15	13	0

Note: This table summarizes responses from 221 middle school (6 - 8) teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual *n*'s vary.

Table 30a: Secondary Teachers: Technology in Assessment (Total Frequencies)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	37	33	21	8	1
123. Calculators	6	5	15	71	3
124. Computers	57	19	14	10	1

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 30b: Secondary Teachers: Technology in Assessment (Unchanged vs. Changed)

Item # and Description:	(A) Not at all	(B) Rarely	(C) Occasion-ally	(D) Frequently	(E) ---
122. Manipulative materials	46 30	37 30	11 30	7 9	0 1
123. Calculators	8 5	9 2	15 15	67 74	1 5
124. Computers	63 52	20 18	12 16	6 15	0 1

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual *n*'s vary.

Table 31a: Elementary Teachers: Aids to Implementation (Total Frequencies)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	43	3	16	34	4
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	47	4	18	27	3
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	64	7	14	12	3
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	54	5	14	23	4
129. Offering specific training events for "lead teachers"	53	6	16	22	3
130. School- or district-wide policy statements articulating a vision of curriculum reform	43	4	37	14	2
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	34	3	38	21	3
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	32	4	44	17	2
133. Revision of criteria for mathematics textbook selection	38	4	45	12	2
134. Revision of criteria for mathematics curriculum design	31	3	46	18	3
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	22	2	21	32	23
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	39	6	26	23	6
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	40	4	18	31	7
138. Fostering a collaborative climate among mathematics (and other) teachers	45	3	20	28	5

(Table continues.)

Table 31a (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	56	12	20	8	4
140. School maintains a library of instructional materials related to the Standards	50	4	15	28	3
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	61	1	9	26	3
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	43	3	8	40	6
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	44	4	16	29	7
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	18	2	11	59	10
145. Teachers observe one another's mathematics classes	24	1	6	59	10
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	15	2	7	65	11
147. Parents observe mathematics classes in progress	14	4	9	33	40

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 31b: Elementary Teachers: Aids to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	39 55	4 3	16 16	38 24	4 2
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	43 60	4 5	21 13	30 21	4 1
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	61 73	7 6	15 11	13 7	3 3
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	48 67	6 4	15 11	26 16	5 2
129. Offering specific training events for "lead teachers"	46 70	6 6	18 11	27 12	4 2
130. School- or district-wide policy statements articulating a vision of curriculum reform	38 53	4 4	41 29	14 13	3 1
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	31 43	2 3	40 35	23 19	5 0
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	29 39	4 4	44 43	19 14	3 0
133. Revision of criteria for mathematics textbook selection	33 51	4 2	48 37	13 10	2 1
134. Revision of criteria for mathematics curriculum design	27 41	3 2	48 41	19 16	3 2
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	17 33	2 3	21 20	33 31	27 14
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	33 53	6 6	29 22	26 17	7 3
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	37 48	4 4	18 18	33 25	8 5
138. Fostering a collaborative climate among mathematics (and other) teachers	43 51	3 2	21 19	29 24	5 4

(Table continues.)

Table 31b (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	54 60	12 11	20 18	9 8	5 2
140. School maintains a library of instructional materials related to the Standards	46 59	4 3	17 12	30 24	3 2
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	60 64	1 0	8 12	28 21	4 3
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	40 49	3 3	6 13	44 31	7 4
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	39 58	5 4	17 13	31 23	9 2
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	14 27	2 2	11 12	62 54	12 5
145. Teachers observe one another's mathematics classes	23 27	1 1	6 6	60 58	10 8
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	11 25	2 2	7 8	66 61	14 4
147. Parents observe mathematics classes in progress	12 18	4 3	8 12	32 37	44 30

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual n's vary.

Table 32a: Middle School Teachers: Aids to Implementation (Total Frequencies)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	51	3	13	30	2
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	55	6	11	27	1
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	73	10	7	10	1
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	60	8	6	24	2
129. Offering specific training events for "lead teachers"	35	4	16	42	4
130. School- or district-wide policy statements articulating a vision of curriculum reform	47	10	31	12	0
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	40	4	34	22	0
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	36	8	40	16	0
133. Revision of criteria for mathematics textbook selection	58	4	34	4	0
134. Revision of criteria for mathematics curriculum design	39	6	37	18	1
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	21	3	16	38	23
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	25	2	21	45	8
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	50	4	16	23	6
138. Fostering a collaborative climate among mathematics (and other) teachers	54	5	18	21	2

(Table continues.)

Table 32a (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	51	21	20	1	7
140. School maintains a library of instructional materials related to the Standards	58	1	11	27	3
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	65	0	9	24	3
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	49	2	5	41	3
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	39	3	11	41	7
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	24	0	6	63	6
145. Teachers observe one another's mathematics classes	24	2	10	52	12
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	21	3	8	60	8
147. Parents observe mathematics classes in progress	13	10	11	31	34

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 32b: Middle School Teachers: Aids to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	53 49	2 4	14 13	28 32	4 1
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	44 63	7 5	12 11	37 20	0 1
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	65 80	13 7	10 5	11 9	1 0
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	53 65	12 6	11 3	23 24	1 2
129. Offering specific training events for "lead teachers"	30 39	6 2	17 15	44 40	4 4
130. School- or district-wide policy statements articulating a vision of curriculum reform	31 56	20 5	35 29	14 11	0 0
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	27 48	10 1	33 35	31 16	0 0
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	22 43	16 5	47 37	16 16	0 0
133. Revision of criteria for mathematics textbook selection	52 62	5 4	39 31	5 3	0 0
134. Revision of criteria for mathematics curriculum design	26 46	9 4	40 35	26 14	0 1
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	9 28	4 3	21 14	32 40	34 16
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	22 26	4 1	20 21	44 45	10 6
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	41 57	7 2	20 13	29 20	4 8
138. Fostering a collaborative climate among mathematics (and other) teachers	49 57	6 4	18 19	21 21	6 0

(Table continues.)

Table 32b (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	44 57	26 17	21 20	1 1	9 5
140. School maintains a library of instructional materials related to the Standards	55 59	0 2	10 12	31 24	3 3
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	63 66	0 0	8 9	24 23	5 2
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	47 50	1 3	4 6	45 38	4 3
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	32 44	3 2	12 11	47 37	7 7
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	25 24	0 0	6 6	64 63	5 7
145. Teachers observe one another's mathematics classes	22 25	3 1	17 5	51 54	8 15
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	19 24	3 2	9 7	65 56	5 11
147. Parents observe mathematics classes in progress	9 16	8 12	11 12	36 27	36 33

Note: This table summarizes responses from 221 middle (6 - 8) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Table 33a: Secondary Teachers: Aids to Implementation (Total Frequencies)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	45	11	10	34	1
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	40	14	15	30	1
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	51	15	9	24	2
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	50	9	9	30	1
129. Offering specific training events for "lead teachers"	26	6	13	51	4
130. School- or district-wide policy statements articulating a vision of curriculum reform	38	8	36	18	0
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	29	8	38	24	1
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	25	8	42	23	2
133. Revision of criteria for mathematics textbook selection	43	9	36	12	1
134. Revision of criteria for mathematics curriculum design	31	7	38	22	2
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	18	6	12	37	28
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	15	4	11	58	12
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	33	7	21	35	4
138. Fostering a collaborative climate among mathematics (and other) teachers	33	3	22	40	1

(Table continues.)

Table 33a (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	46	33	14	4	3
140. School maintains a library of instructional materials related to the Standards	48	3	11	35	3
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	73	1	5	18	2
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	40	4	6	48	3
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	34	0	11	46	9
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	20	2	4	68	6
145. Teachers observe one another's mathematics classes	43	2	7	45	3
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	17	5	10	63	5
147. Parents observe mathematics classes in progress	4	4	6	44	43

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 33b: Secondary Teachers: Aids to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
125. Awarding of grant money to teachers who take responsibility for planning and/or testing curriculum reforms	37 51	9 12	6 13	48 22	0 2
126. Offering in-service workshops designed to increase teachers' awareness of and incorporation of the Standards	22 55	22 7	17 14	36 25	3 0
127. Notifying teachers of opportunities to attend workshops not on school time (e.g., weekend seminars related to the Standards)	41 60	18 12	10 8	31 17	1 2
128. Encouraging teachers to attend regional and state math conferences which emphasize the Standards	39 61	11 8	13 5	36 26	1 1
129. Offering specific training events for "lead teachers"	15 37	5 6	12 14	62 41	7 2
130. School- or district-wide policy statements articulating a vision of curriculum reform	32 42	12 5	35 37	21 15	0 0
131. School-wide plans for reform (specific recommendations to be implemented by teachers)	26 32	10 8	29 44	34 17	2 0
132. District-wide plans for reform (specific recommendations to be implemented by teachers)	20 30	8 7	35 49	35 13	2 1
133. Revision of criteria for mathematics textbook selection	40 45	10 8	36 36	14 11	1 0
134. Revision of criteria for mathematics curriculum design	29 32	9 6	35 42	24 19	3 1
135. Requiring teachers to formulate individual staff development plans, documenting their efforts to incorporate approaches emphasized in the Standards into their instructional practices	11 23	4 7	13 11	40 35	32 24
136. Designating certain teachers as "lead teachers," who will take initiative in educating themselves and their colleagues regarding the Standards	12 18	4 4	9 13	61 56	14 10
137. Encouraging teachers to make their own decisions regarding curriculum and professional development	25 40	8 6	18 23	43 29	5 3
138. Fostering a collaborative climate among mathematics (and other) teachers	36 31	1 4	19 27	42 39	1 1

(Table continues.)

Table 33b (continued):

Item # and Description:	(A) Available and helpful	(B) Available, but not helpful	(C) In process; not sure if helpful	(D) Not available; would be helpful	(E) Not available; would not be helpful
139. Administrators observe mathematics classes in progress	47 46	34 32	15 13	1 5	3 3
140. School maintains a library of instructional materials related to the Standards	40 53	5 1	11 12	39 32	5 1
141. Teachers in my school take an active interest in one another's classrooms, and provide mutual suggestions and support for efforts at curriculum change	69 77	1 1	6 4	20 17	4 0
142. Teachers use a portion of the time at mathematics departmental meetings to engage in math activities and to discuss the usefulness of these activities as classroom exercises	37 43	4 3	3 9	55 42	1 4
143. Unofficially recognized "school leader" acts as a catalyst for new instructional practices	30 38	0 0	9 12	47 45	14 5
144. Teachers in a district form a mathematics "support group" to exchange ideas and experiences with teachers from other schools	14 26	3 1	2 5	71 65	11 3
145. Teachers observe one another's mathematics classes	44 42	3 1	8 7	44 47	3 3
146. Mathematics teachers from different program levels (K-4, 5-8, 9-12) meet periodically to discuss and coordinate efforts at implementing the Standards	16 18	6 4	9 11	63 63	7 3
147. Parents observe mathematics classes in progress	3 5	4 4	5 6	39 48	49 37

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual n's vary.

Table 34a: Elementary Teachers: Obstacles to Implementation (Total Frequencies)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	3	9	27	45	17
149. Administration attitudes (e.g., resistance to new classroom practices	1	4	9	77	9
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	2	9	20	47	22
151. Student attitudes about mathematics	2	7	24	62	5
152. Low level of student ability	5	14	32	45	4
153. Pressure to have students succeed on "standardized" tests	15	33	23	23	6
154. Your own lack of knowledge of the changes advocated in the Standards	12	19	32	27	10
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	13	22	31	27	7
156. Lack of resources (computers, calculators, manipulatives, etc.)	16	21	29	31	3

Note: This table summarizes responses from all 1473 elementary (K - 5) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 34b: Elementary Teachers: Obstacles to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	2 4	8 11	25 33	46 41	18 12
149. Administration attitudes (e.g., resistance to new classroom practices	1 2	4 5	9 9	76 81	10 14
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	2 2	8 12	18 27	46 49	25 10
151. Student attitudes about mathematics	2 3	7 6	24 24	61 66	6 2
152. Low level of student ability	6 2	15 10	33 30	41 57	5 2
153. Pressure to have students succeed on "standardized" tests	15 14	33 34	23 24	22 24	7 4
154. Your own lack of knowledge of the changes advocated in the Standards	15 3	23 6	31 34	20 52	12 5
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	14 7	25 13	30 36	26 41	8 3
156. Lack of resources (computers, calculators, manipulatives, etc.)	17 15	21 22	28 32	32 30	3 1

Note: This table summarizes responses from 1458 elementary (K - 5) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 1142), and lower entries indicate the percent of Changed teachers (n = 316) selecting each response. Actual n's vary.

Table 35a: Middle School Teachers: Obstacles to Implementation (Total Frequencies)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	2	10	27	47	10
149. Administration attitudes (e.g., resistance to new classroom practices	1	4	13	79	4
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	3	10	33	47	7
151. Student attitudes about mathematics	8	29	34	28	2
152. Low level of student ability	18	28	32	21	1
153. Pressure to have students succeed on "standardized" tests	26	4	17	14	1
154. Your own lack of knowledge of the changes advocated in the Standards	2	11	31	54	2
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	7	18	36	38	2
156. Lack of resources (computers, calculators, manipulatives, etc.)	10	27	36	27	1

Note: This table summarizes responses from all 221 middle (6 - 8) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 35b: Middle School Teachers: Obstacles to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	1 4	10 10	24 35	53 43	13 8
149. Administration attitudes (e.g., resistance to new classroom practices	1 0	5 2	9 18	80 78	5 3
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	4 3	6 13	33 34	48 46	9 6
151. Student attitudes about mathematics	7 9	31 27	33 34	27 29	2 2
152. Low level of student ability	21 16	33 23	26 37	19 23	1 1
153. Pressure to have students succeed on "standardized" tests	29 24	43 40	19 15	8 19	1 2
154. Your own lack of knowledge of the changes advocated in the Standards	4 1	21 2	38 25	32 72	4 0
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	8 6	27 12	40 32	23 50	3 0
156. Lack of resources (computers, calculators, manipulatives, etc.)	11 10	28 26	34 37	26 28	1 0

Note: This table summarizes responses from 221 middle (6 - 8) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers (n = 104), and lower entries indicate the percent of Changed teachers (n = 117) selecting each response. Actual n's vary.

Table 36a: Secondary Teachers: Obstacles to Implementation (Total Frequencies)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	2	15	33	39	12
149. Administration attitudes (e.g., resistance to new classroom practices	1	6	16	73	4
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	4	16	32	43	4
151. Student attitudes about mathematics	15	36	30	16	3
152. Low level of student ability	15	29	36	18	2
153. Pressure to have students succeed on "standardized" tests	13	37	27	20	3
154. Your own lack of knowledge of the changes advocated in the Standards	4	12	29	53	2
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	11	24	29	34	2
156. Lack of resources (computers, calculators, manipulatives, etc.)	12	20	33	33	1

Note: This table summarizes responses from all 198 secondary (9 - 12) school teachers who responded to this survey. Cell entries represent the percent of teachers answering the item who selected each response choice. Actual *n*'s vary.

Table 36b: Secondary Teachers: Obstacles to Implementation (Unchanged vs. Changed)

Item # and Description:	(A) Primary obstacle	(B) Major obstacle	(C) Minor obstacle	(D) Not an obstacle	(E) Not sure
148. Parent attitudes about mathematics education (e.g., resistance to new teaching styles)	1 2	12 18	30 35	44 35	14 10
149. Administration attitudes (e.g., resistance to new classroom practices	1 0	6 7	15 17	72 74	6 2
150. Lack of enthusiasm on the part of other mathematics teachers in your school for the types of changes depicted by the Standards	5 4	15 17	30 34	44 42	7 2
151. Student attitudes about mathematics	14 16	44 29	20 40	18 15	5 1
152. Low level of student ability	16 14	29 29	33 40	19 17	3 0
153. Pressure to have students succeed on "standardized" tests	17 9	31 42	26 28	22 19	5 2
154. Your own lack of knowledge of the changes advocated in the Standards	9 0	19 6	38 22	32 71	2 1
155. Your own lack of training in methods for incorporating these changes into the curriculum for your grade level or subject area	17 6	26 22	33 26	21 46	3 0
156. Lack of resources (computers, calculators, manipulatives, etc.)	15 10	23 19	34 32	28 38	1 1

Note: This table summarizes responses from 196 secondary (9 - 12) school teachers who could be classified as Changed or Unchanged. Upper entries indicate the percent of Unchanged teachers ($n = 91$), and lower entries indicate the percent of Changed teachers ($n = 105$) selecting each response. Actual n's vary.

APPENDIX E

FOCUS GROUP INTERVIEW GUIDE

APPENDIX E: INTERVIEW GUIDE

I. INTRODUCTION

A. PURPOSE OF THE GROUPS

B. GROUND RULES

C. INTRODUCE PARTICIPANTS:

1. **Name, grade teach, district how long known about the standards.**

II. HOW DO YOU SEE THE IMPLEMENTATION OF THE STANDARDS PROGRESSING IN YOUR SCHOOL OR DISTRICT? (MAKE SURE EVERYONE CONTRIBUTES HERE)

1. **What kinds of things are changing?**

   a. for example, are any curriculum areas more or less emphasized now?
   b. What about assessment?
   a. For example, what about cooperative groups, calculators, projects, discussions, manipulatives?
   b. How much does the textbook influence what you do in your room---what and how you teach
   c. Has your approach to teaching reasoning and problem-solving changed?

2. **Do most teachers feel the way you do about the standards?**

III. WHAT HAS HELPED YOU MAKE CHANGES IN YOUR CLASSROOM?

IV. IS THERE ANYTHING YOU WOULD LIKE TO DO DIFFERENTLY BUT CAN'T? (WHAT HAS GOTTEN IN THE WAY?)

1. **For example, what about cooperative groups, calculators, projects, discussions, manipulatives?**

2. **How much does the textbook influence what you do in your room---what and how you teach?**

3. **What kinds of evaluation techniques do you use?**

   a. Follow up on any distinction between grades and assessment.

   b. Are calculators, manipulatives, etc. used?

V. SUMMARIZATION: HOW THE STANDARDS HAVE INFLUENCED YOUR TEACHING

A. ASK FOR FEEDBACK ON ACCURACY, AND WHAT SHOULD BE CHANGED

B. THANKS

APPENDIX F

MATHEMATICS STUDY GROUP

APPENDIX F: MATHEMATICS STUDY GROUP

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