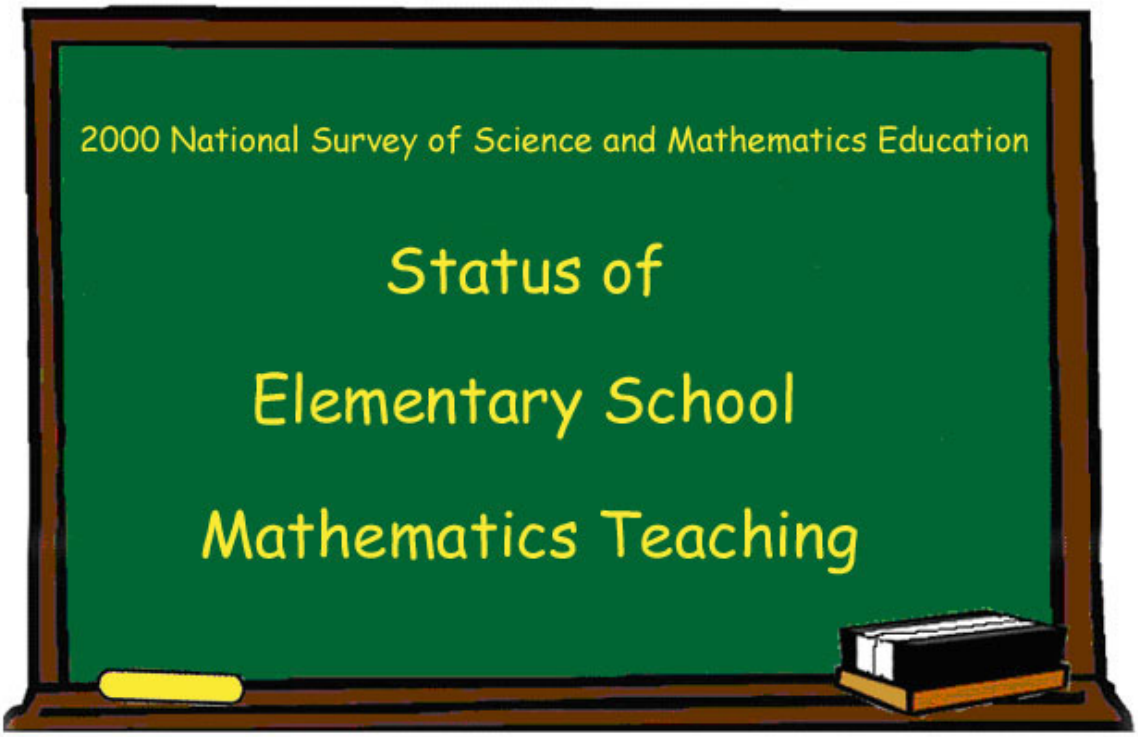

December 2002

Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC. 27514

Kristen A. Malzahn

www.horizon-research.com

The *2000 National Survey of Science and Mathematics Education: Status of Elementary School Mathematics Teaching* was prepared with support from the National Science Foundation under grant number REC-9814246. These writings do not necessarily reflect he views of the National Science Foundation.

Status of Elementary School Mathematics Teaching

Introduction

The 2000 National Survey of Science and Mathematics Education was designed to provide up-to-date information and to identify trends in the areas of teacher background and experience, curriculum and instruction, and the availability and use of instructional resources. A total of 5,728 science and mathematics teachers in schools across the United States participated in this survey, a response rate of 74 percent. Among the questions addressed by the survey:

- How well prepared are science and mathematics teachers in terms of both content and pedagogy?

- What are teachers trying to accomplish in their science and mathematics instruction, and what activities do they use to meet these objectives?

The 2000 National Survey is based on a national probability sample of schools and science and mathematics teachers in grades K–12 in the 50 states and the District of Columbia. The sample was designed to allow national estimates of science and mathematics course offerings and enrollment; teacher background preparation; textbook usage; instructional techniques; and availability and use of science and mathematics facilities and equipment. Every eligible school and teacher in the target population had a known, positive probability of being drawn into the sample.

This report describes the status of elementary (grades K–5) mathematics instruction based on the responses of 704 teachers. Of these teachers, 334 taught primary grades (K–2) and 370 taught intermediate grades (3–5).

Technical detail on the survey sample design, as well as data collection and analysis procedures, is included in the *Report of the 2000 National Survey of Science and Mathematics Education* (Weiss, Banilower, McMahon, & Smith, 2001). The standard errors for the estimates presented in this report are included in parentheses in the tables. The narrative sections of the report generally point out only those differences which are substantial as well as statistically significant at the 0.05 level or beyond.

This status report of elementary school mathematics teaching is organized into major topical areas:

- Characteristics of the elementary school mathematics teaching force in the United States;
- Professional development of elementary school mathematics teachers, both needs and participation;

- Elementary school mathematics instruction, in terms of objectives, time spent, and class activities; and
- Resources available for elementary school mathematics instruction.

Characteristics of the Elementary School Mathematics Teaching Force

General Demographics

Elementary school mathematics teachers in the United States are predominately white females; however, intermediate teachers are more likely than those in the primary grades to be male. Table 1 also shows that the majority of the elementary mathematics teaching force is over 40 years old; more than 1 in 4 is over 50, leading to the likelihood that large numbers of teachers will be retiring in the next 10 years.

Table 1
Characteristics of the Elementary School Mathematics Teaching Force

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Sex						
Male	7	(1.3)	2	(1.2)	12	(2.3)
Female	93	(1.3)	98	(1.2)	88	(2.3)
Race						
American Indian or Alaskan Native	1	(0.2)	1	(0.3)	1	(0.3)
Asian	1	(0.3)	0	—[§]	1	(0.5)
Black or African-American	4	(0.7)	3	(0.8)	4	(1.1)
Hispanic or Latino	5	(1.3)	6	(1.7)	5	(1.3)
Native Hawaiian or Other Pacific Islander	0	(0.1)	0	—[§]	0	(0.3)
White	90	(1.6)	90	(2.0)	90	(1.8)
Age						
>30 years	21	(1.9)	21	(2.6)	21	(2.8)
31–40 years	21	(1.7)	19	(2.2)	23	(2.5)
41–50 years	30	(2.4)	33	(2.9)	28	(3.2)
50 + years	28	(2.2)	27	(2.7)	29	(3.0)
Experience						
0–2 years	18	(1.8)	18	(2.4)	19	(2.7)
3–5 years	13	(1.4)	13	(2.0)	13	(1.9)
6–10 years	14	(1.5)	13	(2.0)	17	(2.4)
11–20 years	25	(1.9)	29	(2.4)	20	(2.7)
20+ years	29	(2.2)	28	(3.0)	31	(2.8)
Master's Degree						
Yes	42	(2.6)	41	(3.3)	43	(3.4)
No	58	(2.6)	59	(3.3)	57	(3.4)

[§] No teachers in the sample selected this response option. Thus, it is impossible to calculate the standard error of this estimate.

Content Preparedness

The National Council of Teachers of Mathematics (NCTM) *Principles and Standards for School Mathematics* call for the introduction of challenging mathematics content to all students beginning in the early grades. If elementary teachers are to effectively guide students in their exploration of mathematics concepts, they must themselves have a firm understanding of those concepts. The 2000 National Survey used proxy measures such as majors or number of mathematics courses taken to indicate the extent to which elementary teachers understand mathematics concepts. As can be seen in Table 2, only 1 percent of elementary teachers have undergraduate majors in mathematics; 88 percent majored in other education.

Table 2
Undergraduate Majors of
Elementary School Mathematics Teachers[†]

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics	1	(0.3)	0	—[§]	1	(0.7)
Mathematics Education	1	(0.3)	0	(0.2)	1	(0.5)
Other Education	88	(1.6)	89	(2.2)	87	(2.3)
Other Fields	11	(1.7)	10	(2.2)	10	(2.4)

[†] These data should be interpreted with caution. When asked to specify the subject(s) of their degrees, approximately 10 percent of the teachers indicated they had undergraduate majors in three or more fields. These teachers were excluded from these analyses.

[§] No teachers in the sample selected this response option. Thus, it is impossible to calculate the standard error of this estimate.

Table 3 shows the number of semesters of college mathematics coursework (including mathematics education) completed by grade K–5 mathematics teachers. The majority has had at most seven semesters, with grade K–2 teachers more likely than those in grades 3–5 to have taken fewer than four semesters of mathematics.

Table 3
Number of Semesters[†] of College Coursework in
Mathematics[‡] Taken by Elementary School Mathematics Teachers

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Fewer than 4 Semesters	23	(1.8)	27	(3.1)	19	(2.4)
4–7 Semesters	46	(2.4)	44	(3.2)	47	(3.3)
8–11 Semesters	21	(2.0)	21	(2.8)	22	(2.5)
More than 11 Semesters	10	(1.3)	8	(1.8)	12	(1.8)

[†] The highest number of courses a teacher could indicate for each of the four categories—calculus, statistics, advanced calculus, and "all other mathematics courses"—was "> 8," and 9 was used as the number of courses in those cases. As a result, these figures underestimate the total for any teacher who completed more than nine courses in a particular category.

[‡] Includes coursework in mathematics education.

In terms of specific courses taken by elementary school mathematics teachers, the vast majority of K–5 teachers have completed coursework in mathematics for elementary school teachers and in mathematics education; far fewer have completed coursework in algebra (44 percent) and probability and statistics (36 percent) (Table 4), areas that the National Council of Teachers of Mathematics suggests should be addressed beginning in the primary grades (National Council of Teachers of Mathematics, 2000). Only 13 percent of elementary teachers reported taking a course in calculus. A higher percentage of intermediate teachers compared to primary teachers, however, have completed college coursework in college algebra/trigonometry/elementary functions (49 and 39 percent, respectively).

Table 4
Elementary School Mathematics
Teachers Completing Various College Courses

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics education	94	(1.0)	93	(1.6)	96	(1.0)
College algebra/trigonometry/elementary functions	44	(2.2)	39	(2.8)	49	(3.0)
Probability and statistics	36	(2.1)	33	(3.2)	39	(3.0)
Applications of mathematics/problem solving	21	(1.6)	22	(2.6)	20	(2.6)
Geometry for elementary/middle school teachers	21	(1.4)	19	(2.0)	22	(2.3)
Calculus	13	(1.5)	13	(2.4)	14	(1.9)

Content preparedness was also measured not only by the extent of teachers' coursework, but also by their perceptions of their preparation. Since elementary teachers are typically responsible for teaching not only mathematics, but also science, language arts, and other academic subjects, the survey asked them to rate their content preparedness in each of those subject areas. As seen in Table 5, it is clear that elementary teachers do not feel equally qualified to teach all of these subjects. Seventy-six percent of self-contained grade K–5 teachers responded that they feel "very well qualified" to teach reading/language arts, compared to 54 percent for mathematics, and 52 percent for social studies. Percentages of teachers indicating they felt very well qualified to teach science were much lower, ranging from 32 percent for life science to 21 percent for physical science. It is interesting to note that only 1 percent feel "not well qualified" to teach mathematics. Despite their lack of strong mathematics content preparation, elementary teachers appear to feel relatively well qualified to teach mathematics, perhaps because they are considering instruction in areas such as number and operations, rather than topics in areas such as algebra or probability.

Table 5
Elementary School Teachers'† Perceptions of Their Qualifications to Teach Each of a Number of Subjects

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Very Well Qualified						
Reading/Language Arts	76	(1.9)	82	(2.4)	70	(3.1)
Mathematics	54	(2.4)	52	(2.9)	57	(3.9)
Social Studies	52	(2.4)	46	(3.1)	59	(3.6)
Life Science	32	(2.2)	28	(2.9)	36	(3.1)
Earth Science	26	(2.2)	24	(3.1)	29	(3.1)
Physical Science	21	(1.9)	19	(2.6)	24	(2.8)
Adequately Qualified						
Reading/Language Arts	23	(1.9)	17	(2.4)	30	(3.1)
Mathematics	45	(2.4)	47	(2.9)	42	(4.0)
Social Studies	46	(2.4)	52	(3.0)	39	(3.6)
Life Science	60	(2.4)	63	(3.1)	55	(3.4)
Earth Science	64	(2.4)	67	(2.9)	61	(3.8)
Physical Science	63	(2.3)	66	(3.0)	60	(3.1)
Not Well Qualified						
Reading/Language Arts	0	(0.3)	0	(0.3)	1	(0.4)
Mathematics	1	(0.4)	1	(0.6)	1	(0.3)
Social Studies	2	(0.6)	2	(0.8)	2	(0.8)
Life Science	9	(1.3)	9	(1.8)	9	(1.9)
Earth Science	10	(1.4)	9	(1.9)	10	(2.2)
Physical Science	16	(1.9)	15	(2.3)	16	(2.6)

† Only teachers who indicated they were teaching reading, mathematics, science, and social studies to one class of students were included in these analyses.

Pedagogical Preparedness

National standards provide a useful frame for interpreting data on elementary teachers' pedagogical preparedness. The National Council of Teachers of Mathematics originally published *Curriculum and Evaluation Standards for School Mathematics* in 1989. Responding to an item about the NCTM *Standards*, roughly two-thirds of elementary teachers indicated they were at least somewhat familiar with the document, and of these, almost 80 percent said they agreed with the ideas in the *Standards*. Over three-fourths of those familiar with the *Standards* report that they implemented them at least to a moderate extent. (See Table 6.)

Table 6
Elementary School Mathematics Teachers' Familiarity with, Agreement with, and Implementation of the NCTM *Standards*

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Familiarity with NCTM *Standards*						
Not at all familiar	37	(2.4)	38	(3.7)	36	(3.3)
Somewhat familiar	31	(2.2)	31	(2.9)	30	(3.3)
Fairly familiar	21	(1.8)	20	(3.0)	23	(2.2)
Very familiar	11	(1.5)	10	(2.0)	11	(2.0)
Extent of agreement with NCTM *Standards*†						
Strongly Disagree	0	—§	0	—§	0	—§
Disagree	1	(0.5)	1	(0.5)	1	(0.8)
No Opinion	20	(2.0)	19	(2.8)	21	(2.9)
Agree	67	(2.4)	69	(3.8)	65	(3.5)
Strongly Agree	12	(1.8)	11	(2.8)	13	(2.6)
Extent to which recommendations have been implemented†						
Not at all	2	(0.9)	3	(1.7)	1	(0.5)
To a minimal extent	16	(1.9)	16	(2.7)	15	(2.9)
To a moderate extent	58	(3.0)	54	(4.8)	61	(3.3)
To a great extent	25	(2.5)	27	(4.0)	23	(3.2)

† These analyses included only those teachers indicating they were at least somewhat familiar with the *Standards.*

§ No teachers in this sample selected this response as on option. Thus, it is impossible to calculate the standard error of this estimate.

The survey asked teachers how well prepared they felt to use each of a number of instructional strategies in their teaching. Three-fourths or more of grade K–5 mathematics teachers rated themselves as being well prepared to implement a number of practices thought of as being closely aligned with the *Standards* (Table 7), including:

- Take students' prior understanding into account when planning curriculum and instruction;
- Develop students' conceptual understanding of mathematics;
- Provide deeper coverage of fewer mathematics concepts
- Make connections between mathematics and other disciplines; and
- Have students work in cooperative groups.

The data also indicate that primary teachers are more likely than intermediate teachers to feel well prepared in other standards-based practices. For example, 87 percent of grade K–2 mathematics teachers, compared to 78 percent of grade 3–5 mathematics teachers feel well prepared to manage a class of students engaged in hands-on/project-based work. Primary teachers are also more likely than their intermediate counterparts to feel well prepared to involve parents in the mathematics education of their children (76 and 60 percent, respectively).

Teachers were less likely to rate themselves well prepared to implement technology practices, which according to the NCTM *Standards* are "essential in teaching and learning mathematics" (National Council of Teachers of Mathematics, 2000). Judging from the data in Table 7, increasing technology skills continues to be a need for elementary teachers, especially when it comes to using the Internet.

Feelings of technology preparedness tended to increase with increasing grade range. For example, only 34 percent of grade K–2 mathematics teachers indicated they were at least fairly well prepared to use calculators/computers to collect and/or analyze data, compared to 52 percent of their grade 3–5 counterparts. Similarly, primary teachers felt less prepared than intermediate teachers to use calculators/computers for drill and practice (60 and 73 percent, respectively), and to demonstrate mathematics principles (37 and 51 percent, respectively). These findings are likely a reflection of the widespread use of calculators in intermediate elementary mathematics instruction. Despite this greater feeling of preparedness for grade 3–5 mathematics teachers, fewer than half indicated they were at least fairly well prepared to use calculators/computers for simulations and applications, and to use the Internet in mathematics teaching for various purposes.

Table 7
Elementary School Mathematics Teachers Considering Themselves Well Prepared† for Each of a Number of Tasks

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Encourage participation of females in mathematics	98	(0.6)	99	(0.6)	97	(1.2)
Listen/ask questions as students work in order to gauge their understanding	95	(0.9)	94	(1.5)	95	(1.4)
Encourage students' interest in mathematics	95	(0.9)	96	(1.2)	94	(1.2)
Develop students' conceptual understanding of mathematics	90	(1.6)	91	(1.9)	88	(2.5)
Encourage participation of minorities in mathematics	90	(1.4)	92	(1.7)	88	(2.4)
Take students' prior understanding into account when planning curriculum and instruction	87	(1.8)	87	(2.0)	87	(2.9)
Have students work in cooperative learning groups	86	(1.8)	86	(2.4)	85	(2.8)
Teach groups that are heterogeneous in ability	85	(1.7)	88	(2.3)	82	(3.1)
Manage a class of students engaged in hands-on/project-based work	83	(1.9)	87	(2.4)	78	(2.9)
Make connections between mathematics and other disciplines	81	(1.7)	82	(2.2)	80	(2.4)
Use the textbook as a resource rather than the primary instructional tool	79	(1.7)	83	(2.3)	75	(2.9)
Provide deeper coverage of fewer mathematics concepts	77	(2.0)	75	(3.3)	79	(2.8)
Recognize and respond to student cultural diversity	69	(2.1)	65	(3.2)	73	(2.7)
Use calculators/computers for mathematics learning games	69	(2.3)	65	(3.6)	73	(2.8)
Involve parents in the mathematics education of their children	68	(2.3)	76	(2.6)	60	(3.2)
Lead a class of students using investigative strategies	67	(2.4)	67	(3.1)	66	(3.3)
Use calculators/computers for drill and practice	66	(2.4)	60	(3.8)	73	(3.2)
Use calculators/computers to demonstrate mathematics principles	44	(2.2)	37	(3.7)	51	(3.1)
Use calculators/computers to collect and/or analyze data	43	(2.3)	34	(3.7)	52	(3.3)
Use calculators/computers for simulations and applications	40	(2.3)	35	(3.7)	45	(3.5)
Teach students who have limited English proficiency	33	(2.3)	34	(2.9)	33	(3.2)
Use the Internet in your mathematics teaching for general reference	25	(1.9)	21	(2.7)	29	(2.8)
Use the Internet in your mathematics teaching for data acquisition	20	(1.8)	17	(2.4)	24	(2.7)
Use the Internet in your mathematics teaching for collaborative projects with classes/individuals in other schools	13	(1.5)	12	(2.1)	15	(2.0)

† Includes teachers responding "very well prepared" or "fairly well prepared" to each statement.

Table 7 also provides evidence of teachers' preparedness to teach the diversity of students in our nation's schools. While 90 percent or more of grade K–5 mathematics teachers indicated feeling well prepared to encourage participation of minorities and females in mathematics, only 33 percent feel well prepared to teach students who have limited English proficiency.

Based on the results of factor analysis, the items in Table 7 were combined into four pedagogical preparedness composite variables. (Definitions of all composite variables, descriptions of how they were created, and reliability information are included in the Appendix.) Each composite has a minimum possible score of 0 and a maximum possible score of 100. Table 8 displays the composite scores related to teachers' pedagogical preparedness by grade range. The mean scores on these composites suggest that elementary mathematics teachers feel relatively well prepared to use standards-based teaching practices and teach students from diverse backgrounds, and less well prepared in technology-related areas.

Table 8
Composite Scores of Elementary School
Mathematics Teachers' Pedagogical Preparedness

	Mean Score					
	Grades K–5		**Grades K–2**		**Grades 3–5**	
Preparedness to Teach Students from Diverse Backgrounds	78	(0.8)	79	(1.1)	78	(1.2)
Preparedness to Use Standards-Based Teaching Practices	73	(0.8)	74	(1.1)	72	(1.2)
Preparedness to Use Calculators/Computers	51	(1.2)	46	(2.1)	55	(1.6)
Preparedness to Use the Internet	24	(1.3)	22	(1.9)	27	(1.6)

Teachers' ratings of their pedagogical preparedness are reflected in the areas they identify as needs for professional development. The survey asked about six different areas, shown in Table 9. It is not surprising to see that a majority (82 percent) of grade K–5 mathematics teachers perceived a substantial need for professional development in learning how to use technology in mathematics instruction when the previous table indicates their lack of preparedness in this area. It is interesting, however, that although the mean score in Table 8 indicates that teachers feel fairly well prepared to use standards-based teaching practices, 62 percent feel the need for professional development in learning how to use inquiry/investigative strategies, which is a common practice in standards-based teaching. (See Table 9.) Teachers' personal interpretations of standards-based teaching and what practices are involved in that type of instruction are potential explanations for this apparent contradiction in the data.

Also interesting is the evidence that relatively few teachers (45 percent) perceive a need for professional development in deepening their own content knowledge, even though many elementary teachers lack extensive mathematics backgrounds.

Table 9
Elementary School Mathematics Teachers Reporting They Perceived a Moderate or Substantial Need for Professional Development in the Preceding Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Learning how to use technology in mathematics instruction	82	(1.8)	81	(2.8)	82	(2.5)
Learning how to use inquiry/investigation-oriented teaching strategies	62	(2.3)	60	(3.4)	63	(3.4)
Learning how to teach mathematics in a class that includes students with special needs	57	(2.3)	58	(3.1)	56	(3.6)
Learning how to assess student learning in mathematics	47	(2.2)	49	(3.1)	44	(3.4)
Understanding student thinking in mathematics	47	(2.0)	43	(3.3)	52	(3.1)
Deepening my own mathematics content knowledge	45	(1.7)	45	(2.9)	44	(3.1)

Professional Development of Elementary School Mathematics Teachers

Elementary school mathematics teachers generally report low levels of participation in professional development specific to mathematics teaching. As can be seen in Table 10, only about one-third have had 16 or more hours of professional development in mathematics education in the previous three years.

Table 10
Time Elementary School Mathematics Teachers Spent on In-Service Education in Mathematics in Preceding Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
None	15	(1.8)	15	(2.6)	15	(2.6)
Less than 6 hours	21	(2.1)	24	(2.5)	18	(2.7)
6–15 hours	33	(2.0)	31	(2.8)	35	(3.2)
16–35 hours	17	(1.6)	17	(2.3)	17	(2.3)
More than 35 hours	14	(1.6)	13	(2.2)	15	(2.2)

As to how this time is spent, the workshop is by far the most common form of professional development (68 percent of elementary mathematics teachers have attended one or more workshops in the previous three years), followed by collaborating with teachers locally, either observing their classrooms (44 percent) or meeting regularly to discuss mathematics teaching (36 percent). (See Table 11.) Eighteen percent have taken a college/university course in the teaching of mathematics, and 13 percent have served as a mentor and/or peer coach in mathematics teaching in the previous three years.

Table 11
Elementary School Mathematics Teachers' Participating in Various Professional Development Activities in the Preceding Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Attended a workshop on mathematics teaching	68	(2.5)	65	(3.3)	72	(3.4)
Observed other teachers teaching mathematics as part of your own professional development (formal or informal)	44	(2.1)	44	(3.1)	45	(3.3)
Met with a local group of teachers to study/discuss mathematics teaching issues on a regular basis	36	(1.8)	36	(3.0)	36	(3.1)
Taken a formal college/university course in the teaching of mathematics	18	(1.8)	20	(3.0)	16	(2.3)
Served as a mentor and/or peer coach in mathematics teaching, as part of a formal arrangement that is recognized or supported by the school or district	13	(1.6)	14	(2.1)	11	(2.0)
Taken a formal college/university mathematics course	11	(1.1)	10	(2.0)	13	(1.9)
Attended a national or state mathematics teacher association meeting	8	(1.3)	6	(1.5)	11	(1.9)
Collaborated on mathematics teaching issues with a group of teachers at a distance using telecommunications	5	(0.9)	5	(1.1)	5	(1.5)

§ No teachers in this sample selected this response as on option. Thus, it is impossible to calculate the standard error of this estimate.

As can be seen in Table 12, roughly half of elementary school mathematics teachers reported not taking coursework in mathematics since 1990, and 40 percent have not taken a college course in either mathematics or the teaching of mathematics since 1990. This finding is a bit disconcerting given the drastic changes that have been advocated in mathematics instruction since the publication of the NCTM *Standards*.

Table 12
Elementary School Mathematics Teachers' Most Recent College Coursework in Field

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics						
1996–2000	23	(1.8)	25	(2.4)	21	(2.6)
1990–1995	26	(2.1)	23	(2.5)	29	(3.4)
Prior to 1990	51	(1.9)	52	(2.8)	50	(3.3)
The Teaching of Mathematics						
1996–2000	27	(2.0)	29	(2.9)	26	(2.7)
1990–1995	24	(2.0)	23	(2.7)	25	(2.9)
Prior to 1990	40	(2.0)	40	(2.9)	41	(3.2)
Never	8	(1.1)	8	(1.7)	8	(1.7)
Mathematics or the Teaching of Mathematics						
1996–2000	34	(2.1)	36	(3.4)	32	(2.9)
1990–1995	26	(2.1)	23	(2.6)	29	(3.4)
Prior to 1990	40	(2.1)	42	(3.1)	39	(3.1)

Teachers were asked to consider their professional development as a whole and characterize it in terms of different potential emphases. (See Table 13.) Understanding student thinking in mathematics, learning how to use inquiry/investigation-oriented teaching strategies, and learning how to assess student learning in mathematics were areas most likely to be heavily emphasized

during professional development. There appears to be a relatively good match between perceived need and emphasis in professional development opportunities in learning how to use inquiry/ investigation-oriented teaching strategies, (i.e., this area was one of the most likely to be rated as a need and also most likely to be emphasized in professional development opportunities). It is not clear if these are simply what are being offered most often or if teachers are actively pursuing these types of opportunities.

Table 13
Elementary School Mathematics Teachers Reporting that Their Professional Development Gave Heavy Emphasis to Various Areas

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Understanding student thinking in mathematics	32	(1.9)	32	(2.7)	31	(3.1)
Learning how to use inquiry/investigation-oriented teaching strategies	31	(2.1)	33	(3.1)	29	(2.8)
Learning how to assess student learning in mathematics	29	(2.0)	31	(3.0)	27	(2.7)
Learning how to use technology in mathematics instruction	22	(1.8)	22	(2.5)	21	(2.5)
Deepening my own mathematics content knowledge	20	(2.0)	20	(2.4)	19	(2.6)
Learning how to teach mathematics in a class that includes students with special needs	14	(1.4)	12	(2.0)	15	(2.3)

In contrast, there seems to be a very poor match between needs and opportunities in terms of technology; this was the most highly rated need (more than 80 percent of teachers), but only 22 percent of elementary teachers indicated that their professional development emphasized this area.

Elementary School Mathematics Instruction

Each teacher responding to the survey was asked to provide detailed information about his/her mathematics instruction in a randomly selected mathematics class. The next three sections draw on teachers' descriptions of what transpires during elementary school mathematics instruction in the United States, in terms of instructional objectives, time spent, and class activities.

Instructional Objectives

Teachers were given a list of potential objectives and asked to rate each in terms of the emphasis they receive in the randomly selected class. As can be seen in Table 14, most elementary mathematics teachers report giving a heavy emphasis to learning mathematical concepts (88 percent), followed by learning how to solve problems (81 percent), and learning how to reason mathematically (68 percent). While learning mathematical algorithms/procedures and preparing for standardized tests are heavily emphasized in fewer than half the grade K–5 mathematics classes, a larger percentage of classes in grades 3–5 tend to focus on these objectives than do classes in grades K–2. For example, 50 percent of grade 3–5 classes, compared to 36 percent of grade K–2 classes give a heavy emphasis to learning algorithms/procedures. Forty-nine percent of grades 3–5 classes compared to 28 percent of grade K–2 classes give a heavy emphasis to

preparing for standardized tests; these data should not be surprising as high-stakes standardized testing, which typically begins in grade 3, is becoming more common.

Table 14
Elementary School Mathematics Classes with Heavy Emphasis on Various Instructional Objectives

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Learn mathematical concepts	88	(1.2)	87	(2.0)	89	(1.8)
Learn how to solve problems	81	(1.7)	75	(2.8)	87	(2.1)
Learn to reason mathematically	68	(1.8)	61	(2.6)	75	(2.7)
Develop students' computational skills	66	(2.1)	59	(2.9)	74	(2.9)
Learn how mathematics ideas connect with one another	58	(2.1)	55	(3.2)	61	(2.9)
Increase students' interest in mathematics	52	(2.2)	55	(3.1)	49	(3.0)
Prepare for further study in mathematics	44	(2.2)	46	(3.2)	42	(2.9)
Learn mathematical algorithms/procedures	43	(1.9)	36	(2.8)	50	(3.1)
Learn to perform computations with speed and accuracy	41	(2.1)	33	(3.0)	48	(3.1)
Prepare for standardized tests	38	(2.3)	28	(2.8)	49	(3.2)
Learn to explain ideas in mathematics effectively	36	(2.0)	33	(2.9)	39	(3.1)
Understand the logical structure of mathematics	28	(1.9)	27	(3.0)	30	(2.7)
Learn how to apply mathematics in business and industry	11	(1.3)	9	(1.9)	13	(2.0)
Learn about the history and nature of mathematics	3	(0.6)	3	(0.9)	3	(1.0)

Three composite variables were created from the list of instructional objectives. The three composites are shown here with the instructional objectives that comprise them:

Mathematics Reasoning
- Learn mathematics concepts
- Learn how to solve problems
- Learn how to reason mathematically
- Learn how mathematics ideas connect with one another

Basic Mathematics Skills
- Develop students' computational skills
- Prepare for standardized tests
- Learn to perform computations with speed and accuracy

Nature of Mathematics
- Understand the logical structure of mathematics
- Learn about the history and nature of mathematics
- Learn how to apply mathematics in business and industry
- Learn to explain ideas in mathematics effectively

As shown in Table 15, Mathematics Reasoning objectives are the most likely to receive heavy emphasis in elementary mathematics instruction. Basic Mathematics Skills objectives are the next most heavily emphasized, even more so in grades 3–5 than in grades K–2 (mean scores of 83 and 69, respectively).

Table 15
Mean Composite Scores Related to
Elementary School Mathematics Class Objectives

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics Reasoning	90	(0.6)	88	(1.0)	92	(0.7)
Basic Mathematics Skills	76	(0.8)	69	(1.4)	83	(1.0)
Nature of Mathematics	53	(0.9)	48	(1.6)	58	(1.2)

Time Spent

The survey asked teachers to provide information about the amount of time spent in mathematics instruction. Although teachers were asked to indicate the number of minutes spent in the most recent lesson, it was recognized that some subjects are not taught every day in some elementary classes. For example, some elementary classes have instruction in reading and mathematics each day and in science and social studies every other day. Therefore, teachers were also asked to indicate if the selected lesson had taken place on the most recent school day. As seen in Table 16, 95 percent of elementary classes spent time on mathematics instruction on a typical day.

Table 16
Elementary School Mathematics
Lesson Taught on Most Recent Day of School

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics	95	(1.1)	94	(1.5)	96	(1.4)

The average number of minutes per day typically spent on instruction in mathematics, science, social studies, and reading/language arts is shown in Table 17. To facilitate comparisons among the subject areas, only teachers who teach all four of these subjects to one class of students were included in the analyses. In 2000, grade K–5 self-contained classes spent an average of 56 minutes on mathematics instruction, compared to 105 minutes on reading/language arts and only 23 minutes on science. The average number of minutes spent on mathematics instruction was significantly greater in intermediate grades than in the primary grades, with an average of 61 minutes in grades 3–5 and 51 minutes in grades K–2. Over a school year, this equates to approximately 30 additional hours of mathematics instruction in the higher grades

Table 17
Average Number of Minutes Per Day Spent Teaching Each Subject in Self-Contained Classes†

	Number of Minutes					
	Grades K–5		Grades K–2		Grades 3–5	
Reading/Language Arts	105	(2.8)	107	(3.1)	104	(4.1)
Mathematics	56	(1.0)	51	(1.3)	61	(1.4)
Science	23	(0.7)	20	(0.9)	27	(1.0)
Social Studies	25	(0.8)	20	(1.4)	30	(0.9)

† Only teachers who indicated they teach reading, mathematics, science, and social studies to one class of students were included in these analyses.

Class Activities

The 2000 National Survey of Science and Mathematics Education provides three sources of information about how mathematics is taught at the elementary school level. One series of items listed various instructional strategies and asked elementary teachers to indicate the frequency with which they used each in a randomly selected class. A second item listed a number of activities and asked teachers to indicate which occurred in the most recent lesson in their randomly selected class. Finally, a third item asked teachers to indicate the percentage of class time devoted to each of several activities in their most recent lesson.

The data for elementary school mathematics instruction from these three items are presented in Tables 18–22. Although data in Table 15 show that teachers report placing heavy emphasis on mathematics reasoning and conceptual understanding, data in Tables 18–22 indicate that the predominant instructional strategies are discussion and completing textbook/worksheet problems. It may be that teachers are relying heavily on discussion and rote computational practice and drills to strengthen students' conceptual understanding and reasoning abilities in mathematics, even though such strategies may not be the most effective according to the *Standards*. Both of these activities tend to be more frequent in grades 3–5 than in grades K–2. The use of concrete manipulatives is another frequent instructional strategy, especially in the primary grades.

Table 18
Elementary Mathematics Classes Where Teachers Report that Students Take Part in Various Instructional Activities

	Percent of Classes									
	Never		A few times a year		Once or twice a month		Once or twice a week		All or almost all lessons	
Answer textbook or worksheet questions	4	(0.8)	3	(0.7)	10	(1.4)	37	(2.1)	46	(2.3)
Review homework/worksheet assignments	6	(1.0)	6	(1.0)	14	(1.7)	35	(2.4)	39	(2.2)
Practice routine computations/algorithms	5	(1.0)	5	(1.0)	12	(1.5)	41	(2.0)	37	(2.1)
Engage in mathematical activities using concrete materials	0	(0.1)	2	(0.7)	18	(1.9)	45	(2.2)	36	(2.1)
Follow specific instructions in an activity or investigation	0	(0.2)	5	(0.9)	21	(1.7)	43	(2.1)	30	(2.0)
Work in groups	0	(0.2)	4	(1.0)	24	(2.1)	53	(2.5)	19	(1.7)
Use mathematical concepts to interpret and solve applied problems	3	(0.7)	9	(1.2)	24	(1.7)	48	(1.9)	17	(1.6)
Read from a mathematics textbook in class	27	(2.0)	13	(1.4)	16	(1.5)	26	(1.9)	17	(1.8)
Listen and take notes during presentation by teacher	42	(2.3)	17	(1.9)	16	(1.8)	13	(1.5)	12	(1.6)
Record, represent, and/or analyze data	3	(0.9)	11	(1.8)	37	(2.3)	38	(2.4)	11	(1.3)
Read other mathematics-related materials in class	14	(1.5)	23	(2.0)	38	(2.1)	20	(1.7)	5	(1.0)
Write reflections	29	(2.1)	24	(2.0)	26	(2.0)	16	(1.5)	5	(0.9)
Use calculators or computers for learning or practicing skills	13	(1.7)	20	(1.7)	39	(2.2)	25	(2.0)	4	(0.7)
Use calculators or computers to develop conceptual understanding	16	(2.1)	23	(1.9)	37	(2.4)	21	(1.8)	3	(0.6)
Work on extended mathematics investigations or projects	43	(2.3)	35	(2.6)	16	(1.8)	4	(0.8)	2	(0.6)
Design their *own* activity or investigation	14	(1.7)	34	(2.0)	36	(1.9)	15	(1.6)	1	(0.5)
Make formal presentations to the rest of the class	31	(2.0)	36	(2.1)	23	(2.1)	9	(1.2)	1	(0.5)
Use calculators or computers as a tool	46	(2.4)	24	(1.8)	20	(1.7)	9	(1.3)	1	(0.4)

Table 19
Grade K–2 Mathematics Classes Where Teachers Report that Students Take Part in Various Instructional Activities

	Percent of Classes									
	Never		A few times a year		Once or twice a month		Once or twice a week		All or almost all lessons	
Answer textbook or worksheet questions	8	(1.6)	6	(1.3)	11	(2.1)	35	(3.1)	40	(3.2)
Review homework/worksheet assignments	12	(1.9)	11	(1.9)	18	(2.7)	33	(3.5)	26	(2.3)
Practice routine computations/algorithms	9	(2.1)	7	(1.6)	15	(2.3)	36	(2.7)	33	(3.0)
Engage in mathematical activities using concrete materials	0	(0.3)	1	(0.4)	6	(1.9)	36	(3.1)	57	(3.2)
Follow specific instructions in an activity or investigation	1	(0.4)	6	(1.1)	25	(3.0)	41	(3.3)	27	(2.8)
Work in groups	1	(0.4)	3	(1.0)	28	(3.3)	49	(3.4)	20	(2.2)
Use mathematical concepts to interpret and solve applied problems	6	(1.5)	12	(1.9)	29	(2.8)	40	(2.9)	13	(2.0)
Read from a mathematics textbook in class	49	(3.4)	10	(1.8)	14	(1.9)	15	(2.2)	13	(2.5)
Listen and take notes during presentation by teacher	68	(3.9)	12	(2.1)	9	(2.2)	6	(1.9)	6	(1.5)
Record, represent, and/or analyze data	6	(1.8)	13	(2.6)	36	(2.9)	36	(3.0)	9	(2.2)
Read other mathematics-related materials in class	21	(2.6)	17	(2.0)	36	(3.0)	23	(2.4)	3	(0.9)
Write reflections	35	(3.1)	24	(2.4)	22	(2.3)	14	(2.0)	5	(1.6)
Use calculators or computers for learning or practicing skills	21	(3.1)	23	(2.6)	31	(2.7)	23	(2.6)	3	(0.9)
Use calculators or computers to develop conceptual understanding	22	(3.5)	24	(2.9)	32	(2.9)	20	(2.6)	2	(0.7)
Work on extended mathematics investigations or projects	55	(3.3)	29	(3.3)	12	(2.4)	3	(0.8)	1	(0.6)
Design their *own* activity or investigation	18	(2.9)	36	(2.4)	32	(3.1)	12	(2.4)	2	(0.8)
Make formal presentations to the rest of the class	43	(2.8)	34	(2.8)	17	(2.7)	5	(1.2)	0	(0.3)
Use calculators or computers as a tool	62	(3.6)	19	(2.4)	13	(2.0)	6	(1.3)	1	(0.5)

Table 20
Grade 3–5 Mathematics Classes Where Teachers Report that Students Take Part in Various Instructional Activities

	Percent of Classes									
	Never		A few times a year		Once or twice a month		Once or twice a week		All or almost all lessons	
Answer textbook or worksheet questions	1	(0.5)	0	(0.3)	9	(1.5)	39	(2.7)	51	(2.8)
Review homework/worksheet assignments	0	(0.3)	1	(0.5)	10	(2.2)	38	(3.2)	51	(3.4)
Practice routine computations/algorithms	1	(0.4)	2	(0.8)	10	(1.6)	47	(3.1)	41	(2.8)
Engage in mathematical activities using concrete materials	0	—[§]	3	(1.4)	29	(2.8)	53	(3.2)	15	(2.3)
Follow specific instructions in an activity or investigation	0	—[§]	4	(1.3)	18	(2.8)	44	(2.9)	34	(2.6)
Work in groups	0	(0.0)	4	(1.7)	21	(2.5)	57	(3.6)	18	(2.5)
Use mathematical concepts to interpret and solve applied problems	0	(0.2)	6	(1.8)	18	(1.9)	56	(2.7)	20	(2.6)
Read from a mathematics textbook in class	6	(1.7)	16	(2.1)	19	(2.4)	38	(3.2)	22	(2.6)
Listen and take notes during presentation by teacher	16	(2.7)	22	(3.0)	23	(2.6)	21	(2.6)	18	(2.6)
Record, represent, and/or analyze data	0	(0.2)	8	(2.0)	39	(3.4)	40	(3.8)	12	(2.1)
Read other mathematics-related materials in class	7	(1.4)	30	(3.1)	39	(2.9)	18	(2.2)	6	(1.7)
Write reflections	24	(2.8)	24	(3.3)	29	(3.0)	17	(2.3)	5	(1.2)
Use calculators or computers for learning or practicing skills	4	(1.4)	17	(2.5)	47	(3.4)	27	(3.4)	5	(1.0)
Use calculators or computers to develop conceptual understanding	9	(2.0)	23	(3.1)	43	(3.1)	21	(2.8)	3	(0.8)
Work on extended mathematics investigations or projects	30	(3.0)	42	(3.3)	19	(2.3)	6	(1.3)	2	(1.0)
Design their *own* activity or investigation	10	(1.9)	32	(2.9)	40	(2.9)	17	(2.2)	1	(0.5)
Make formal presentations to the rest of the class	19	(2.5)	38	(3.0)	28	(2.7)	13	(1.9)	2	(0.9)
Use calculators or computers as a tool	30	(2.9)	29	(2.9)	27	(2.9)	12	(2.3)	1	(0.7)

[§] No teachers in this sample selected this response as on option. Thus, it is impossible to calculate the standard error of this estimate.

Table 21
Elementary School Mathematics Classes
Participating in Various Activities in Most Recent Lesson

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Discussion	90	(1.5)	88	(2.0)	92	(2.1)
Students completing textbook/worksheet problems	78	(1.9)	75	(2.8)	80	(2.5)
Students doing hands-on/manipulative activities	71	(2.2)	84	(2.9)	58	(3.0)
Lecture	70	(2.1)	64	(3.0)	77	(2.5)
Students working in small groups	54	(2.4)	51	(3.2)	56	(3.0)
Students reading about mathematics	20	(1.6)	12	(1.8)	27	(3.1)
Test or quiz	13	(1.5)	10	(1.8)	17	(2.1)
Students using calculators	8	(1.0)	2	(0.6)	14	(1.8)
Students using computers	7	(1.0)	8	(1.6)	5	(1.2)
Students using other technologies	2	(0.5)	3	(0.7)	2	(0.7)
None of the above	0	(0.2)	0	(0.3)	0	(0.3)

Table 22
Average Percentage of Elementary School
Mathematics Class Time Spent on Different Types of Activities

	Average Percent					
	Grades K–5		Grades K–2		Grades 3–5	
Whole class lecture/discussion	29	(0.7)	26	(0.9)	31	(1.0)
Individual students reading textbooks, completing worksheets, etc.	25	(1.0)	23	(1.5)	26	(1.2)
Working with hands-on or manipulative materials	25	(1.1)	32	(1.6)	18	(1.3)
Daily routines, interruptions, and other non-instructional activities	10	(0.4)	10	(0.6)	10	(0.6)
Non-manipulative small group work	8	(0.7)	6	(0.8)	11	(0.9)
Other activities	4	(0.5)	3	(0.7)	4	(0.7)

Discussion

Teachers reported that discussion took place in 90 percent of the most recent mathematics lessons, with no significant difference between grade ranges. (See Table 21.) On the average, 29 percent of grade K–5 instructional time was devoted to lecture/discussion, with this average being higher in grades 3–5 (31 percent) than in grades K–2 (26 percent). (See Table 22.) Survey data do not provide insights into the quality of discussion that occurs in classrooms. Student outcomes may be quite different depending on whether discussion is focused on explaining algorithms and computation, as opposed to exposing and developing students' understanding of mathematical concepts.

Students Working Problems

Seventy-eight percent of grade K–5 mathematics teachers indicated that their students practice routine computations/algorithms at least once a week, with 37 percent doing so in all or almost all lessons. (See Tables 18–20.) In 78 percent of elementary school mathematics classes, students completed textbook/worksheet problems in their most recent lesson, ranking second behind discussion. (See Table 21.)

Use of Hands-On/Manipulatives

In addition to discussion and completing problems, students frequently work with hands-on/manipulatives as part of their mathematics instruction, especially in grades K–2. (See Tables 18–22.) For example, teachers in 57 percent of K–2 mathematics classes report their students engaging in mathematical activities using concrete materials in all or almost all lessons, compared to only 15 percent of grade 3–5 classes. Similarly, 84 percent of grade K–2 classes, compared to 58 percent of grade 3–5 classes included students doing hands-on/manipulative activities in their most recent lesson. The average percentage of class time spent on working with manipulatives is also significantly higher in primary grades than their intermediate level counterparts (32 and 18 percent, respectively). It is interesting to note that the use of manipulatives (or concrete materials) and the use of textbook/worksheets follow opposite trends as elementary grade ranges increases, with manipulative use more frequent in grades K–2 and textbook/worksheet use more frequent in grades 3–5.

Table 23 presents the mean scores for composite variables related to mathematics teaching practice. To achieve a score of 100, a class would have to do each of the activities in a composite in every mathematics lesson. A score of 0 would indicate that none of the activities in a composite are ever done. The data in this table suggest that the most frequently used strategies are those aimed at helping students learn to communicate mathematics ideas—discussion, posing open-ended questions, asking students to explain their reasoning—with the use of traditional teaching practices having the second highest mean score overall. Traditional practices dominate instruction more in intermediate grades than in primary grades (mean score of 78 versus 59, respectively).

Table 23
Class Mean Scores for Elementary School
Mathematics Teaching Practice Composite Variables

	Mean Scores					
	Grades K–5		**Grades K–2**		**Grades 3–5**	
Use of Strategies to Develop Students' Abilities to Communicate Ideas	74	(0.7)	72	(0.9)	76	(1.0)
Use of Traditional Teaching Practices	69	(0.7)	59	(1.3)	78	(0.8)
Use of Calculators/Computers for Developing Concepts and Skills	35	(0.9)	30	(1.4)	39	(1.3)
Use of Calculators/Computers for Investigation	26	(0.8)	21	(1.0)	30	(1.2)

Elementary teachers were also asked about the amount of homework assigned per week. As seen in Table 24, students in grades 3–5 are expected to spend more time on homework than are their primary counterparts, with 55 percent of classes in grades 3–5 compared to 10 percent in grades K–2 assigned more than an hour of homework each week.

Table 24
Amount of Assigned Homework Assigned in Elementary School Mathematics Classes per Week

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
0–30 minutes	42	(2.1)	68	(2.9)	15	(2.0)
31–60 minutes	26	(1.9)	21	(2.7)	31	(2.8)
61–90 minutes	15	(1.7)	6	(1.4)	25	(3.0)
91–120 minutes	10	(1.4)	2	(0.8)	18	(2.5)
2–3 hours	5	(1.0)	1	(0.7)	9	(1.9)
More than 3 hours	2	(0.5)	1	(0.4)	3	(1.0)

Activities That Are Not Frequent

The survey data also point to some activities that are not very frequent in elementary mathematics instruction. Although Table 23 suggests a high mean score for using strategies to develop students' ability to communicate ideas, Table 18 indicates a low percentage of grade K–5 classes participating in activities related to communication. For example, only 21 percent of the classes participate in writing reflections (e.g., in a journal) at least once or twice a week, and 31 percent of classes never participate in making formal presentations to the rest of the class; formal presentations are, however, more frequent in grades 3–5 than in K–2, with 81 percent of grade 3–5 classes including this practice, compared to 57 percent of grade K–2 classes. (See Tables 19–20.) Given the age at which writing skills typically develop, it is understandable that mathematics instruction in grades 3–5 is more likely to include written reflections and presentations. The high mean score for developing ability to communicate ideas in Table 23 is most likely the result of the substantial percentage of classes participating in discussion (as seen in Table 21), rather than these other related practices.

Survey data show the low frequency of technology use, which is to be expected based on data presented earlier in this report that the majority of teachers feel a need for professional development in this area, but most have not received such help. Only 29 percent of K–5 mathematics classes use calculators/computers for learning/practicing skills at least once or twice a week, and only 24 percent use them that often to develop conceptual understanding. (See Table 18.) Fewer than 10 percent of elementary mathematics classes incorporated calculator/computer use in their most recent lesson. (See Table 21.)

When calculators/computers are integrated into elementary school mathematics lessons, the most common uses are for playing learning games or doing drill and practice. For example, 44 percent of grade K–5 classes use calculators/computers at least once or twice a week to play mathematics learning games; 31 percent of classes use them that frequently for drill and practice. (See Table 25.)

Table 25
Elementary Mathematics Classes Where Teachers Report that Students Use Calculators/Computers for Various Activities

	Percent of Classes									
	Never		A few times a year		Once or twice a month		Once or twice a week		All or almost all lessons	
Grades K–5										
Do drill and practice	19	(2.0)	20	(2.0)	29	(2.1)	27	(2.1)	4	(0.8)
Demonstrate mathematics principles	29	(1.9)	25	(2.1)	26	(1.9)	15	(1.4)	5	(0.8)
Play mathematics learning games	12	(1.5)	13	(1.6)	31	(2.2)	37	(1.9)	7	(1.0)
Do simulations	48	(2.0)	25	(1.8)	17	(1.4)	8	(1.0)	2	(0.5)
Collect data using sensors or probes	71	(1.9)	19	(1.8)	7	(1.0)	2	(0.5)	1	(0.2)
Retrieve or exchange data	60	(2.3)	23	(2.1)	12	(1.4)	4	(0.9)	1	(0.5)
Solve problems using simulations	52	(2.1)	22	(2.0)	16	(1.5)	8	(1.0)	2	(0.5)
Take a test or quiz	54	(2.2)	18	(1.7)	14	(1.4)	11	(1.5)	2	(0.4)
Grades K–2										
Do drill and practice	24	(3.3)	20	(3.0)	26	(2.6)	28	(2.6)	3	(1.1)
Demonstrate mathematics principles	38	(3.5)	25	(3.1)	20	(2.5)	12	(1.7)	5	(1.3)
Play mathematics learning games	14	(2.1)	12	(2.1)	25	(2.5)	41	(2.7)	9	(1.7)
Do simulations	60	(2.6)	19	(2.2)	12	(2.0)	8	(1.3)	2	(0.7)
Collect data using sensors or probes	80	(2.4)	13	(2.2)	5	(1.2)	2	(0.7)	1	(0.3)
Retrieve or exchange data	72	(2.8)	16	(2.3)	9	(1.8)	2	(0.8)	1	(0.5)
Solve problems using simulations	63	(2.5)	16	(2.1)	12	(1.8)	8	(1.3)	1	(0.5)
Take a test or quiz	69	(3.1)	13	(2.1)	9	(1.6)	8	(1.7)	1	(0.3)
Grades 3–5										
Do drill and practice	15	(2.3)	20	(2.4)	33	(2.9)	27	(3.1)	5	(1.1)
Demonstrate mathematics principles	20	(2.5)	25	(3.1)	33	(2.8)	18	(2.2)	4	(1.1)
Play mathematics learning games	10	(2.1)	15	(2.3)	38	(3.3)	33	(3.1)	5	(1.4)
Do simulations	35	(3.0)	31	(2.8)	23	(2.4)	9	(1.6)	1	(0.5)
Collect data using sensors or probes	63	(3.2)	25	(2.7)	10	(1.7)	2	(0.6)	1	(0.4)
Retrieve or exchange data	47	(3.2)	31	(3.2)	14	(2.2)	6	(1.4)	2	(0.7)
Solve problems using simulations	40	(3.0)	29	(3.1)	21	(2.3)	8	(1.5)	2	(0.7)
Take a test or quiz	39	(3.1)	23	(2.9)	20	(2.5)	15	(2.2)	3	(0.9)

Resources Available for Elementary School Mathematics Instruction

Elementary teachers were given a list of equipment and asked to indicate the extent to which each is used in their mathematics instruction. Table 26 shows the percentage of elementary school mathematics classes reporting at least some use of each type of equipment, as well as the percentages of classes where each is "needed, but not available" or "not needed." Overhead projectors are common in grade K–5 mathematics instruction, with 89 percent of classes using them. In terms of calculator use, four-function calculators were reported more frequently used at some point during the year in grades 3–5 (79 percent), than in grades K–2 (50 percent).

It is promising to see that teachers in most of the elementary classes reported having access to necessary instructional resources. From the given list of equipment, grade K–5 teachers in 10

percent or fewer of mathematics classes reported needing a particular resource and not having it. Although the frequency of technology use is low, teachers' apparent access to computers and four-function calculators is high. Elementary school mathematics teachers in only 2 percent or less of classes reported needing, but not having each of these two instructional resources.

Table 26
Equipment Need, Availability, and
Use in Elementary School Mathematics Classes

	Percent of Classes					
	Not Needed		Needed, but Not Available		Used	
Grades K–5						
Overhead projector	10	(1.6)	1	(0.3)	89	(1.7)
Videotape player	55	(2.8)	0	(0.2)	44	(2.8)
Videodisc player	87	(1.7)	3	(0.7)	10	(1.6)
CD-ROM player	45	(2.4)	4	(1.2)	51	(2.5)
Four-function calculators	32	(2.0)	2	(0.8)	65	(2.2)
Fraction calculators	86	(1.4)	6	(1.1)	8	(1.1)
Computers	10	(1.7)	1	(0.5)	88	(1.8)
Calculator/computer lab interfacing devices	69	(2.5)	8	(1.5)	23	(2.2)
Computers with Internet connection	45	(2.9)	7	(1.5)	48	(3.0)
Grades K–2						
Overhead projector	12	(2.3)	1	(0.6)	87	(2.4)
Videotape player	55	(4.2)	0	(0.3)	44	(4.2)
Videodisc player	88	(2.2)	3	(1.1)	10	(2.1)
CD-ROM player	42	(4.0)	5	(1.5)	53	(4.0)
Four-function calculators	49	(3.6)	1	(0.4)	50	(3.6)
Fraction calculators	96	(1.1)	3	(0.9)	2	(0.7)
Computers	9	(2.2)	1	(0.6)	90	(2.4)
Calculator/computer lab interfacing devices	72	(3.0)	6	(1.3)	21	(2.7)
Computers with Internet connection	54	(4.1)	5	(1.4)	40	(4.2)
Grades 3–5						
Overhead projector	8	(2.2)	0	(0.1)	92	(2.2)
Videotape player	55	(3.7)	0	(0.3)	44	(3.7)
Videodisc player	87	(2.5)	4	(1.0)	10	(2.4)
CD-ROM player	48	(3.4)	4	(1.6)	49	(3.3)
Four-function calculators	17	(2.6)	3	(1.5)	79	(3.0)
Fraction calculators	76	(2.5)	10	(2.0)	14	(2.1)
Computers	12	(2.4)	2	(0.8)	87	(2.6)
Calculator/computer lab interfacing devices	65	(3.5)	10	(2.4)	24	(2.9)
Computers with Internet connection	35	(3.5)	8	(2.1)	56	(3.7)

The survey also provides information about the use of commercially published textbooks or programs in elementary school mathematics instruction. As seen in Table 27, teachers in almost 9 out of 10 grade K–5 mathematics classes reported using one or more commercially published textbooks/programs, with this percentage being significantly higher in grades 3–5 than in grades K–2. Table 28 lists the most commonly used elementary mathematics textbooks.

Table 27
Elementary School Mathematics
Classes Using Textbooks/Programs

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Use one or more commercially published textbooks or programs	88	(1.5)	85	(2.2)	92	(1.8)
Use one textbook or program all or most of the time	63	(2.4)	60	(3.3)	67	(3.1)
Use multiple textbooks or programs	25	(2.2)	25	(2.8)	25	(3.1)
No textbook or program used	12	(1.5)	15	(2.2)	8	(1.8)

Table 28
Most Commonly Used Textbooks in
Elementary School Mathematics Instruction

Title	Publisher	Percent of Classes Using	
Math Advantage	Harcourt Brace/Harcourt, Brace & Jovanovich	10	(1.9)
Addison-Wesley Math	Addison Wesley Longman, Inc./Scott Foresman	7	(1.5)
Everyday Math	Everyday Learning Corporation	7	(1.8)
Mathematics, The Path to Math Success	Silver Burdett Ginn	5	(1.5)
Exploring Mathematics	Addison Wesley Longman, Inc./Scott Foresman	4	(1.7)
Math in My World	McGraw-Hill/Merrill Co.	4	(1.7)

When asked to rate the quality of their textbook, most elementary school mathematics teachers considered it to be of relatively high quality, with more than three-fourths of grade K–5 mathematics teachers considering their textbook/program to be good to excellent. Forty percent of elementary school mathematics classes cover 75–90 percent of the textbook/program, with 39 percent of classes covering more than that. (See Table 30.)

Table 29
Elementary School Mathematics Teachers' Perceptions of
Quality of Textbooks/Programs Used in Mathematics Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Very poor	1	(0.5)	1	(0.7)	1	(0.9)
Poor	3	(0.9)	2	(0.8)	4	(1.5)
Fair	17	(2.0)	18	(3.1)	16	(2.6)
Good	34	(2.5)	31	(3.7)	37	(3.4)
Very good	36	(2.5)	38	(3.7)	35	(3.2)
Excellent	9	(1.4)	10	(2.1)	7	(1.8)

Table 30
Percentage of Elementary School Mathematics Textbooks/Programs Covered During the Course

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Less than 25 percent	1	(0.4)	1	(0.5)	1	(0.6)
25–49 percent	3	(0.9)	4	(1.5)	2	(1.0)
50–74 percent	17	(2.0)	11	(2.5)	23	(2.7)
75–90 percent	40	(2.4)	35	(3.4)	44	(3.3)
More than 90 percent	39	(2.8)	50	(3.5)	29	(3.7)

Summary

Despite their lack of strong mathematics preparation, elementary school mathematics teachers seem to feel relatively confident in their mathematics content knowledge and in their ability to teach the content in their classes according to the NCTM *Standards.* At the same time, grade K–5 mathematics teachers expressed a substantial need for professional development in a number of ways, especially in using technology. Unfortunately, low participation in professional development activities and/or the lack of technology emphasis during these activities means that many teachers do not receive the help they need. In contrast, it appears as though elementary school mathematics teachers are receiving more professional development activities focused on learning how to use inquiry/investigation-oriented teaching strategies.

While there is some evidence indicating that elementary teachers' mathematics objectives and instruction are aligned with the *Standards,* there is also evidence suggesting a pattern of traditional mathematics instruction. The use of manipulatives and the use of traditional teaching practices—practicing computations/ algorithms, answering textbook/worksheet problems, doing drill and practice, and preparing for standardized tests—follow opposite trends as grade range increases, with manipulative use more frequent in grades K–2 and traditional practices more frequent in grades 3–5. The integration of computers into mathematics instruction is still extremely infrequent, overall.

References

National Council of Teachers of Mathematics. *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics, 1989.

National Council of Teacher of Mathematics. *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics, 2000.

Weiss, I.R., Banilower, E.R., McMahon, K.C., and Smith, P.S. *Report of the 2000 National Survey of Science and Mathematics Education.* Chapel Hill, NC: Horizon Research, Inc., 2001.

Appendix

Description of Composite Variables

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites." Each composite represents an important construct related to mathematics education.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for instance, an item with a scale ranging from 1 to 4 was re-coded to have a scale of 0 to 3. By doing this, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a 9-item composite where each item is on a scale of 0–3 would have a denominator of 0.27.

Composite definitions for the mathematics teacher questionnaire are presented below along with the item numbers. Reliability information is based on the entire sample of K–12 mathematics teachers.

Table A-1
Mathematics Teacher Preparedness to Use Standards-Based Teaching Practices

Take students' prior understanding into account when planning curriculum and instruction.	Q3a
Develop students' conceptual understanding of mathematics	Q3b
Provide deeper coverage of fewer mathematics concepts	Q3c
Make connections between mathematics and other disciplines	Q3d
Lead a class of students using investigative strategies	Q3e
Manage a class of students engaged in hands-on/project-based work	Q3f
Have students work in cooperative learning groups	Q3g
Listen/ask questions as students work in order to gauge their understanding	Q3h
Use the textbook as a resource rather than the primary instructional tool	Q3i
Teach groups that are heterogeneous in ability	Q3j
Number of Items in Composite	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.86**

Table A-2
Mathematics Teacher Preparedness to Teach Students from Diverse Backgrounds

Recognize and respond to student cultural diversity	Q3l
Encourage students' interest in mathematics	Q3m
Encourage participation of females in mathematics	Q3n
Encourage participation of minorities in mathematics	Q3o
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.80**

Table A-3
Mathematics Teacher Preparedness to Use Calculators/Computers

Use calculators/computers for drill and practice	Q3q
Use calculators/computers for mathematics learning games	Q3r
Use calculators/computers to collect and/or analyze data	Q3s
Use calculators/computers to demonstrate mathematics principles	Q3t
Use computers for simulations and applications	Q3u
Number of Items in Composite	**5**
Reliability (Cronbach's Coefficient Alpha)	**0.89**

Table A-4
Mathematics Teacher Preparedness to Use the Internet

Use the Internet in your mathematics teaching for general reference	Q3v
Use the Internet in your mathematics teaching for data acquisition	Q3w
Use the Internet in your mathematics teaching for collaborative projects with classes/individuals in other schools	Q3x
Number of Items in Composite	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.90**

Table A-5
Nature of Mathematics Objectives

Understand the logical structure of mathematics	Q23i
Learn about the history and nature of mathematics	Q23j
Learn how to explain ideas in mathematics effectively	Q23k
Learn how to apply mathematics in business and industry	Q23l
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.73**

Table A-6
Basic Mathematics Skills Objectives

Develop students' computational skills	Q23d
Learn to perform computations with speed and accuracy	Q23m
Prepare for standardized tests	Q23n
Number of Items in Composite	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.69**

Table A-7
Mathematics Reasoning Objectives

Learn mathematical concepts	Q23b
Learn how to solve problems	Q23e
Learn to reason mathematically	Q23f
Learn how mathematics ideas connect with one another	Q23g
Number of Items in Composite	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.75**

Table A-8
Use of Traditional Teaching Practices

Introduce content through formal presentations	Q24a
Assign science/mathematics homework	Q24j
Listen and take notes during presentation by teacher	Q25a
Read from a science/mathematics textbook in class	Q25c
Practice routine computations/algorithms	Q25f
Review homework/worksheet assignments	Q25g
Answer textbook or worksheet questions	Q25k
Review student homework	Q27f
Number of Items in Composite	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.74**

Table A-9
Use of Strategies to Develop Students' Abilities to Communicate Ideas

Pose open-ended questions	Q24b
Engage the whole class in discussions	
Require student to explain their reasoning when giving an answer	Q24d
Ask students to explain concepts to one another	Q24e
Ask students to consider alternative methods for solutions	Q24f
Ask students to use multiple representations (e.g., numeric, graphic, geometric, etc.)	Q24g
Help students see connections between science/mathematics and other disciplines	Q24h
Number of Items in Composite	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.77**

Table A-10
Use of Calculators/Computers for Investigations

Record, represent, and/or analyze data	Q25l
Use calculators or computers as a tool (e.g., spreadsheets, data analysis)	Q25r
Do simulations	Q26d
Collect data using sensors or probes	Q26e
Retrieve or exchange data	Q26f
Solve problems using simulations	Q26g
Number of Items in Composite	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.85**

Table A-11
Use of Calculators/Computers for Developing Concepts and Skills

Use calculators or computers for learning or practicing skills	Q25p
Use calculators or computers to develop conceptual understanding	Q25q
Do drill and practice	Q26a
Demonstrate mathematics principles	Q26b
Take a test or quiz	Q26h
Use graphing calculators	Q28g3
Number of Items in Composite	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.86**