2012 National Survey of Science and Mathematics Education

Status of Elementary School Mathematics

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Disclaimer

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INTRODUCTION

The 2012 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 7,752 science and mathematics teachers in schools across the United States participated in this survey, a response rate of 77 percent. The research questions addressed by the study are:

1. To what extent do science and mathematics instruction and ongoing assessment mirror current understanding of learning?

2. What influences teachers' decisions about content and pedagogy?

3. What are the characteristics of the science/mathematics teaching force in terms of race, gender, age, content background, beliefs about teaching and learning, and perceptions of preparedness?

4. What are the most commonly used textbooks/programs, and how are they used?

5. What formal and informal opportunities do science/mathematics teachers have for ongoing development of their knowledge and skills?

6. How are resources for science/mathematics education, including well-prepared teachers and course offerings, distributed among schools in different types of communities and different socioeconomic levels?

The 2012 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 1,038 elementary mathematics teachers. Of these teachers, 525 taught primary grades (K–2) and 513 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 2012 National Survey of Science and Mathematics Education.*[1] The standard errors for the estimates presented in this report are included in parentheses in the

[1] Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education.* Chapel Hill, NC: Horizon Research, Inc.

tables. The narrative sections of the report generally point out only those differences that are substantial as well as statistically significant at the 0.05 level.[2]

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

- Characteristics of the elementary school mathematics teaching force;
- Professional development of elementary school mathematics teachers;
- Elementary school mathematics instruction, in terms of time spent, objectives, and activities;
- Resources available for elementary school mathematics instruction; and
- Factors affecting 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 grades teachers are slightly more likely than those in the primary grades to be male (see Table 1). The majority of the elementary mathematics teaching force is over 40 years old; more than 1 in 4 are over 50, indicating that large numbers of teachers may be retiring in the next 10 years.

[2] The False Discovery Rate was used to control the Type I error rate when comparing multiple groups on the same outcome. Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society*, B, 57, 289–300.

Table 1
Characteristics of the Elementary Mathematics Teaching Force

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Sex						
Male	8	(1.0)	4	(1.1)	12	(1.8)
Female	92	(1.0)	96	(1.1)	88	(1.8)
Race						
White	92	(1.1)	93	(1.2)	92	(1.7)
Black or African American	4	(0.9)	4	(0.8)	5	(1.3)
Hispanic or Latino	9	(1.3)	11	(1.7)	8	(1.4)
Asian	1	(0.3)	2	(0.6)	1	(0.4)
American Indian or Alaska Native	1	(0.3)	1	(0.4)	0	(0.2)
Native Hawaiian or Other Pacific Islander	0	(0.3)	0	---[†]	1	(0.5)
Two or more races	1	(0.3)	1	(0.5)	1	(0.3)
Age						
≤ 30	17	(1.3)	16	(1.4)	18	(1.9)
31–40	26	(1.4)	25	(1.9)	27	(2.3)
41–50	27	(1.6)	24	(2.1)	30	(2.3)
51–60	24	(1.4)	27	(2.1)	20	(1.8)
61+	6	(0.9)	8	(1.2)	5	(1.1)
Experience Teaching Mathematics at the K–12 Level						
0–2 years	12	(1.1)	11	(1.2)	14	(1.8)
3–5 years	14	(1.4)	14	(1.8)	15	(2.1)
6–10 years	22	(1.3)	23	(1.8)	21	(2.1)
11–20 years	30	(1.6)	31	(2.0)	30	(2.3)
≥ 21 years	21	(1.6)	22	(2.5)	19	(1.6)

[†] No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

As can be seen in Table 2, only 4 percent of elementary mathematics teachers have college degrees in mathematics or mathematics education. However, the vast majority have had formal preparation for teaching leading to a teacher credential, with roughly two-thirds receiving their teaching credential as part of their undergraduate program (see Table 3).

Table 2
Elementary Mathematics Teacher Degrees

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics	4	(0.5)	3	(0.7)	4	(0.9)
Mathematics Education	1	(0.3)	1	(0.3)	2	(0.6)
Mathematics or Mathematics Education	4	(0.6)	4	(0.7)	5	(1.0)

Table 3
Elementary Mathematics Teachers' Paths to Certification

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
An undergraduate program leading to a bachelor's degree and a teaching credential	63 (2.2)	59 (2.8)	68 (2.7)
A master's program that also awarded a teaching credential	22 (2.0)	24 (2.7)	19 (2.6)
A post-baccalaureate credentialing program (no master's degree awarded)	14 (1.9)	15 (2.6)	13 (2.5)
No formal teacher preparation	1 (0.4)	1 (0.7)	1 (0.4)

Content Preparedness

The *Common Core State Standards for Mathematics*[3] for grades K–5 call for the development of conceptual understanding of key ideas in number and operations, algebraic thinking, measurement and data, and geometry through the engagement in various mathematical practices. If elementary teachers are to effectively guide students in their exploration of mathematical concepts in these ways, they must themselves have a firm understanding of those concepts. In terms of specific college courses taken by elementary mathematics teachers, the vast majority of K–5 teachers have completed coursework in mathematics content for elementary school teachers and in mathematics education; 55 percent have completed coursework in college algebra/ trigonometry/functions. Less than half of K–5 teachers (ranging from 19–46 percent) have completed coursework in statistics, probability, college geometry, or calculus (see Table 4).

Table 4
Elementary Mathematics Teachers Completing Various College Courses

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
Mathematics content for elementary school teachers	95 (0.7)	96 (0.9)	94 (1.0)
College Algebra/Trigonometry/Functions	55 (1.6)	56 (2.3)	53 (2.1)
Computer Science	50 (2.1)	46 (2.6)	55 (2.6)
Statistics	46 (1.6)	46 (2.2)	46 (2.5)
Integrated Mathematics	43 (1.7)	44 (2.7)	42 (2.2)
Probability	24 (1.6)	24 (2.4)	25 (2.0)
College Geometry	23 (1.5)	23 (2.1)	24 (1.9)
Calculus	19 (1.4)	17 (2.0)	20 (1.9)
Mathematics Education	95 (0.7)	95 (0.9)	94 (1.0)
Student teaching in mathematics	86 (1.2)	86 (1.6)	85 (1.7)

The National Council of Teachers of Mathematics (NCTM) has recommended that elementary mathematics teachers take college coursework in a number of different areas: number and operations (for which "mathematics for elementary teachers" can serve as a proxy), algebra, geometry, probability, and statistics. As can be seen in Table 5, only 10 percent of elementary

[3] National Governors Association Center for Best Practices, Council of Chief State School Officers (2010). *Common core state standards*. Washington, DC: Author.

mathematics teachers have taken each of the five courses recommended by the NCTM. The typical elementary mathematics teacher has had coursework in only 1–2 of these 5 areas.

Table 5
Elementary Mathematics Teachers' Coursework Related to NCTM Course-Background Standards

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
All 5 courses	10 (1.2)	11 (1.8)	9 (1.3)
3–4 courses	32 (1.6)	32 (2.2)	32 (2.3)
1–2 courses	57 (1.8)	57 (2.5)	58 (2.4)
No courses	1 (0.3)	1 (0.5)	1 (0.5)

In addition to asking teachers about their college coursework, the survey asked how well prepared they feel to teach various topics. As elementary teachers are typically responsible for teaching not only mathematics, but also science, language arts, and social studies, the survey asked them to rate their preparedness to teach each of those subject areas. As seen in Table 6, it is clear that elementary teachers do not feel equally well prepared to teach all of these subjects. Eighty-one percent of self-contained K–5 teachers feel very well prepared to teach reading/ language arts, compared to 47 percent for social studies, and 40 percent for science. It is interesting to note that only 1 percent feel not adequately prepared to teach mathematics. Despite their lack of strong mathematics content preparation, elementary teachers appear to feel relatively well prepared to teach mathematics, perhaps because they are considering instruction in areas such as number and operations, rather than topics in areas such as early algebra.

Table 6
Elementary Mathematics Teachers' Perceptions of Preparedness to Teach Each Subject

	Percent of Teachers[†]			
	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Grades K–5				
Reading/Language Arts	0 (0.1)	2 (0.3)	17 (0.9)	81 (1.0)
Mathematics	1 (0.4)	3 (0.7)	19 (1.5)	77 (1.7)
Social Studies	1 (0.3)	12 (0.9)	41 (1.5)	47 (1.5)
Science	2 (0.5)	15 (1.4)	44 (1.8)	40 (2.1)
Grades K–2				
Reading/Language Arts	0 (0.2)	1 (0.2)	13 (1.1)	86 (1.1)
Mathematics	1 (0.6)	4 (1.0)	17 (1.9)	78 (2.1)
Social Studies	1 (0.3)	10 (1.0)	40 (2.0)	48 (2.0)
Science	2 (0.6)	12 (1.4)	43 (2.1)	44 (2.5)
Grades 3–5				
Reading/Language Arts	0 ---[‡]	3 (0.8)	23 (1.7)	74 (1.8)
Mathematics	1 (0.5)	2 (0.6)	21 (2.7)	76 (2.8)
Social Studies	2 (0.5)	13 (1.3)	41 (2.2)	44 (2.2)
Science	3 (1.1)	19 (2.4)	44 (2.8)	33 (3.0)

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

[‡] No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

This hypothesis is supported by data from an item on the survey that asked elementary mathematics teachers to rate how well prepared they feel to teach each of a number of fundamental topics in elementary mathematics. Over three-fourths of elementary mathematics teachers feel very well prepared to teach about number and operations (see Table 7). Just over half feel very well prepared to teach measurement and data representation and geometry, and just under half feel very well prepared to teach early algebra. Few elementary mathematics teachers feel not adequately prepared in any of these areas.

Table 7
Elementary Mathematics Teachers' Perceptions of Preparedness to Teach Each of a Number of Topics

	Percent of Teachers[†]			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Grades K–5				
Number and Operations	0 (0.1)	2 (0.4)	21 (1.3)	77 (1.4)
Measurement and Data Representation	1 (0.4)	9 (1.1)	33 (1.9)	56 (2.0)
Geometry	3 (0.6)	10 (1.0)	33 (1.7)	54 (1.9)
Early Algebra	5 (0.7)	13 (1.1)	36 (1.7)	46 (2.0)
Grades K–2				
Number and Operations	0 (0.2)	2 (0.6)	20 (1.6)	78 (1.7)
Measurement and Data Representation	2 (0.6)	9 (1.4)	34 (2.5)	54 (2.5)
Geometry	5 (0.9)	10 (1.3)	33 (2.4)	53 (2.4)
Early Algebra	6 (1.1)	17 (1.8)	36 (2.4)	41 (2.4)
Grades 3–5				
Number and Operations	0 ---[‡]	2 (0.7)	21 (2.2)	77 (2.4)
Measurement and Data Representation	1 (0.4)	9 (1.6)	32 (2.5)	58 (2.8)
Geometry	1 (0.4)	10 (1.6)	34 (2.3)	56 (2.5)
Early Algebra	4 (0.9)	8 (1.5)	35 (2.4)	53 (2.8)

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

[‡] No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning in mathematics. As can be seen in Table 8, elementary mathematics teachers hold a number of views that align with what is known about effective mathematics instruction. For example, nearly all elementary mathematics teachers agree that most class periods should provide opportunities for students to share their thinking and reasoning, include some review of previously covered ideas and skills, and conclude with a summary of the key ideas addressed. Nearly all also believe that students should be provided with the purpose for a lesson as it begins. In addition, over three-fourths of grade K–5 teachers agree that it is better for mathematics instruction to focus on ideas in-depth, even if that means covering fewer topics.

However, many elementary mathematics teachers also hold views that are inconsistent with effective mathematics instruction. About 9 in 10 believe that students should be provided with definitions for new vocabulary at the beginning of instruction on a mathematical idea. About half also believe that teachers should explain an idea to students before having them investigate the idea. In addition, although primary grades teachers are less likely than intermediate grades teachers to think that students learn best in classes with students of similar abilities and that homework should be assigned most days, a substantial portion agrees with each of these statements.

Table 8
Elementary Mathematics Teachers Agreeing[†]
with Various Statements about Teaching and Learning

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
Most class periods should provide opportunities for students to share their thinking and reasoning	97 (0.5)	97 (0.8)	97 (0.9)
Most class periods should include some review of previously covered ideas and skills	96 (0.6)	95 (0.9)	96 (0.9)
Students should be provided with the purpose for a lesson as it begins	95 (0.6)	96 (0.9)	95 (1.0)
Most class periods should conclude with a summary of the key ideas addressed	95 (0.8)	94 (1.1)	95 (1.0)
At the beginning of instruction on a mathematical idea, students should be provided with definitions for new vocabulary that will be used	90 (1.1)	91 (1.5)	88 (1.5)
Inadequacies in students' mathematics background can be overcome by effective teaching	87 (1.3)	88 (1.5)	86 (1.9)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics	78 (1.5)	77 (2.0)	80 (2.1)
Students should be assigned homework most days	67 (1.7)	61 (2.2)	75 (2.4)
Students learn mathematics best in classes with students of similar abilities	52 (1.7)	47 (2.2)	57 (2.5)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned	52 (1.7)	53 (2.4)	51 (2.4)
Teachers should explain an idea to students before having them investigate the idea	48 (1.8)	53 (2.3)	44 (2.7)

[†] Includes teachers indicating "strongly agree" or "agree" on a 5-point scale ranging from 1 "strongly disagree" to 5 "strongly agree."

Pedagogical Preparedness

The survey asked teachers two series of items focused on their preparedness for a number of tasks associated with instruction. First, they were asked how well prepared they feel to address diverse learners in their instruction. Second, they were asked how well prepared they feel to monitor and address student understanding, focusing on a specific mathematics unit.

As can be seen in Table 9, 50 percent or more of elementary teachers feel very well prepared to manage classroom discipline, encourage the participation of females in mathematics, encourage participation of students from low socioeconomic backgrounds in mathematics, and encourage

participation of racial or ethnic minorities in mathematics. Forty-two percent of elementary teachers feel very well prepared to plan differentiated instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity. However, less than one-fourth of elementary teachers feel very well prepared to teach mathematics to students with learning disabilities, English-language learners, or students with physical disabilities.

Table 9
Elementary Mathematics Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Manage classroom discipline	69	(2.1)	71	(2.7)	68	(3.4)
Encourage participation of females in mathematics	55	(2.1)	56	(3.4)	54	(3.2)
Encourage participation of students from low socioeconomic backgrounds in mathematics	51	(2.1)	54	(3.2)	48	(3.0)
Encourage participation of racial or ethnic minorities in mathematics	50	(2.1)	52	(3.1)	48	(3.0)
Encourage students' interest in mathematics	48	(2.3)	51	(3.2)	44	(4.0)
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	42	(2.2)	46	(3.3)	38	(3.3)
Provide enrichment opportunities for gifted students	26	(2.2)	28	(3.1)	25	(3.2)
Teach mathematics to students who have learning disabilities	23	(2.1)	25	(2.7)	22	(3.0)
Teach mathematics to English-language learners	23	(2.3)	27	(3.0)	19	(2.8)
Teach mathematics to students who have physical disabilities	16	(1.6)	21	(2.4)	11	(2.0)

Table 10 shows the percentage of classes taught by teachers who feel very well prepared for each of a number of tasks related to instruction. Teachers in roughly two-thirds of elementary classes, feel very well prepared to assess student understanding at the end of a mathematics unit, implement the mathematics textbook/program to be used during the unit, and monitor student understanding during instruction. Eliciting students' initial ideas or anticipating student difficulties are tasks that teachers in slightly less than half of elementary classes feel very well prepared to do.

Table 10
Elementary Mathematics Classes in which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Assess student understanding at the conclusion of this unit	66 (1.7)	68 (2.0)	65 (2.7)
Implement the mathematics textbook/program to be used during this unit†	62 (2.0)	65 (2.5)	60 (2.8)
Monitor student understanding during this unit	62 (1.6)	68 (2.3)	57 (2.1)
Find out what students thought or already knew about the key mathematical ideas	48 (1.9)	51 (2.4)	44 (2.6)
Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit	46 (1.8)	49 (2.4)	43 (2.6)

† This item was presented only to teachers who indicated using commercially published textbooks/programs in the most recent unit.

PROFESSIONAL DEVELOPMENT OF ELEMENTARY SCHOOL MATHEMATICS TEACHERS

One important measure of teachers' continuing education is how long it has been since they participated in professional development. As can be seen in Table 11, 87 percent of K–5 mathematics teachers have participated in mathematics-focused professional development (i.e., focused on mathematics content or the teaching of mathematics) in the last three years.

Table 11
Elementary Mathematics Teachers' Most Recent Participation in Mathematics-Focused† Professional Development

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
In the last 3 years	87 (1.3)	86 (2.1)	88 (1.5)
4–6 years ago	7 (0.9)	7 (1.4)	7 (1.1)
7–10 years ago	1 (0.4)	2 (0.8)	1 (0.4)
More than 10 years ago	1 (0.3)	1 (0.5)	1 (0.6)
Never	3 (0.7)	3 (0.9)	3 (1.0)

† Includes professional development focused on mathematics or mathematics teaching.

However, elementary mathematics teachers in general, report low levels of participation in professional development specific to mathematics teaching. Only about 1 in 10 has spent more than 35 hours in mathematics-related professional development in the last three years (see Table 12).

Table 12
Time Spent on Professional Development† in the Last Three Years

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
Less than 6 hours	35 (2.1)	36 (3.1)	33 (2.2)
6–15 hours	35 (1.6)	35 (2.3)	34 (2.2)
16–35 hours	20 (1.5)	19 (2.0)	20 (2.0)
More than 35 hours	11 (1.0)	9 (1.2)	12 (1.4)

† Includes professional development focused on mathematics or mathematics teaching.

As to how this time is spent, the workshop is the most common form of professional development, with 91 percent of elementary mathematics teachers having attended one in the previous three years (see Table 13). Two-thirds of elementary mathematics teachers have participated in a professional learning community or other type of teacher study group focused on mathematics or mathematics teaching. Less than half of elementary teachers have received feedback about their mathematics teaching from a mentor/coach.

Table 13
Elementary Mathematics Teachers Participating in Various Professional Development Activities in the Last Three Years

	Percent of Teachers		
	Grades K–5	Grades K–2	Grades 3–5
Attended a workshop on mathematics or mathematics teaching	91 (1.0)	92 (1.4)	90 (1.6)
Participated in a professional learning community/lesson study/teacher study group focused on mathematics or mathematics teaching	66 (1.8)	67 (2.5)	65 (2.5)
Received feedback about your mathematics teaching from a mentor/coach formally assigned by the school/district/diocese†	46 (2.2)	45 (2.9)	46 (3.0)
Attended a national, state, or regional mathematics teacher association meeting	10 (1.0)	9 (1.4)	12 (1.6)

† This item was asked of all teachers whether or not they had participated in professional development in the last three years.

The emerging consensus about effective professional development suggests that teachers need opportunities to work with colleagues who face similar challenges, including other teachers from their school and those who have similar teaching assignments. Other recommendations include engaging teachers in challenging mathematics content, both to learn disciplinary content and to experience investigation-oriented learning; to examine student work and other classroom artifacts for evidence of what students do and do not understand; and to apply what they have learned in their classrooms and subsequently discuss how it went.[4] Accordingly, teachers who

[4] Elmore, R. F. (2002). *Bridging the gap between standards and achievement: The imperative for professional development in education.* Washington, DC: Albert Shanker Institute.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915–945.

had participated in professional development in the last three years were asked a series of additional questions about the nature of those experiences.

As can be seen in Table 14, about half of elementary mathematics teachers who have participated in professional development in the last three years have had substantial opportunity to work closely with other teachers from their school and/or grade. Less than half have had substantial opportunities to engage in mathematics investigations, apply what they have learned in their classrooms and then discuss how it went, or examine classroom artifacts.

Table 14
Elementary Mathematics Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent[†]

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Worked closely with other mathematics teachers from your school	54	(2.3)	53	(3.4)	56	(3.5)
Worked closely with other mathematics teachers who taught the same grade and/or subject whether or not they were from your school	49	(2.3)	48	(3.0)	51	(3.5)
Had opportunities to engage in mathematics investigations	46	(2.3)	45	(3.2)	47	(3.5)
Had opportunities to try out what you learned in your classroom and then talk about it as part of the professional development	46	(2.6)	48	(3.8)	44	(3.1)
Had opportunities to examine classroom artifacts (e.g., student work samples)	43	(2.4)	41	(3.3)	46	(3.5)
The professional development was a waste of your time	5	(1.0)	5	(1.4)	6	(1.5)

[†] Includes teachers indicating 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."

College courses have the potential to address content in more depth than may be possible in other professional development venues, such as workshops. As another indicator of the extent to which teachers are staying current in their field, the 2012 National Survey asked teachers when they had last taken a formal course for college credit in both mathematics and how to teach mathematics. As can be seen in Table 15, 45 percent of elementary mathematics teachers have not taken a course for college credit in either mathematics or the teaching of mathematics in the last 10 years.

Table 15
Elementary Mathematics Teachers' Most Recent College Coursework

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Mathematics						
In the last 3 years	12	(1.1)	10	(1.5)	13	(1.6)
4–6 years ago	17	(1.4)	17	(2.0)	18	(1.7)
7–10 years ago	20	(1.3)	21	(1.9)	19	(2.0)
More than 10 years ago	50	(1.7)	51	(2.6)	50	(2.4)
Never	1	(0.3)	1	(0.4)	1	(0.3)
The Teaching of Mathematics						
In the last 3 years	14	(1.3)	11	(1.6)	17	(1.8)
4–6 years ago	17	(1.4)	18	(1.9)	16	(1.9)
7–10 years ago	17	(1.2)	18	(1.6)	17	(1.9)
More than 10 years ago	46	(1.7)	48	(2.6)	44	(2.3)
Never	5	(0.7)	5	(0.9)	6	(1.0)
Mathematics or the Teaching of Mathematics						
In the last 3 years	16	(1.4)	14	(1.8)	19	(1.9)
4–6 years ago	19	(1.3)	20	(2.0)	18	(1.8)
7–10 years ago	19	(1.4)	19	(1.8)	20	(2.0)
More than 10 years ago	45	(1.7)	47	(2.8)	44	(2.3)
Never	1	(0.3)	1	(0.4)	0	(0.2)

Another series of items asked about the focus of the opportunities teachers had to learn about content and the teaching of that content in the last three years, whether through professional development or college coursework. A large proportion of elementary teachers have had professional growth opportunities that gave heavy emphasis to learning how to use hands-on activities/manipulatives for mathematics instruction. Other areas emphasized were planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity; monitoring student understanding during instruction; assessing student understanding at the conclusion of instruction; and implementing particular instructional materials (see Table 16). Relatively few elementary mathematics teachers have had professional growth opportunities with a heavy emphasis on providing alternative experiences for students with special needs or teaching mathematics to English-language learners.

Table 16
Elementary Mathematics Teachers Reporting that their Professional Development/Coursework in the Last Three Years Gave Heavy Emphasis† to Various Areas

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Learning how to use hands-on activities/manipulatives for mathematics instruction	80	(2.3)	83	(3.1)	77	(3.0)
Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	60	(2.8)	66	(4.1)	53	(3.2)
Assessing student understanding at the conclusion of instruction on a topic	58	(2.5)	63	(3.8)	54	(3.3)
Monitoring student understanding during mathematics instruction	57	(2.5)	62	(4.1)	51	(3.0)
Implementing the mathematics textbook/program to be used in your classroom	56	(3.0)	56	(3.4)	55	(4.0)
Learning about difficulties that students may have with particular mathematical ideas and procedures	48	(2.7)	52	(3.9)	45	(3.8)
Deepening your own mathematics content knowledge	43	(2.6)	45	(4.0)	41	(3.8)
Finding out what students think or already know about the key mathematical ideas prior to instruction on those ideas	43	(2.4)	48	(3.7)	37	(3.5)
Providing enrichment experiences for gifted students	37	(3.0)	44	(4.4)	29	(3.4)
Providing alternative mathematics learning experiences for students with special needs	33	(2.6)	38	(3.6)	28	(3.2)
Teaching mathematics to English-language learners	21	(2.3)	26	(3.5)	15	(2.7)

† Includes teachers responding 4 or 5 on a 5-point scale ranging from 1 "Not at all" to 5 "To a great extent."

In addition to asking teachers about their involvement as participants in professional development, the survey asked teachers whether they had served in various leadership roles in the profession in the last three years. As can be seen in Table 17, roughly a third of elementary teachers have supervised a student teacher, but one-tenth or less have served as a mentor/coach, led a teacher study group or workshop, or taught in-service workshops.

Table 17
Elementary Mathematics Teachers Serving in Various Leadership Roles in the Last Three Years

	Percent of Teachers					
	Grades K–5		Grades K–2		Grades 3–5	
Supervised a student teacher	35	(2.3)	34	(2.5)	36	(3.7)
Served as a formally assigned mentor/coach for mathematics teaching	10	(1.5)	10	(1.9)	11	(2.0)
Led a teacher study group focused on mathematics teaching	8	(1.4)	6	(1.6)	11	(2.1)
Taught in-service workshops on mathematics or mathematics teaching	6	(1.2)	4	(1.3)	8	(1.9)

ELEMENTARY SCHOOL MATHEMATICS INSTRUCTION

Each teacher responding to the survey was asked to provide detailed information about his/her mathematics instruction (non-self-contained teachers such as mathematics specialists were asked about 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 class characteristics, teachers' autonomy for making decisions regarding the content and pedagogy of their classes, instructional objectives, time spent, class activities, and homework and assessment practices.

Class Characteristics

The typical elementary mathematics class has 21 students; two-thirds of the classes have between 18 and 26 students. Demographic data for elementary mathematics students are shown Table 18.

Table 18
Demographics of Students in Elementary Mathematics Classes

	Percent of Students		
	Grades K–5	Grades K–2	Grades 3–5
Sex			
Male	53 (0.5)	54 (0.6)	52 (0.7)
Female	47 (0.5)	46 (0.6)	48 (0.7)
Race/Ethnicity			
White	55 (1.6)	54 (1.9)	57 (2.2)
Black or African American	15 (1.4)	14 (1.4)	16 (1.9)
Hispanic or Latino	21 (1.7)	22 (2.1)	19 (2.0)
Asian	3 (0.3)	3 (0.4)	4 (0.5)
American Indian or Alaska Native	1 (0.2)	1 (0.3)	1 (0.2)
Native Hawaiian or Other Pacific Islander	1 (0.2)	1 (0.4)	1 (0.2)
Two or more races	4 (0.3)	4 (0.4)	3 (0.5)

As can be seen in Table 19, students in a majority of elementary mathematics classes appear to be grouped by prior-achievement level. Forty-five percent of classes consist of mixed prior-achievement levels.

Table 19
Prior-Achievement Grouping in Elementary Mathematics Classes

	Percent of Classes			
	Mostly Low Achievers	Mostly Average Achievers	Mostly High Achievers	A Mixture of Levels
Grades K–5	12 (1.0)	34 (1.6)	9 (0.9)	45 (1.5)
Grades K–2	8 (1.4)	37 (2.4)	9 (1.5)	45 (2.3)
Grades 3–5	15 (1.5)	32 (2.1)	9 (1.3)	45 (2.4)

Teachers' Perceptions of Their Decision Making Autonomy

Teachers were asked the extent to which they had control over a number of curriculum and instruction decisions for their classes. In elementary mathematics classes, teachers are more likely to perceive themselves as having strong control over pedagogical decisions such as determining the amount of homework to be assigned, selecting teaching techniques, and choosing criteria for grading student performance (see Table 20). In fewer classes, teachers perceive themselves as having strong control over curriculum decisions such as determining course goals and objectives, selecting what content/skills to teach, and selecting textbooks/programs.

Table 20
Elementary Mathematics Classes in which Teachers Report Having Strong Control over Various Curriculum and Instruction Decisions

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Determining the amount of homework to be assigned	56 (2.6)	57 (2.9)	56 (4.2)
Selecting teaching techniques	44 (2.5)	47 (3.0)	41 (4.2)
Choosing criteria for grading student performance	29 (2.4)	26 (2.6)	32 (3.9)
Determining course goals and objectives	12 (1.5)	12 (2.1)	12 (2.4)
Selecting content, topics, and skills to be taught	8 (1.1)	8 (1.5)	8 (1.7)
Selecting textbooks/programs	3 (0.8)	4 (1.3)	2 (0.8)

These items were combined into two composite variables: Curriculum Control and Pedagogical Control.[5] Composite scores confirm that in elementary mathematics classes, teachers feel much more in control of pedagogical decisions than curriculum decisions (see Table 21).

Table 21
Elementary Mathematics Class Mean Scores for Curriculum Control and Pedagogical Control Composites

	Mean Score		
	Grades K–5	Grades K–2	Grades 3–5
Pedagogical Control	74 (1.1)	73 (1.4)	75 (2.0)
Curriculum Control	29 (1.2)	28 (1.7)	29 (1.7)

Instructional Objectives

Teachers were given a list of potential objectives and asked to rate each in terms of the emphasis they receive in the mathematics class. As can be seen in Table 22, 69 percent of elementary mathematics classes focus heavily on understanding mathematical ideas. About half of grade K–5 classes are likely to emphasize learning mathematical practices and increasing students' interest in mathematics. Learning mathematical algorithms/procedures and learning test taking skills/strategies are heavily emphasized in less than half the grade K–5 mathematics classes;

[5] The body of this report includes data on selected composite variables. Data for all composite variables are available in the Appendix.

given that most accountability systems begin at 3rd grade, it is not surprising that a larger percentage of classes in grades 3–5 focus on each of these objectives than do classes in grades K–2.

Table 22
Elementary Mathematics Classes with
Heavy Emphasis on Various Instructional Objectives

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Understanding mathematical ideas	69 (1.4)	69 (2.2)	69 (2.0)
Learning mathematical practices (e.g., considering how to approach a problem, justifying solutions)	51 (1.5)	46 (2.2)	56 (2.1)
Increasing students' interest in mathematics	50 (1.7)	53 (2.3)	47 (2.5)
Preparing for further study in mathematics	47 (1.9)	49 (2.4)	45 (2.4)
Learning about real-life applications of mathematics	45 (1.7)	43 (2.2)	47 (2.6)
Learning mathematical procedures and/or algorithms	44 (1.9)	39 (2.5)	50 (2.7)
Learning test taking skills/strategies	37 (1.5)	27 (2.0)	46 (2.4)
Learning to perform computations with speed and accuracy	36 (1.9)	35 (2.3)	36 (2.3)

Time Spent

The survey asked self-contained elementary teachers to provide information about the frequency of their mathematics instruction. As can be seen in Table 23, mathematics is taught on most or all days in nearly all classes at the elementary grades.

Table 23
Frequency with which Self-Contained
Elementary Classes Receive Mathematics Instruction

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
All/Most days, every week	99 (0.5)	99 (0.5)	99 (0.6)
Three or fewer days, every week	1 (0.3)	1 (0.4)	1 (0.5)
Some weeks, but not every week	0 (0.2)	1 (0.3)	0 (0.3)

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

The average number of minutes per day typically spent on instruction in reading/language arts, mathematics, science, and social studies is shown in Table 24. 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 2012, grade K–5 self-contained classes spent an average of 55 minutes per day on mathematics instruction, compared to 88 minutes on reading/language arts and only 20 minutes on science. The average number of minutes spent on mathematics instruction was significantly greater in the intermediate grades than in the primary grades, with an average of 60 minutes in grades 3–5 and 52 minutes in grades K–2. Over a school year, this equates to approximately 24 additional hours of mathematics instruction in the higher grades.

Table 24
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	88	(1.3)	90	(2.0)	84	(1.8)
Mathematics	55	(0.8)	52	(1.1)	60	(1.0)
Science	20	(0.4)	18	(0.5)	22	(0.7)
Social Studies	17	(0.4)	16	(0.5)	19	(0.6)

[†] 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 2012 National Survey included several items that provide information about how mathematics is taught at the elementary school level. One series of items listed various instructional strategies and asked teachers to indicate the frequency with which they used each in their mathematics class. As can be seen in Table 25, the vast majority of elementary mathematics classes include the teacher explaining mathematical ideas and whole class discussions on a weekly basis. Having students explain and justify their method for solving a problem, a practice consistent with the "Standards for Mathematical Practice" in the *Common Core Standards for Mathematics,* is also a prevalent weekly occurrence in elementary mathematics classes. Consistent with other survey data, the influence of accountability systems is evident in the types of class activities that occur, especially in grades 3–5. For example having students practice for standardized tests, and take tests and/or quizzes that include constructed-response/open-ended items is more common in intermediate grades, whereas the use of manipulatives is more common in primary grades. It is somewhat striking that, in contrast to what is known from learning theory about the importance of reflection, only about 1 in 4 elementary mathematics classes have students write reflections on what they are learning.

Table 25
Elementary Mathematics Classes in which
Teachers Report Using Various Activities at Least Once a Week

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Explain mathematical ideas to the whole class	97 (0.5)	98 (0.5)	96 (0.8)
Engage the whole class in discussions	96 (0.8)	96 (0.9)	95 (1.0)
Have students explain and justify their method for solving a problem	88 (1.0)	84 (1.5)	91 (1.5)
Have students work in small groups	85 (1.2)	86 (1.4)	84 (1.9)
Provide manipulatives for students to use in problem-solving/ investigations	82 (1.2)	93 (1.0)	71 (2.1)
Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)	78 (1.3)	73 (2.0)	82 (1.7)
Have students compare and contrast different methods for solving a problem	66 (1.6)	61 (2.5)	71 (2.2)
Have students present their solution strategies to the rest of the class	64 (1.5)	60 (2.1)	68 (2.1)
Give tests and/or quizzes that are predominantly short-answer (e.g., multiple choice, true/false, fill in the blank)	47 (1.8)	43 (2.4)	52 (2.3)
Have students read from a mathematics textbook/program or other mathematics-related material in class, either aloud or to themselves	41 (1.8)	39 (2.1)	43 (2.6)
Focus on literacy skills (e.g., informational reading or writing strategies)	40 (2.0)	42 (2.7)	38 (2.6)
Give tests and/or quizzes that include constructed-response/open-ended items	39 (1.9)	29 (2.1)	48 (2.7)
Have students practice for standardized tests	31 (1.6)	20 (2.1)	41 (2.5)
Have students develop mathematical proofs	30 (1.7)	29 (2.4)	32 (2.4)
Have students write their reflections (e.g., in their journals) in class or for homework	26 (1.7)	23 (2.3)	29 (2.6)
Have students attend presentations by guest speakers focused on mathematics in the workplace	3 (0.7)	2 (0.7)	3 (1.0)

Overall, elementary mathematics classes utilize the Internet more than any other instructional technology (see Table 26). Four-function calculators are more likely to be used on a weekly basis in grade 3–5 mathematics classes than in grade K–2 classes (21 percent vs. 4 percent).

Table 26
Elementary Mathematics Classes in which Teachers Report that Students Use Various Instructional Technologies at Least Once a Week

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Internet	43 (2.4)	42 (3.4)	44 (3.2)
Personal computers, including laptops	36 (2.5)	34 (3.3)	38 (3.2)
Four-function calculators	13 (1.7)	4 (1.3)	21 (2.9)
Hand-held computers	5 (1.1)	4 (1.1)	7 (2.1)
Classroom response system or "Clickers"	4 (1.3)	2 (0.9)	7 (2.4)
Scientific calculators	4 (1.3)	0 (0.4)	7 (2.3)
Probes for collecting data	0 (0.3)	0 (0.3)	1 (0.4)
Graphing calculators	0 (0.0)	0 (0.1)	0 ---[†]

[†] No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Two composite variables were created from the class activities items: "use of reform-oriented teaching practices" (e.g., have students solve problems and consider multiple representations and explain and justify their method) and "use of technology." As can be seen in Table 27, reform-oriented practices are commonly used in elementary mathematics classes; however the use of technology is generally low. In both cases, these practices are more likely used in grade 3–5 classes than grade K–2 classes.

Table 27
Elementary Mathematics Class Mean Scores for the Teaching Practice Composites

	Mean Score		
	Grades K–5	Grades K–2	Grades 3–5
Use of Reform-Oriented Teaching Practices	75 (0.6)	72 (0.9)	77 (0.8)
Use of Instructional Technology	33 (1.1)	31 (1.5)	35 (1.3)

In addition to asking about class activities across the entire school year, the 2012 National Survey asked teachers about activities that took place during their most recent mathematics lesson. With only a few exceptions, the frequency of activities in grades K–2 and 3–5 is fairly similar. For example, most primary and intermediate mathematics lessons include the explanation of a mathematical idea and whole class discussion (see Table 28). Having students complete textbook/worksheet problems is also prevalent, occurring in 4 out of 5 mathematics lessons. Grade K–2 and 3–5 classes differ in the use of hands-on/manipulative activities. At the primary level, 86 percent of lessons include students doing hands-on/manipulative activities compared to 68 percent of intermediate lessons. In contrast, grade 3–5 mathematics lessons are more likely than their primary counterparts to have students practice for standardized tests.

Table 28
Elementary Mathematics Classes
Participating in Various Activities in the Most Recent Lesson

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Teacher explaining a mathematical idea to the whole class	93	(0.9)	94	(1.2)	92	(1.3)
Whole class discussion	89	(1.1)	90	(1.4)	88	(1.8)
Students completing textbook/worksheet problems	80	(1.5)	81	(1.7)	78	(2.3)
Students doing hands-on/manipulative activities	77	(1.4)	86	(1.7)	68	(2.3)
Teacher conducting a demonstration while students watched	75	(1.5)	79	(1.9)	70	(2.3)
Students using instructional technology	29	(1.7)	29	(2.5)	30	(2.5)
Students reading about mathematics	19	(1.3)	14	(1.8)	24	(2.0)
Test or quiz	19	(1.3)	19	(1.9)	19	(2.0)
Practicing for standardized tests	14	(1.3)	9	(1.3)	20	(2.2)

The survey also asked teachers to estimate the time spent on each of a number of types of activities in this most recent mathematics lesson. On average, there is little difference between primary and intermediate mathematics classes (see Table 29). Forty percent of class time is spent on whole class activities, 29 percent on small group work, and 26 percent on students working individually. Non-instructional activities, including attendance taking and interruptions, account for 6 percent of mathematics class time.

Table 29
Average Percentage of Time Spent on Different
Activities in the Most Recent Elementary Mathematics Lesson

	Average Percent of Class Time					
	Grades K–5		Grades K–2		Grades 3–5	
Whole class activities (e.g., lectures, explanations, discussions)	40	(0.7)	40	(0.8)	39	(0.9)
Small group work	29	(0.8)	29	(0.9)	29	(1.1)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	26	(0.6)	25	(0.7)	26	(0.9)
Non-instructional activities (e.g., attendance taking, interruptions)	6	(0.3)	5	(0.4)	6	(0.4)

Homework and Assessment Practices

Teachers were asked about the amount of mathematics homework assigned per week in their class. As can be seen in Table 30, most K–5 elementary classes are assigned 60 minutes or less of homework per week. However, the amount of time students are asked to spend on mathematics homework increases with grade range as 46 percent of grade 3–5 classes are assigned more than one hour of homework each week, compared to 13 percent of grade K–2 classes.

Table 30
Amount of Homework Assigned in Elementary Mathematics Classes per Week

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Fewer than 15 minutes per week	16 (1.9)	29 (3.1)	5 (1.7)
15–30 minutes per week	19 (2.0)	28 (2.9)	11 (2.2)
31–60 minutes per week	35 (2.6)	30 (3.0)	39 (3.7)
61–90 minutes per week	17 (1.8)	9 (1.7)	25 (3.0)
91–120 minutes per week	9 (1.3)	4 (1.6)	14 (2.1)
More than 120 minutes per week	4 (0.9)	0 (0.3)	7 (1.7)

Teachers were also given a list of ways that they might assess student progress and asked to describe which practices they used in the most recently completed mathematics unit. These data are shown in Table 31. The vast majority of elementary mathematics classes included informal assessment practices during the unit to see if students were "getting it." For example, 97 percent of elementary mathematics classes involved the teacher questioning students during activities to monitor understanding. Reviewing student work and using informal assessment techniques were also common practices used K–5 mathematics classes.

In addition, the use of formal assessment techniques such as assigning grades to student work, quizzes, and tests were also prevalent features of mathematics units, especially in the upper elementary grades. Teachers in roughly 8 out of 10 grade 3–5 mathematics classes administered a test or quiz to assign grades and assigned grades to student work; these practices are less common in primary grades mathematics classes.

Table 31
Elementary Mathematics Classes in which Teachers Report Assessing Students Using Various Methods in the Most Recent Unit

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Questioned individual students during class activities to see if they were "getting it"	97 (0.6)	97 (0.8)	97 (0.8)
Reviewed student work (e.g., homework, notebooks, journals, portfolios, projects) to see if they were "getting it"	96 (0.7)	95 (0.9)	97 (0.8)
Used information from informal assessments of the entire class (e.g., asking for a show of hands, thumbs up/thumbs down, clickers, exit tickets) to see if students were "getting it"	90 (1.1)	90 (1.4)	91 (1.5)
Went over the correct answers to assignments, quizzes, and/or tests with the class as a whole	83 (1.2)	76 (1.7)	90 (1.7)
Administered one or more quizzes and/or tests to assign grades	73 (1.6)	66 (2.1)	80 (2.5)
Administered one or more quizzes and/or tests to see if students were "getting it"	73 (1.7)	67 (2.2)	79 (2.7)
Assigned grades to student work (e.g., homework, notebooks, journals, portfolios, projects)	63 (1.9)	50 (2.8)	75 (2.4)
Administered an assessment, task, or probe at the beginning of the unit to find out what students thought or already knew about the key mathematical ideas	63 (1.8)	62 (2.1)	64 (2.6)
Had students use rubrics to examine their own or their classmates' work	10 (1.1)	6 (1.0)	14 (2.0)

The survey asked how often students in the mathematics class were required to take assessments the teachers did not develop, such as state or district benchmark assessments. Given the increased emphasis on high stakes assessments, a result of the 2001 No Child Left Behind Act, it is not surprising that 91 percent of all elementary mathematics classes, and 99 percent of grade 3–5 classes, are required to take such an assessment at least once a year (see Table 32).

Table 32
Frequency of Required External Testing in Elementary Mathematics Classes

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Never	9 (0.9)	19 (1.8)	1 (0.3)
Once a year	14 (1.3)	13 (1.7)	14 (1.9)
Twice a year	8 (0.9)	10 (1.6)	5 (1.1)
Three or four times a year	38 (1.7)	32 (2.4)	44 (2.5)
Five or more times a year	31 (1.7)	26 (2.2)	36 (2.8)

RESOURCES AVAILABLE FOR ELEMENTARY SCHOOL MATHEMATICS INSTRUCTION

Instructional Materials

The 2012 National Survey collected data on the use of instructional materials in elementary mathematics classes. Eighty-five percent of grade K–5 mathematics classes are using commercially published textbooks/programs (see Table 33).

Table 33
Elementary Mathematics Classes Using Commercially Published Instructional Materials

	Percent of Classes
Grades K–5	85 (1.5)
Grades K–2	84 (1.9)
Grades 3–5	86 (2.0)

The survey also asked if one textbook/program is used all or most of the time, or if multiple materials are used. Most grade K–5 mathematics classes tend to use a single textbook/program (see Table 34).

Table 34
Instructional Materials Used in Elementary Mathematics Classes

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
One commercially published textbook or program most of the time	62 (2.3)	65 (2.5)	59 (3.2)
Multiple commercially published textbooks/programs most of the time	23 (1.6)	20 (2.1)	27 (2.7)
Non-commercially published instructional materials most of the time	15 (1.5)	16 (1.9)	14 (2.0)

Teachers who indicated that they used commercially published materials were asked to record the title, author, year, and ISBN of the material used most often in the class. Using this information, the publisher of the material was identified. The most commonly used elementary mathematics materials are *EnVision Math* (Pearson) and *Everyday Mathematics* (McGraw-Hill).

Since the 1990's, the National Science Foundation (NSF) has funded the development of mathematics instructional materials. Using title and publisher information, each textbook/ program listed by teachers was coded as having been developed with NSF funding or not. A quarter of elementary classes use materials developed with NSF support for instruction.

Table 35 shows the publication year of commercially published instructional materials used in elementary mathematics classes. In 2012, 82 percent of elementary classes using commercially published materials were using ones published in 2007 or later.

Table 35
Publication Year of
Instructional Materials in Elementary Mathematics Classes

	Percent of Classes†		
	Grades K–5	Grades K–2	Grades 3–5
2006 or earlier	18 (2.3)	20 (2.7)	17 (2.6)
2007–09	52 (2.5)	50 (2.9)	53 (3.2)
2010–12	30 (2.4)	30 (3.2)	30 (3.2)

† Only classes using commercially published textbooks/programs were included in these analyses.

It is interesting to note that while national experts in science and mathematics education are often critical of textbook quality,[6] most elementary mathematics teachers consider their instructional materials to be of relatively high quality, as those in over three-fourths of grade K–5 classes using commercially published materials rated them as good or better (see Table 36).

[6] For example, American Association for the Advancement of Science (2000). *Middle grades mathematics textbooks: A benchmarks-based evaluation.* Washington, DC: American Association for the Advancement of Science.

Table 36
Perceived Quality of
Instructional Materials Used in Elementary Mathematics Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
Very Poor	1	(0.6)	2	(1.1)	1	(0.6)
Poor	3	(0.9)	3	(1.3)	4	(1.3)
Fair	20	(2.4)	18	(2.8)	21	(3.6)
Good	38	(2.5)	41	(3.4)	34	(4.2)
Very Good	30	(2.5)	29	(3.1)	30	(3.8)
Excellent	9	(1.4)	7	(1.8)	10	(2.1)

† Only classes using commercially published textbooks/programs were included in these analyses.

Over 80 percent of elementary school mathematics classes using commercially published instructional materials cover 75 percent or more (see Table 37) and spend more than half of their instructional time using the materials (see Table 38).

Table 37
Percentage of Instructional Materials
Covered in Elementary Mathematics Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
Less than 25 percent	2	(0.8)	1	(0.8)	2	(1.3)
25–49 percent	5	(1.3)	4	(1.6)	6	(2.3)
50–74 percent	13	(1.8)	9	(2.0)	17	(3.4)
75 percent or more	81	(2.4)	86	(2.6)	75	(4.2)

† Only classes using commercially published textbooks/programs were included in these analyses.

Table 38
Percentage of Instructional Time Spent Using
Instructional Materials in Elementary Mathematics Classes

	Percent of Classes†					
	Grades K–5		Grades K–2		Grades 3–5	
Less than 25 percent	4	(1.2)	4	(1.4)	4	(1.8)
25–49 percent	12	(2.3)	10	(2.6)	13	(3.0)
50–74 percent	20	(2.6)	22	(3.4)	18	(3.8)
75 percent or more	64	(3.4)	64	(4.1)	64	(4.6)

† Only classes using commercially published textbooks/programs were included in these analyses.

A similar story emerges from responses to questions asking teachers to describe how they used their textbook/program in their most recent unit. As can be seen in Table 39, textbooks heavily influence K–5 mathematics instruction. Teachers in 81 percent of elementary mathematics classes using commercially published materials use the textbook/program to guide the overall structure and content emphasis in their most recent unit. It is also clear that elementary mathematics teachers deviate from their textbooks substantially when designing instruction. Teachers in more than half of these K–5 mathematics classes incorporate activities from other sources substantially.

Table 39
Ways Elementary Mathematics Teachers
Substantially[†] Used their Instructional Materials in the Most Recent Unit

	Percent of Classes[‡]		
	Grades K–5	Grades K–2	Grades 3–5
Used the textbook/program to guide the overall structure and content emphasis of the unit	81 (1.6)	84 (1.7)	78 (2.5)
Followed the textbook/program to guide the detailed structure and content emphasis of the unit	74 (2.0)	78 (2.2)	70 (2.9)
Incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/program was lacking	62 (2.1)	59 (2.8)	66 (3.0)
Picked what is important from the textbook/program and skipped the rest	43 (2.0)	38 (2.6)	48 (3.2)

[†] Includes those responding 4 or 5 on a 5-point scale ranging from 1 "not at all" to 5 "to a great extent."
[‡] Only classes using commercially published textbooks/programs in the most recent unit were included in these analyses.

Teachers in nearly all elementary mathematics classes that supplement their textbook/program do so to differentiate instruction for students at different achievement levels and provide students with additional practice (see Table 40). Once again, the influence of standardized testing in the upper elementary grades is evident; intermediate grades classes are more likely than primary grades classes to use supplemental activities for test preparation purposes (77 percent and 53 percent, respectively).

Table 40
Reasons Why Elementary
Mathematics Instructional Materials Are Supplemented

	Percent of Classes[†]		
	Grades K–5	Grades K–2	Grades 3–5
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity	96 (1.0)	96 (1.6)	97 (1.5)
Supplemental activities were needed to provide students with additional practice	95 (1.5)	94 (2.2)	96 (1.7)
Supplemental activities were needed to prepare students for standardized tests	65 (2.7)	53 (4.3)	77 (4.0)
Your pacing guide indicated that you should use supplemental activities	49 (3.2)	52 (3.8)	45 (4.7)

[†] Only classes using commercially published textbooks/programs in the most recent unit and whose teachers reported supplementing some activities were included in these analyses.

Teachers were also asked why they skipped parts of their textbook/program. As can be seen in Table 41, teachers in over 70 percent of elementary mathematics classes that skip activities do so because they have other ones that work better or because students already knew the content. Teachers of intermediate grades classes were more likely than their primary counterparts to skip activities because the ideas are not in their pacing guides/state standards. This finding both

speaks to the prevalence of pacing guides and suggests that supplementing is commonly prescribed by schools/districts, especially in the upper elementary grades.

Table 41
Reasons Why Parts of the Elementary Mathematics Instructional Materials Are Skipped

	Percent of Classes[†]					
	Grades K–5		Grades K–2		Grades 3–5	
You have different activities for those mathematical ideas that work better than the ones you skipped	78	(2.5)	84	(3.3)	73	(3.7)
Your students already knew the mathematical ideas or were able to learn them without the activities you skipped	71	(2.9)	74	(4.2)	68	(4.4)
The mathematical ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	68	(2.9)	56	(4.5)	78	(3.6)
The activities you skipped were too difficult for your students	31	(3.3)	32	(4.7)	30	(4.1)
You did not have the materials needed to implement the activities you skipped	29	(2.9)	27	(4.2)	32	(4.3)

[†] Only classes using commercially published textbooks/programs in the most recent unit and whose teachers reported skipping some activities were included in these analyses.

Facilities and Equipment

Teachers were presented with a list of instructional technologies and asked about their availability in their mathematics class. The three response options were:

- Do not have one per group available;
- At least one per group available upon request or in another room; and
- At least one per group located in your classroom.

As can be seen in Table 42, Internet access (80 percent), personal computers (68 percent), and four-function calculators (58 percent) are the most widely available instructional technologies in grade K–5 mathematics classes.

Table 42
Availability[†] of Instructional Technologies in Elementary Mathematics Classes

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Internet access	80	(1.9)	79	(2.4)	81	(2.8)
Personal computers, including laptops	68	(2.5)	65	(3.4)	70	(3.0)
Four-function calculators	58	(3.0)	49	(3.8)	67	(3.6)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	39	(2.6)	27	(2.7)	51	(4.1)
Probes for collecting data (e.g., motion sensors, temperature probes)	19	(2.0)	16	(2.4)	21	(3.3)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	17	(2.2)	14	(2.2)	20	(3.6)
Scientific calculators	16	(2.2)	9	(2.2)	23	(3.2)
Graphing calculators	11	(1.9)	7	(1.6)	15	(3.2)

[†] Includes only those rating the availability as at least one per group available, either in the classroom, upon request, or in another room.

When asked about the adequacy of resources for instruction, teachers in 57–82 percent of elementary mathematics classes rated their manipulatives, measurement tools, and consumable supplies as adequate (see Table 43). Teachers in half of elementary classes rated their instructional technology as adequate.

Table 43
Elementary Mathematics Classes with Adequate† Resources for Instruction

	Percent of Classes					
	Grades K–5		Grades K–2		Grades 3–5	
Manipulatives (e.g., pattern blocks, algebra tiles)	82	(1.8)	87	(1.9)	76	(2.6)
Measurement tools (e.g., protractors, rulers)	67	(1.9)	66	(2.5)	68	(2.6)
Consumable supplies (e.g., graphing paper, batteries)	57	(1.8)	59	(2.4)	56	(2.7)
Instructional technology (e.g., calculators, computers, probes/sensors)	50	(2.1)	50	(2.5)	49	(3.0)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "not adequate" to 5 "adequate."

FACTORS AFFECTING ELEMENTARY SCHOOL MATHEMATICS INSTRUCTION

Teachers were asked about factors that affect instruction in their elementary mathematics class. As can be seen in Table 44, in the majority of elementary mathematics classes, teachers think that most of the factors promote effective instruction, including principal support; students' motivation, interest, and effort in mathematics; and district/diocese curriculum frameworks. At the primary level, more so than the intermediate level, time available to plan individually and with colleagues and attend professional development are also seen as factors promoting effective instruction. Community views on mathematics instruction are seen as promoting effective instruction in a less than half of elementary mathematics classes.

Table 44
Factors Promoting† Effective Instruction in Elementary Mathematics Classes

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Principal support	82 (1.8)	83 (2.5)	81 (2.7)
Students' motivation, interest, and effort in mathematics	78 (2.2)	83 (2.9)	74 (2.9)
District/Diocese curriculum frameworks	76 (2.2)	80 (2.9)	73 (3.2)
Current state standards	75 (2.5)	80 (3.1)	71 (3.2)
District/Diocese/School pacing guides	69 (2.3)	73 (3.1)	66 (3.3)
Time for you to plan, individually and with colleagues	66 (2.3)	72 (3.0)	60 (3.4)
Time available for your professional development	63 (2.3)	70 (2.9)	58 (3.3)
Students' reading abilities	61 (2.7)	63 (3.8)	58 (3.7)
Teacher evaluation policies	60 (2.5)	68 (2.8)	52 (3.9)
District/Diocese testing/accountability policies	59 (2.6)	63 (3.3)	56 (3.1)
Parent expectations and involvement	59 (2.8)	65 (3.3)	53 (4.2)
Textbook/program selection policies	58 (2.6)	59 (3.2)	57 (3.5)
State testing/accountability policies	52 (2.6)	55 (3.2)	49 (3.2)
Community views on mathematics instruction	48 (2.6)	51 (3.7)	44 (3.9)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."
‡ Item presented only to public and catholic school teachers.

The teacher survey also included a series of items about technology-related issues. Teachers were asked to indicate how great a problem each posed for instruction in their mathematics class. As can be seen in Table 45, these resources are generally not seen as problematic in elementary mathematics classes.

Table 45
Extent to which Technology Quality Is a Serious Problem for Instruction in Elementary Mathematics Classes

	Percent of Classes		
	Grades K–5	Grades K–2	Grades 3–5
Old age of computers	18 (2.0)	18 (2.3)	18 (2.9)
Lack of access to computers	13 (1.7)	12 (2.1)	14 (2.4)
Lack of availability of technology support	11 (1.7)	9 (1.9)	12 (2.8)
Lack of availability of appropriate computer software	10 (1.4)	9 (2.1)	12 (2.1)
Slow speed of the Internet connection	10 (1.4)	8 (1.8)	11 (1.8)
Unreliability of the Internet connection	6 (1.2)	6 (1.6)	6 (1.5)
Lack of access to the Internet	6 (1.0)	5 (1.3)	6 (1.6)

Composites from these two series of questionnaire items were created to summarize the extent to which various factors support effective instruction. The means are shown in Table 46. Overall, these data indicate that the climate is generally supportive for elementary mathematics instruction, though slightly more so in primary grade classes than intermediate grade classes.

Table 46
Class Mean Scores on Factors Affecting Instruction Composites

	Mean Score		
	Grades K–5	Grades K–2	Grades 3–5
Extent to which the Policy Environment Promotes Effective Instruction	72 (1.2)	76 (1.3)	69 (1.7)
Extent to which Stakeholders Promote Effective Instruction	71 (1.3)	74 (1.5)	68 (1.9)
Extent to which School Support Promotes Effective Instruction	71 (1.4)	76 (1.8)	67 (2.2)
Extent to which IT Quality is Problematic for Instruction	24 (1.2)	22 (1.7)	26 (1.7)

SUMMARY

Nearly all elementary mathematics teachers are white, and fewer than 1 in 10 are male. Only 4 percent have a degree in mathematics or the teaching of mathematics, and 10 percent have taken each of the five college mathematics courses recommended by the NCTM. Despite their lack of strong mathematics preparation, the majority of elementary mathematics teachers feel very well prepared to teach fundamental topics such as number and operations, and measurement and data representation. In addition, although elementary mathematics teachers hold a number of beliefs about teaching and learning that are in alignment with what is known about effective mathematics instruction (e.g., most class periods should provide opportunities for students to share their thinking and reasoning), they also hold views that are inconsistent with this research. For example, 9 out of 10 elementary mathematics teachers believe that students should be provided with definitions for new vocabulary at the beginning of instruction on an idea.

Asked about their professional development experiences, the vast majority of elementary mathematics teachers have participated in mathematics-focused professional development in the last three years. However, only about 1 in 10 have had sustained professional development (more than 35 hours) in that time period. Roughly half reported that their professional development in the last three years included opportunities reflective of effective professional development, such as working closely with other mathematics teachers and engaging in mathematics investigations. Less than a third reported their professional development gave a heavy emphasis to providing alternative mathematics learning experiences for students with special needs or teaching mathematics to English-language learners, which may explain why only a small proportion of elementary teachers feel very well prepared to teach mathematics to students with learning disabilities, English-language learners, or students with physical disabilities.

Elementary mathematics teachers feel much more in control of pedagogical decisions, such as determining the amount of homework to be assigned, than curriculum decisions, such as determining course goals and objectives. Data on instruction indicate that elementary mathematics instruction relies heavily on the explanation of ideas and whole group discussion, with students often completing textbook/worksheet problems. However, the data also indicate that students are engaged in practices consistent with the *Common Core State Standards for Mathematics,* such as explaining and justifying methods for solving a problem. The influence of high-stakes assessments on mathematics instruction is also evident, especially in the intermediate grades. For example, a larger percentage of grade 3–5 classes than grade K–2 classes tend to focus on learning test-taking skills/strategies, and are more likely to have students practice taking

standardized tests. In contrast, the use of hands-on/manipulative activities is more prevalent in primary mathematics classes.

Over 80 percent of elementary mathematics classes use commercially published instructional materials and rely heavily on them during instructional time. However, the data also suggest that that K–5 mathematics teachers deviate from their textbooks by supplementing or skipping parts of the instructional materials. Common reasons for supplementing materials include being able to differentiate instruction for students of different achievement levels, providing students with additional practice, and test preparation.

Teachers in over half of elementary mathematics classes rated their instructional resources (e.g., manipulatives, measurement tools, and consumable supplies) as adequate. Internet access, personal computers, and four-function calculators are the most widely available instructional technologies in grades K–5 mathematics classes.

APPENDIX

Table A-1
Teacher Mean Scores for Composites

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Perceptions of Preparedness to Encourage Students' Interest in Mathematics	79	(1.0)	81	(1.4)	77	(1.5)
Perceptions of Preparedness to Teach Students from Diverse Backgrounds	59	(1.0)	62	(1.4)	56	(1.3)
Quality of Professional Development	62	(1.5)	62	(1.5)	62	(1.3)
Extent to which PD/Coursework Focused on Student-Centered Instruction	57	(1.2)	60	(1.7)	53	(1.3)

Table A-2
Class Mean Scores for Composites

	Mean Score					
	Grades K–5		Grades K–2		Grades 3–5	
Perceptions of Preparedness to Implement Instruction in Particular Unit	83	(0.6)	85	(0.8)	82	(0.8)
Curriculum Control	29	(1.2)	28	(1.7)	29	(1.7)
Pedagogical Control	74	(1.1)	73	(1.4)	75	(2.0)
Reform-Oriented Instructional Objectives	81	(0.5)	81	(0.7)	81	(0.7)
Use of Reform-Oriented Teaching Practices	75	(0.6)	72	(0.9)	77	(0.8)
Use of Instructional Technology	33	(1.1)	31	(1.5)	35	(1.3)
Adequacy of Resources for Instruction	70	(0.9)	71	(1.0)	69	(1.4)
Extent to which Stakeholders Promote Effective Instruction	71	(1.3)	74	(1.5)	68	(1.9)
Extent to which the Policy Environment Promotes Effective Instruction	72	(1.2)	76	(1.3)	69	(1.7)
Extent to which School Support Promotes Effective Instruction	71	(1.4)	76	(1.8)	67	(2.2)
Extent to which IT Quality is Problematic for Instruction	24	(1.2)	22	(1.7)	26	(1.7)