CHAPTER SIX

Instructional Resources

Overview

The quality and availability of instructional resources is a major factor in science and mathematics teaching. The 2012 National Survey of Science and Mathematics Education included a series of items on science and mathematics textbooks/programs—which ones were being used, how teachers used their textbooks, and teachers' perceptions of textbook quality. Teachers were also asked about the availability and use of a number of other instructional resources, including various types of calculators, computers, and Internet capabilities. These results are presented in the following sections.

Textbook Usage

The 2012 National Survey collected data on the use of commercially published textbooks or programs in science and mathematics classes. As can be seen in Table 6.1, more than three-fourths of middle and high school science classes and elementary, middle, and high school mathematics classes use published textbooks/programs. Use of textbooks/programs is somewhat less common, however, in elementary science classes (69 percent).

Table 6.1
Classes Using Commercially Published Textbooks/Programs, by Subject

	Percent of Classes	
	Science	**Mathematics**
Elementary School	69 (2.1)	85 (1.5)
Middle School	80 (1.9)	81 (1.8)
High School	77 (1.2)	81 (1.0)

The survey also asked how if one textbook/program is used all or most of the time, or if multiple materials are used (see Tables 6.2 and 6.3). The percentage of mathematics classes using one or more commercially published materials is strikingly similar across grade ranges (81–85 percent). Most of these classes rely on a single textbook/program.

Table 6.2
Instructional Materials Used in Mathematics Classes,† by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
One commercially published textbook or program most of the time	62	(2.2)	55	(2.4)	65	(1.4)
Multiple commercially published textbooks/programs most of the time	23	(1.6)	27	(2.1)	16	(0.9)
Non-commercially published instructional materials most of the time	15	(1.5)	19	(1.8)	19	(1.0)

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

Science instructional materials tend to be more diverse in format than mathematics materials. For that reason, teachers were presented with different options to describe the materials used in science classes. The data in Table 6.3 show some sharp contrasts among grade ranges. For example, high school science classes are much more likely than elementary and middle school classes to use a textbook rather than modules. Also noticeable is the relatively heavy use of non-commercially published materials in elementary school science classes, compared to science instruction in later grades, and compared to mathematics instruction in elementary grades (see Table 6.2). Overall, much science instruction in grades K–12 (particularly in elementary and middle grades) appears to be pulled together from multiple sources, more so than in mathematics instruction.

Table 6.3
Instructional Materials Used in Science Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Mainly commercially published textbook(s)						
One textbook	26	(2.0)	34	(2.3)	52	(1.7)
Multiple textbooks	5	(0.8)	11	(1.0)	7	(0.7)
Mainly commercially published modules						
Modules from a single publisher	12	(1.5)	11	(1.9)	2	(0.4)
Modules from multiple publishers	4	(1.0)	3	(0.7)	2	(0.4)
Other						
A roughly equal mix of commercially published textbooks and commercially published modules most of the time	22	(1.7)	20	(2.0)	15	(1.2)
Non-commercially published materials most of the time	31	(2.1)	20	(1.9)	23	(1.2)

Teachers who indicated that the randomly selected class used a published textbook/program 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. Table 6.4 shows the market share held by each of the major science and mathematics textbook publishers. It is interesting to note that three publishers—Houghton Mifflin Harcourt, McGraw-Hill, and Pearson—account for instructional materials used in more than three-fourths of science and mathematics classes. In elementary and middle school mathematics, these three publishers alone account for the materials used in 95 percent or more of classes. The only other publisher with a substantial share of the market is Delta Education in elementary science.

Table 6.4
Market Share of Commercial Textbook Publishers†, by Subject and Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Science						
Pearson	15	(2.4)	31	(2.9)	43	(2.2)
Houghton Mifflin Harcourt	47	(3.4)	33	(2.9)	22	(1.5)
McGraw-Hill	16	(2.4)	25	(2.6)	18	(1.3)
Cengage Learning	0	---‡	0	(0.2)	6	(0.8)
Delta Education	11	(1.9)	1	(0.7)	1	(0.2)
Carolina Biological Supply Company	2	(0.8)	2	(0.6)	0	---‡
Lab-Aids	0	---‡	2	(1.6)	0	(0.0)
National Geographic Society	4	(1.8)	0	(0.2)	0	---‡
Mathematics						
Houghton Mifflin Harcourt	35	(2.7)	41	(3.2)	35	(1.6)
Pearson	33	(3.0)	26	(2.5)	30	(2.0)
McGraw-Hill	29	(2.5)	28	(2.8)	18	(1.6)
Cengage Learning	0	---‡	0	---‡	9	(1.0)
W. H. Freeman	0	---‡	0	---‡	2	(0.6)

† Only publishers with two percent or more of the market share in any grade range are included in this table.
‡ No teachers at this grade level in the sample reported using materials from this publisher. Thus, it is not possible to calculate the standard error of this estimate.

Tables 6.5 and 6.6 list the most commonly used science and mathematics textbooks in each grade range; secondary textbooks are shown by course type, as well.

Table 6.5
Most Commonly Used Science Textbooks, by Grade Range and Course

	Publisher	**Title**
Elementary		
Elementary Science	Houghton Mifflin Harcourt	*Harcourt Science*
	Pearson	*Scott Foresman Science*
Middle		
Life Science	Houghton Mifflin Harcourt	*Life Science*
	McGraw-Hill	*Life Science*
Earth Science	Pearson	*Earth Science*
	Houghton Mifflin Harcourt	*Earth Science*
Physical Science	Houghton Mifflin Harcourt	*Physical Science*
	Pearson	*Focus on Physical Science*
General/Integrated Science	McGraw-Hill	*Glencoe Science*
	Houghton Mifflin Harcourt	*Holt Science & Technology*
High		
Biology	Pearson	*Biology*
	Houghton Mifflin Harcourt	*Biology*
Earth Science	Houghton Mifflin Harcourt	*Earth Science*
	Pearson	*Earth Science*
Chemistry	Pearson	*Chemistry*
	Houghton Mifflin Harcourt	*Modern Chemistry*
Physics	Pearson	*Conceptual Physics*
	McGraw-Hill	*Physics - Principles and Problems*
Environmental Science	Houghton Mifflin Harcourt	*Environmental Science*
	Cengage Learning	*Living in the Environment*
Coordinated/Integrated Science	Pearson	*Physical Science Concepts in Action*
	McGraw-Hill	*Physical Science*

Table 6.6
Most Commonly Used Mathematics Textbooks, by Grade Range and Course

	Publisher	Title
Elementary		
Elementary Mathematics	Pearson	*Envision Math*
	McGraw-Hill	*Everyday Mathematics*
Middle		
Middle School Mathematics	McGraw-Hill	*Math Connects*
	Pearson	*Connected Mathematics*
	Houghton Mifflin Harcourt	*Mathematics Course 3*
	Houghton Mifflin Harcourt	*Algebra I*
	Houghton Mifflin Harcourt	*Mathematics Course 2*
High		
Non-college prep Mathematics	Houghton Mifflin Harcourt	*Algebra 1*
	Houghton Mifflin Harcourt	*Geometry*
	Pearson	*Algebra 1*
Formal/College-prep Mathematics Level 1	Houghton Mifflin Harcourt	*Algebra 1*
	Pearson	*Algebra 1*
	McGraw-Hill	*Algebra 1*
Formal/College-prep Mathematics Level 2	Houghton Mifflin Harcourt	*Geometry*
	Pearson	*Geometry*
Formal/College-prep Mathematics Level 3	Houghton Mifflin Harcourt	*Algebra 2*
	Pearson	*Algebra 2*
Formal/College-prep Mathematics Level 4	Cengage Learning	*Precalculus with Limits: A Graphing Approach*
	McGraw-Hill	*Advanced Mathematical Concepts: Precalculus with Applications*
Courses that might qualify for college credit	Pearson	*Calculus: Graphical, Numerical, Algebraic*
	Cengage Learning	*Calculus of a Single Variable*

Since 1950, the National Science Foundation (NSF) has funded the development of instructional materials in science and mathematics. Using title and publisher information, each textbook listed by teachers was coded as having been developed with NSF funding or not. As shown in Table 6.7, elementary mathematics classes are the most likely (25 percent) to be using such materials.

Table 6.7
Classes Using Instructional Materials
Developed with NSF Funding, by Subject and Grade Range

	Percent of Classes†			
	Science		Mathematics	
Elementary School	10	(1.8)	25	(2.5)
Middle School	6	(1.6)	11	(2.0)
High School	3	(0.5)	0	(0.2)

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

Table 6.8 shows the publication year of science and mathematics textbooks. In 2012, more than half of science classes were using textbooks published prior to 2007. In general, mathematics classes are more likely than science classes to use newer textbooks. The contrast between elementary science and elementary mathematics is particularly striking, as science classes are much more likely than mathematics classes (58 percent vs. 30 percent) to use textbooks published in 2006 or earlier.

Table 6.8
Publication Year of Textbooks/Programs, by Subject and Grade Range

	Percent of Classes†		
	Elementary	**Middle**	**High**
Science			
2006 or earlier	58 (3.0)	52 (2.6)	60 (1.9)
2007–09	24 (2.8)	35 (2.9)	26 (1.8)
2010–12	18 (2.6)	13 (2.0)	14 (1.3)
Mathematics			
2006 or earlier	30 (2.4)	40 (2.4)	52 (1.9)
2007–09	52 (2.5)	44 (2.6)	33 (1.6)
2010–12	18 (2.3)	16 (1.4)	15 (1.0)

† Only classes using published textbooks/modules 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,[7] most teachers consider their textbooks to be of relatively high quality. As can be seen in Table 6.9, teachers in the majority of science and mathematics classes in each grade range consider their textbooks/programs to be good or better, including 71–76 percent of classes in science and 76–78 percent of classes in mathematics at the various grade ranges.

[7] 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 6.9
Perceived Quality of Textbooks/Programs Used in Classes, by Subject and Grade Range

	Percent of Classes†		
	Elementary	Middle	High
Science			
Very Poor	6 (2.6)	2 (1.5)	1 (0.5)
Poor	4 (1.4)	3 (1.0)	3 (0.8)
Fair	19 (2.6)	18 (2.5)	20 (2.6)
Good	32 (2.9)	32 (3.5)	32 (2.3)
Very Good	32 (3.7)	36 (3.3)	33 (2.6)
Excellent	7 (1.8)	8 (2.6)	11 (1.5)
Mathematics			
Very Poor	1 (0.6)	2 (1.2)	1 (0.4)
Poor	3 (0.9)	4 (0.9)	4 (0.8)
Fair	20 (2.4)	19 (2.4)	16 (1.3)
Good	38 (2.5)	34 (2.6)	33 (2.5)
Very Good	30 (2.5)	33 (2.9)	37 (2.3)
Excellent	9 (1.4)	9 (1.6)	8 (1.0)

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

Table 6.10 shows the percentages of science and mathematics classes in elementary, middle, and high school that "cover" various proportions of their textbooks. Note that in each grade range mathematics classes are more likely than science classes to go through a substantial portion of their textbook, often covering 75 percent or more of their textbooks.

Table 6.10
Percentage of Textbooks/Programs Covered during the Course, by Subject and Grade Range

	Percent of Classes†		
	Elementary	Middle	High
Science			
Less than 25 percent	13 (3.3)	3 (1.3)	8 (1.7)
25–49 percent	8 (2.6)	15 (3.9)	18 (2.4)
50–74 percent	27 (4.7)	35 (4.7)	33 (2.8)
75–100 percent	52 (5.6)	47 (5.7)	41 (3.5)
Mathematics			
Less than 25 percent	2 (0.8)	2 (0.7)	1 (0.4)
25–49 percent	5 (1.3)	7 (2.1)	7 (1.2)
50–74 percent	13 (1.8)	22 (3.1)	25 (2.1)
75–100 percent	81 (2.4)	69 (3.5)	67 (2.1)

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

Mathematics classes at all grade ranges are more likely than science classes to spend a substantial portion of their time using the textbook (see Table 6.11). For example, almost half of high school mathematics classes use the textbook more than 75 percent of the time, compared to only 13 percent of high school science classes. It is also striking that in most high school science classes, less than half of the instructional time is spent using the textbook.

Table 6.11
Percentage of Instructional Time Spent Using Instructional Materials during the Course, by Grade Range

	Percent of Classes[†]					
	Elementary		Middle		High	
Science						
Less than 25 percent	15	(3.2)	25	(5.1)	46	(2.8)
25–49 percent	27	(3.4)	22	(3.3)	26	(2.3)
50–74 percent	22	(4.0)	26	(3.2)	15	(2.4)
75 percent or more	35	(4.2)	26	(4.8)	13	(2.1)
Mathematics						
Less than 25 percent	4	(1.2)	14	(2.0)	21	(2.2)
25–49 percent	12	(2.3)	14	(1.9)	14	(1.7)
50–74 percent	20	(2.6)	23	(3.2)	20	(1.7)
75 percent or more	64	(3.4)	49	(3.5)	45	(2.7)

[†] Only classes using published textbooks/programs were included in these analyses

Survey respondents were asked to describe how they used their textbook in their most recent unit. Two important findings emerge from these data. First, textbooks heavily influence science and mathematics instruction at all grade ranges (see Table 6.12). Teachers in 64 percent or more of classes in the various subject/grade-range categories report using the textbook substantially to guide the overall structure and content emphasis in their most recent unit; large proportions (45–74 percent) use the textbook for more detailed organization. There is some evidence that teachers in upper grades are less likely than those in lower grades to rely on the textbook for organizing instructional units. For example, in 45 percent of high school science classes, teachers use the textbook substantially to guide the detailed structure of the unit, compared to 65 percent of elementary classes.

Second, it is clear that teachers deviate from their textbooks substantially when designing instruction. In more than half of science and mathematics classes, teachers report incorporating activities from other sources substantially; more than 4 in 10 report "picking and choosing" from the textbook.

Table 6.12
Ways Teachers Substantially† Used Their Textbook in the Most Recent Unit, by Grade Range

	Percent of Classes‡					
	Elementary		Middle		High	
Science Classes						
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/module was lacking	64	(2.7)	75	(2.5)	79	(1.7)
You used the textbook/module to guide the overall structure and content emphasis of the unit	77	(2.8)	66	(2.7)	64	(2.1)
You picked what is important from the textbook/module and skipped the rest	42	(2.2)	49	(3.2)	51	(2.0)
You followed the textbook/module to guide the detailed structure and content emphasis of the unit	65	(2.8)	51	(3.0)	45	(2.3)
Mathematics Classes						
You incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what the textbook/program was lacking	62	(2.1)	68	(2.6)	56	(1.9)
You used the textbook/program to guide the overall structure and content emphasis of the unit	81	(1.6)	71	(2.2)	74	(1.5)
You picked what is important from the textbook/program and skipped the rest	43	(2.0)	51	(2.5)	52	(1.6)
You followed the textbook/program to guide the detailed structure and content emphasis of the unit	74	(2.0)	56	(2.7)	57	(1.5)

† 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 published textbooks/programs in the most recent unit were included in these analyses.

Teachers in over 40 percent of science and mathematics classes skip activities in the textbook substantially. In both subjects, the most often selected reason is having another activity that works better than the one skipped (see Table 6.13). Teachers cite this reason with striking consistency across grade ranges. Differences across grades, however, are also apparent. For example, in mathematics, teachers in 31 percent of elementary classes cite the difficulty of the activity as the reason for skipping it, compared to 55 percent in high school mathematics classes. Also, not having materials for an activity is much more likely to be cited as a reason in science classes (49–62 percent) than in mathematics classes (29–30 percent).

Table 6.13
Reasons Why Parts of the Textbook Are Skipped, by Grade Range

	Percent of Classes†					
	Elementary		Middle		High	
Science Classes						
You have different activities for those science ideas that work better than the ones you skipped	84	(2.8)	89	(3.2)	88	(1.8)
The science ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	66	(3.5)	65	(5.0)	60	(3.1)
Your students already knew the science ideas or were able to learn them without the activities you skipped	60	(3.8)	56	(4.1)	57	(2.9)
You did not have the materials needed to implement the activities you skipped	62	(3.4)	61	(5.2)	49	(3.1)
The activities you skipped were too difficult for your students	50	(4.0)	47	(5.0)	49	(3.1)
Mathematics Classes						
You have different activities for those mathematical ideas that work better than the ones you skipped	78	(2.5)	79	(2.9)	79	(2.0)
The mathematical ideas addressed in the activities you skipped are not included in your pacing guide and/or current state standards	68	(2.9)	78	(3.2)	66	(2.9)
Your students already knew the mathematical ideas or were able to learn them without the activities you skipped	71	(2.9)	57	(3.9)	54	(2.8)
You did not have the materials needed to implement the activities you skipped	29	(2.9)	30	(4.4)	30	(2.7)
The activities you skipped were too difficult for your students	31	(3.2)	41	(3.3)	55	(2.5)

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

Given that teachers often report skipping activities in their textbooks because they know of better ones, it is perhaps not surprising that teachers in well more than half of science and mathematics classes report supplementing their published materials (see Table 6.12). Of the reasons listed on the questionnaire, two stand out above the rest: providing students with additional practice and differentiating instruction for students at different achievement levels (see Table 6.14). The influence of standardized testing is also evident, with teachers in anywhere from half to almost three-fourths of science and mathematics classes supplementing for test preparation purposes. Finally, in 36–58 percent of classes, depending on subject and grade level, teachers supplement their published text because their pacing guide indicates that they should. This finding both speaks to the prevalence of pacing guides and suggests that supplementing is commonly prescribed by schools/districts.

Table 6.14
Reasons Why the Textbook Is Supplemented, by Grade Range

	Percent of Classes[†]					
	Elementary		Middle		High	
Science Classes						
Supplemental activities were needed to provide students with additional practice	86	(2.1)	94	(2.4)	93	(1.6)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity	93	(1.6)	96	(1.2)	92	(1.4)
Supplemental activities were needed to prepare students for standardized tests	49	(4.1)	63	(5.4)	53	(3.3)
Your pacing guide indicated that you should use supplemental activities	58	(3.2)	49	(4.6)	37	(2.5)
Mathematics Classes						
Supplemental activities were needed to provide students with additional practice	95	(1.5)	96	(1.1)	94	(1.3)
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)	97	(1.0)	91	(1.7)
Supplemental activities were needed to prepare students for standardized tests	65	(2.7)	72	(4.4)	55	(2.6)
Your pacing guide indicated that you should use supplemental activities	49	(3.1)	40	(4.2)	36	(2.1)

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

Facilities and Equipment

Teachers were presented with a list of instructional technologies and asked about their availability in the randomly selected 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.

The percentages of science classes with at least some availability (either in the classroom, upon request, or in another room) are shown in Table 6.15. Internet access is particularly widespread, regardless of grade range. Personal computers are also widely available. Other, more science-specific resources, seem to follow predictable patterns of availability. For example, microscopes and probes for collecting data are more prevalent in middle and high school than in elementary school classrooms, perhaps due to the sophistication of science activities in secondary grades.

Table 6.15
Availability† of Instructional
Technologies in Science Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Internet access	84	(1.9)	85	(2.4)	86	(1.3)
Microscopes	48	(3.2)	82	(1.9)	81	(1.9)
Personal computers, including laptops	69	(2.4)	75	(2.9)	79	(1.6)
Non-graphing calculators	69	(2.9)	83	(2.3)	77	(2.1)
Probes for collecting data (e.g., motion sensors, temperature probes)	32	(3.1)	43	(2.9)	64	(2.5)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	41	(3.8)	46	(2.7)	47	(2.3)
Graphing calculators	9	(2.3)	30	(2.9)	44	(2.3)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	20	(2.3)	19	(2.2)	20	(1.5)

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

Interestingly, the availability of some resources depends on the achievement level of students in the class. For example, as shown in Table 6.16, calculators, probes for collecting data, and microscopes are much more likely to be available in classes with mostly high-achieving students than in classes with mostly low-achieving students.

Table 6.16
Availability† of Instructional Technologies in
Science Classes, by Prior Achievement Level of Students

	Percent of Classes					
	Mostly High Achievers		Average/Mixed Achievers		Mostly Low Achievers	
Graphing calculators	39	(3.6)	23	(1.5)	18	(3.3)
Non-graphing calculators	79	(3.3)	77	(1.6)	61	(6.0)
Probes for collecitng data	58	(4.7)	43	(2.1)	34	(4.4)
Microscopes	82	(3.0)	63	(2.0)	59	(5.1)

† Availability defined as having at least one instructional technology per small group (4–5 students).

In mathematics, it is not surprising that more sophisticated calculators are more widely available in secondary classes than in elementary classes. For example, the availability of graphing calculators ranges from 11 percent of elementary classes to 83 percent of high school classes (see Table 6.17).

Table 6.17
Availability† of Instructional Technologies in Mathematics Classes, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Graphing calculators	11	(1.9)	50	(2.9)	83	(1.7)
Scientific calculators	16	(2.2)	69	(2.7)	74	(1.7)
Internet access	80	(1.9)	80	(2.0)	70	(1.9)
Four-function calculators	58	(3.0)	77	(2.0)	61	(1.9)
Personal computers, including laptops	68	(2.5)	68	(2.5)	58	(2.3)
Classroom response system or "Clickers" (handheld devices used to respond electronically to questions in class)	39	(2.6)	53	(3.0)	44	(2.5)
Probes for collecting data (e.g., motion sensors, temperature probes)	19	(2.0)	18	(2.1)	26	(2.2)
Hand-held computers (e.g., PDAs, tablets, smartphones, iPads)	17	(2.2)	21	(2.5)	17	(1.4)

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

As in science, some resources are not distributed evenly across all mathematics classes. One obvious disparity is associated with the percentage of non-Asian minority students in the class. As can be seen in Table 6.18, calculators and probes for collecting data are much more likely to be available in classes with the lowest percentages of these students, compared to classes with the highest percentages.

Table 6.18
Availability† of Instructional Technologies in Mathematics Classes, by Percent of Non-Asian Minority Students in Class

	Percent of Classes							
	Lowest Quartile		Second Quartile		Third Quartile		Highest Quartile	
Scientific calculators	58	(2.4)	50	(3.5)	43	(3.1)	37	(3.2)
Graphing calculators	53	(2.6)	44	(3.0)	39	(3.2)	34	(3.2)
Probes for collecting data	30	(2.4)	18	(2.2)	20	(3.0)	16	(2.0)

† Availability defined as having at least one instructional technology per small group (4–5 students).

Clearly, not all mathematics classes have access to all types of calculators. It appears that teachers compensate in part by expecting students to provide their own; especially in the case of more sophisticated calculators in high school mathematics classes (see Table 6.19). For example, students in almost 4 out of 10 high school mathematics classes are expected to bring their own scientific calculator.

Table 6.19
Expectations that Students will Provide their Own Instructional Technologies, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Science Classes						
Graphing/Other calculators	4	(1.0)	27	(2.6)	55	(2.2)
Laptop computers	2	(0.8)	2	(0.9)	8	(1.1)
Hand-held computers	1	(0.7)	3	(1.3)	7	(1.0)
Mathematics Classes						
Scientific calculators	3	(0.8)	22	(2.2)	38	(2.0)
Graphing calculators	3	(0.7)	8	(1.9)	30	(2.0)
Four-function calculators	5	(1.3)	23	(2.4)	23	(1.8)
Laptop computers	3	(0.9)	4	(0.9)	7	(1.1)
Hand-held computers	3	(0.8)	3	(0.9)	6	(0.9)

The 2012 National Survey also asked science and mathematics program representatives how much money their schools spent during the most recently completed year on three kinds of resources: equipment (excluding computers), consumable supplies (e.g., chemicals, graph paper), and software specific to science and mathematics instruction. By dividing these amounts by school enrollment, per-pupil estimates were generated (see Table 6.20). In science, per-pupil spending on equipment and supplies increases sharply with grade range, as does overall per-pupil spending. In mathematics, per-pupil spending is substantially higher in elementary schools than in middle and high schools.

Table 6.20
Median Amount Schools Spend per Pupil on Science and Mathematics Equipment and Consumable Supplies,† by Grade Range

	Median Amount					
	Elementary		Middle		High	
Science						
Equipment	$ 0.26	(0.1)‡	$ 0.71	(0.2)	$ 2.06	(0.3)
Consumable Supplies	$ 0.95	(0.1)	$ 1.45	(0.1)	$ 3.44	(0.2)
Total§	$ 1.55	(0.3)	$ 3.13	(0.4)	$ 6.11	(0.7)
Mathematics						
Equipment	$ 0.95	(0.2)	$ 0.73	(0.1)	$ 1.05	(0.2)
Consumable Supplies	$ 1.08	(0.2)	$ 0.64	(0.1)	$ 0.61	(0.1)
Total§	$ 4.27	(0.7)	$ 2.76	(0.4)	$ 2.46	(0.4)

† The survey asked about spending on software in addition to equipment and supplies. The median per pupil spending on software in each subject/grade-range combination is $0.00.

‡ Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.

§ Includes spending on software.

Expenditures for science and mathematics are not distributed equally across all schools. For example, rural schools spend more per pupil than suburban and urban schools on science and mathematics resources (see Tables 6.21 and 6.22). Per-pupil expenditures on science and mathematics equipment do not vary widely by the percentage of students in the school who are eligible for free/reduced-price lunch. And although there appears to be some variation in spending on supplies by percentage of students eligible for free/reduced-price lunch, there is no clear pattern.

Table 6.21
Median Amount Schools Spend per Pupil on Science Equipment and Consumable Supplies, by Equity Factors

	Median Amount		
	Equipment	**Consumable Supplies**	**Total**[†]
Percent of Students in School Eligible for FRL			
Lowest Quartile	$ 0.63 (0.2)	$ 1.67 (0.5)	$ 3.56 (0.8)
Second Quartile	$ 0.27 (0.1)[‡]	$ 0.98 (0.3)	$ 1.85 (0.5)
Third Quartile	$ 0.57 (0.2)	$ 1.17 (0.2)	$ 2.47 (0.6)
Highest Quartile	$ 0.35 (0.4)[‡]	$ 0.65 (0.1)	$ 1.54 (0.5)
School Size			
Smallest Schools	$ 0.78 (0.2)	$ 1.95 (0.4)	$ 3.94 (0.5)
Second Group	$ 0.30 (0.1)[‡]	$ 1.08 (0.2)	$ 1.96 (0.4)
Third Group	$ 0.40 (0.1)	$ 0.95 (0.2)	$ 1.82 (0.4)
Largest Schools	$ 0.44 (0.1)	$ 0.79 (0.2)	$ 2.04 (0.4)
Community Type			
Rural	$ 0.81 (0.2)	$ 1.63 (0.3)	$ 3.78 (0.4)
Suburban	$ 0.39 (0.1)	$ 1.40 (0.2)	$ 2.49 (0.3)
Urban	$ 0.34 (0.2)	$ 0.98 (0.2)	$ 1.91 (0.7)
Region			
Midwest	$ 0.55 (0.2)	$ 1.80 (0.5)	$ 3.18 (0.7)
Northeast	$ 1.34 (0.3)	$ 1.99 (0.5)	$ 4.15 (1.0)
South	$ 0.56 (0.1)	$ 0.92 (0.1)	$ 2.42 (0.4)
West	$ 0.14 (0.3)[‡]	$ 0.99 (0.2)	$ 1.45 (0.5)

† The "Total" column includes spending on software.

‡ Standard errors for medians are typically computed in Wesvar 5.1 using the Woodruff method. Wesvar was unable to compute a standard error for this estimate using this method; thus, the potentially less-consistent replication standard error is reported.

Table 6.22
Median Amount Schools Spend per Pupil on Mathematics Equipment and Consumable Supplies, by Equity Factors

	Median Amount		
	Equipment	Consumable Supplies	Total†
Percent of Students in School Eligible for FRL			
Lowest Quartile	$ 0.93 (0.2)	$ 1.06 (0.3)	$ 3.60 (0.8)
Second Quartile	$ 0.82 (0.2)	$ 0.66 (0.1)	$ 2.75 (0.4)
Third Quartile	$ 1.02 (0.2)	$ 0.99 (0.2)	$ 3.69 (0.6)
Highest Quartile	$ 0.92 (0.1)	$ 0.65 (0.2)	$ 3.37 (1.0)
School Size			
Smallest Schools	$ 1.11 (0.2)	$ 0.86 (0.2)	$ 3.93 (0.8)
Second Group	$ 0.82 (0.2)	$ 0.68 (0.2)	$ 3.44 (0.5)
Third Group	$ 0.66 (0.1)	$ 0.92 (0.2)	$ 2.75 (0.4)
Largest Schools	$ 0.68 (0.2)	$ 0.61 (0.1)	$ 2.06 (0.5)
Community Type			
Rural	$ 1.29 (0.3)	$ 1.01 (0.2)	$ 4.58 (0.7)
Suburban	$ 0.81 (0.1)	$ 0.89 (0.1)	$ 2.98 (0.5)
Urban	$ 0.58 (0.1)	$ 0.49 (0.1)	$ 2.45 (0.5)
Region			
Midwest	$ 0.72 (0.2)	$ 0.70 (0.2)	$ 3.25 (0.6)
Northeast	$ 2.22 (0.5)	$ 1.11 (0.4)	$ 5.18 (1.4)
South	$ 0.89 (0.2)	$ 0.64 (0.1)	$ 2.93 (0.5)
West	$ 0.72 (0.2)	$ 0.91 (0.2)	$ 2.19 (0.7)

† The "Total" column includes spending on software.

Expenditures for science instruction seem to be reflected in teachers' ratings of the adequacy of resources they have on hand. As shown in Table 6.23, teachers of high school science classes were much more likely than teachers of elementary school science classes to rate their facilities, equipment, consumable supplies, and instructional technology as mostly adequate (4 or 5 on a 5-point scale from 1 "not adequate" to 5 "adequate"). In elementary schools, teachers of about two-thirds of science classes rated their resources as somewhat adequate or less.

Table 6.23
Science Classes with Adequate† Resources for Instruction, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	31 (2.6)	57 (3.0)	71 (1.7)
Equipment (e.g., microscopes, beakers, photogate timers, Bunsen burners)	37 (2.5)	47 (2.8)	60 (1.8)
Consumable supplies (e.g., chemicals, living organisms, batteries)	34 (2.7)	39 (2.5)	59 (1.9)
Instructional technology (e.g., calculators, computers, probes/sensors)	34 (2.5)	37 (2.7)	48 (2.2)

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

In mathematics classes, a key finding is that teachers in 4 out of 5 elementary mathematics classes rated their manipulatives as mostly adequate, but the percentages in middle and high school mathematics classes are substantially lower (see Table 6.24). These data suggest that substantial proportions of secondary mathematics teachers want to use manipulative materials but do not have adequate access to them. Note also that with the exception of manipulatives in elementary grades, there is substantial room for improvement in teachers' views of the adequacy of their resources.

Table 6.24
Mathematics Classes with Adequate† Resources for Instruction, by Grade Range

	Percent of Classes					
	Elementary		Middle		High	
Measurement tools (e.g., protractors, rulers)	67	(1.9)	70	(2.1)	70	(1.4)
Instructional technology (e.g., calculators, computers, probes/sensors)	50	(2.1)	62	(2.2)	69	(1.7)
Consumable supplies (e.g., graphing paper, batteries)	57	(1.8)	62	(2.3)	66	(1.7)
Manipulatives (e.g., pattern blocks, algebra tiles)	82	(1.8)	58	(2.1)	43	(1.7)

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

A composite variable named “Adequacy of Resources for Instruction” was created from these items. As shown in Table 6.25, perceptions of the adequacy of resources vary substantially by content area in elementary and middle school classrooms but are essentially the same in high school classrooms. This summary view echoes other findings reported in this section, suggesting that science instruction in the earlier grades is underresourced from the teachers’ point of view.

Table 6.25
Class Mean Scores on the
Adequacy of Resources for Instruction Composite, by Grade Range

	Mean Score			
	Science		Mathematics	
Elementary School	49	(1.4)	70	(0.9)
Middle School	57	(1.4)	71	(1.0)
High School	68	(0.9)	70	(0.8)

Mathematics teachers’ views of the adequacy of their resources do not tend to differ substantially by various equity factors. In science, teachers of classes with mostly high-achieving students have the most positive views about their resources, compared to classes with average/mixed achievers and those with mostly low-achieving students (see Table 6.26). Similarly, teachers of classes with the lowest percentage of non-Asian minority students have more positive views than those with the highest percentage, as do teachers of classes with the lowest percentage of free/reduced-price lunch students, compared to those with higher percentages.

Table 6.26
Class Mean Scores on the Adequacy of Resources for Instruction Composite, by Equity Factors

	Mean Score	
	Science	**Mathematics**
Prior Achievement Level of Class		
Mostly High Achievers	69 (1.6)	74 (0.9)
Average/Mixed Achievers	56 (0.9)	70 (0.7)
Mostly Low Achievers	47 (2.4)	68 (1.4)
Percent of Non-Asian Minority Students in Class		
Lowest Quartile	60 (1.5)	73 (0.9)
Second Quartile	59 (1.5)	71 (1.1)
Third Quartile	58 (1.3)	70 (1.0)
Highest Quartile	50 (1.7)	69 (1.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	64 (1.7)	73 (1.3)
Second Quartile	55 (1.4)	71 (1.0)
Third Quartile	54 (1.5)	69 (1.1)
Highest Quartile	50 (1.7)	68 (1.4)

Summary

An investigation of the textbooks and equipment teachers use with their classes reveals a great deal about the learning environment experienced by grade K–12 students in 2012. Science classes are more likely than mathematics classes to use multiple textbooks (or programs or modules), especially at the elementary level. Across both science and mathematics, the same three publishers dominate, accounting for at least 75 percent of the market at each level. Science classes are more likely than mathematics classes to use older textbooks. For example, 58 percent of elementary science classes that use a textbook have one published before 2007, compared to 30 percent of elementary mathematics classes. Interestingly, more than 70 percent of teachers in both subjects rate their textbooks as good or better.

Textbooks appear to exert substantial influence on instruction, from the amount of class time spent using the textbook (especially in mathematics) to the ways teachers use them to plan for and organize instruction. At the same time, it is clear that teachers deviate from their published materials substantially, both skipping parts of the text (most often because teachers know of something better) and supplementing with other materials (most often to provide additional practice or to differentiate instruction).

The availability of instructional equipment follows somewhat predictable patterns in both subjects. More sophisticated technologies (e.g., microscopes, graphing calculators) are more likely to be present in high schools than elementary schools. However, across classes, these resources are sometimes not distributed equitably. In science for example, classes composed of mostly high-achieving students are more likely than those composed of mixed or low-achieving students to have access to microscopes and graphing calculators.

The amount of money schools report spending on instructional resources seems quite inadequate, especially viewed as a per-pupil expenditure. In science, the problem is especially pronounced in elementary grades, where median per-pupil spending is half of that spent in middle schools and less than one-third of spending in high schools. The lack of spending is related to the finding that elementary science teachers are less likely than their middle school and high school counterparts to view their resources as adequate. There is no such disparity by grade level in mathematics.

An analysis of spending by school poverty suggests no major differences; however, urban and suburban schools tend to spend less per pupil than rural ones on science and mathematics equipment and supplies. This disparity is almost certainly related to school size, as small schools spend substantially more per pupil than large schools.