CHAPTER SEVEN

Factors Affecting Instruction

Overview

Students' opportunities to learn science and mathematics are affected by a myriad of factors, including teacher preparedness, school and district policies and practices, and administrator and community support. Although the primary focus of the 2012 National Survey of Science and Mathematics Education was on teachers and teaching, the study also collected information on the context of classroom practice. Among the data collected were the extent of use of various programs and practices in the school, the extent of influence of state standards for science and mathematics education, and the extent of various problems that may affect science and mathematics instruction in the school. These data are presented in the following sections.

School Programs and Practices

The designated school program representatives were given a list of programs and practices and asked to indicate whether each was being implemented in the school. These individuals were also asked about several instructional arrangements for students in self-contained classrooms—whether they were pulled out for remediation or enrichment in science and mathematics and whether they received science and mathematics instruction from specialists instead of, or in addition to, their regular teacher. Table 7.1 shows the percentage of elementary schools indicating that each program or practice is in place.

The use of science specialists, either in place of or in addition to the regular classroom teacher, is uncommon (10–16 percent of schools). Pull-out instruction, whether for remediation or enrichment, is also quite rare (7–10 percent of schools). The picture is quite different in elementary school mathematics instruction. Students are pulled out for remediation in almost 60 percent of schools, and in roughly one-third of schools, students are pulled out for enrichment. The prevalence of these practices may be due in part to the fact that mathematics is much more likely than science to be tested for accountability purposes. In addition, Title 1 funds are more likely to be targeted for remediation in mathematics and reading than in science.

Table 7.1
Use of Various Instructional Arrangements in Elementary Schools, by Subject

	Percent of Schools	
	Science	Mathematics
Students in self-contained classes pulled out from science/mathematics instruction for additional instruction in other content areas	22 (2.3)	19 (2.6)
Students in self-contained classes receive science instruction from a science/mathematics specialist *in addition* to their regular teacher	16 (2.4)	26 (2.6)
Students in self-contained classes receive science instruction from a science/mathematics specialist *instead of* their regular teacher	10 (1.9)	10 (1.9)
Students in self-contained classes pulled out for enrichment in science/mathematics	10 (1.8)	31 (2.8)
Students in self-contained classes pulled out for remedial instruction in science/mathematics	7 (1.5)	58 (3.0)

Each high school science and mathematics program representative was asked how many years of the subject students were required to take in order to graduate. As shown in Table 7.2, the vast majority of schools require at least three years of science and mathematics; almost half require four years of mathematics. For most schools, graduation requirements are just as demanding as state university entrance requirements.[8] However, when there is a difference, graduation requirements tend to be more rigorous; 30 percent of schools require more science and mathematics courses for graduation than state universities do for entrance.

Table 7.2
High School Graduation vs.
State University Entrance Requirements, by Subject

	Percent of High Schools	
	Science	Mathematics
Graduation Requirement		
1 Year	1 (1.0)	0 ---†
2 Years	14 (1.6)	5 (1.0)
3 Years	64 (2.5)	50 (3.0)
4 Years	21 (2.4)	45 (3.0)
State University Entrance Requirement		
1 Year	0 ---†	0 ---†
2 Years	23 (1.4)	0 ---†
3 Years	73 (2.2)	72 (2.3)
4 Years	4 (2.1)	28 (2.3)
Difference		
2 Years Fewer Required for Graduation	2 (1.2)	1 (0.7)
1 Year Fewer Required for Graduation	9 (2.0)	15 (2.2)
No Difference	59 (3.3)	53 (2.5)
1 Year More Required for Graduation	24 (2.9)	30 (2.4)
2 Years More Required for Graduation	6 (0.8)	0 ---†

† No schools in the sample were in this category; thus, it is not possible to compute a standard error.

[8] State (public) university entrance requirements were mined from the Internet. When state university systems included multiple tiers, the lowest 4-year university tier requirements were used.

The study asked schools whether they had implemented block scheduling. The rationale for block scheduling is largely two-fold. First, the schedule affords longer class periods, which can be especially important in science, where a 50-minute class constrains the kinds of laboratory activities that can be conducted. Second, students can take eight classes per year instead of six or seven. As shown in Table 7.3, approximately one-third of all middle and high schools use block scheduling.

Table 7.3
Prevalence of Block Scheduling

	Percent of Schools
Middle Schools	31 (3.4)
High Schools	34 (3.1)

Finally, science and mathematics program representatives were asked to indicate which of several practices their school included to enhance student interest and/or achievement. The results are shown in Tables 7.4 and 7.5. Especially in science, such programs tend to be more prevalent as grade range increases. For example, almost half of high schools have science clubs, compared to 20 percent of elementary schools. Similarly, 40 percent of high schools have one or more teams participating in science competitions, whereas only 13 percent of elementary schools do. In mathematics, the percentage of schools offering school-based programs to enhance interest and achievement (apart from tutoring) is strikingly low. For example, only one-third of high schools have mathematics clubs, and less than a fourth of all schools offer after-school enrichment in mathematics.

Table 7.4
School Programs/Practices to Enhance Students' Interest and/or Achievement in Science/Engineering, by Grade Range

	Percent of Schools		
	Elementary	Middle	High
Offers after-school help in science and/or engineering (e.g., tutoring)	31 (2.7)	53 (3.6)	81 (2.9)
Encourages students to participate in science and/or engineering summer programs or camps offered by community colleges, universities, museums, or science centers	50 (3.5)	63 (3.6)	75 (3.5)
Sponsors visits to business, industry, and/or research sites related to science and/or engineering	30 (2.7)	35 (3.4)	48 (3.6)
Offers one or more science clubs	20 (2.6)	29 (3.0)	47 (3.4)
Participates in a local or regional science and/or engineering fair	35 (3.0)	39 (3.3)	46 (3.2)
Has one or more teams participating in science competitions (e.g., Science Olympiad)	13 (2.0)	22 (2.2)	40 (3.4)
Has one or more teams participating in engineering competitions (e.g., Robotics)	11 (1.9)	19 (2.4)	33 (2.4)
Offers formal after-school programs for enrichment in science and/or engineering	17 (2.5)	24 (2.7)	29 (3.1)
Sponsors meetings with adult mentors who work in science and/or engineering fields	16 (2.4)	24 (3.0)	28 (2.6)
Offers one or more engineering clubs	7 (2.0)	13 (2.5)	21 (2.0)
Holds family science and/or engineering nights	26 (2.8)	23 (3.0)	16 (2.9)

Table 7.5
School Programs/Practices to Enhance Students' Interest and/or Achievement in Mathematics, by Grade Range

	Percent of Schools					
	Elementary		Middle		High	
Offers after-school help in mathematics (e.g., tutoring)	67	(2.4)	80	(2.8)	92	(2.7)
Encourages students to participate in mathematics summer programs or camps offered by community colleges, universities, museums or mathematics centers	44	(2.7)	51	(2.8)	55	(3.6)
Has one or more teams participating in mathematics competitions (e.g., Math Counts)	24	(2.4)	35	(2.7)	43	(3.6)
Offers one or more mathematics clubs	15	(2.0)	23	(2.0)	32	(2.7)
Offers formal after-school programs for enrichment in mathematics	18	(2.0)	24	(2.5)	21	(2.9)
Participates in a local or regional mathematics fair	13	(2.2)	17	(2.6)	21	(3.4)
Sponsors visits to business, industry, and/or research sites related to mathematics	15	(2.3)	15	(2.2)	17	(2.8)
Holds family math nights	31	(2.6)	19	(2.3)	10	(2.8)
Sponsors meetings with adult mentors who work in mathematics fields	10	(1.7)	9	(1.6)	10	(1.5)

Interestingly, these programs are not distributed equally across all types of schools. Some differences are particularly evident by size of school. For example, 37 percent of the largest schools hold family science nights compared to only 16 percent of the smallest schools (see Table 7.6). A similarly large gap exists for the prevalence of family math nights (see Table 7.7). Disparities are also evident for enrichment programs, discipline-specific clubs, participation in competitions, and participation in science fairs.

Table 7.6
School Programs/Practices to Enhance Students' Interest in Science/Engineering, by School Size†

	Percent of Schools							
	Smallest Schools		Second Group		Third Group		Largest Schools	
Encourage students to participate in summer programs/camps	58	(4.0)	59	(4.2)	54	(4.2)	65	(4.3)
Participation in local or regional science fair	28	(3.5)	43	(3.8)	45	(3.7)	54	(4.2)
After-school help	45	(3.8)	47	(3.7)	39	(3.4)	51	(4.0)
Science clubs	21	(3.0)	32	(3.3)	42	(3.8)	38	(4.0)
Family nights	16	(2.8)	23	(3.9)	29	(4.2)	37	(4.2)
Sponsor visits to business, industry, and/or research sites	34	(3.3)	31	(3.4)	34	(3.8)	36	(3.8)
After-school programs for enrichment	19	(2.9)	20	(2.9)	26	(2.7)	32	(4.1)
Participation in science competitions	18	(2.4)	19	(2.4)	27	(3.0)	29	(3.2)
Participation in engineering competitions	14	(2.4)	20	(2.8)	20	(2.5)	27	(2.9)
Sponsor meetings with mentors who work in science and/or engineering fields	17	(3.1)	23	(3.3)	19	(2.8)	21	(3.4)
Engineering clubs	10	(2.5)	10	(1.9)	16	(2.1)	19	(2.7)

† See Appendix E for a definition of the school size categories.

Table 7.7
School Programs/Practices to Enhance
Students' Interest in Mathematics, by School Size†

	Percent of Schools							
	Smallest Schools		Second Group		Third Group		Largest Schools	
After-school help	69	(3.4)	79	(3.8)	76	(3.6)	83	(3.1)
Encourage students to participate in summer programs/camps	46	(4.1)	47	(3.6)	48	(3.9)	50	(4.4)
Family nights	15	(2.8)	28	(3.8)	32	(4.0)	43	(4.3)
Participation in mathematics competitions	26	(3.3)	34	(4.1)	37	(3.6)	39	(4.3)
After-school programs for enrichment	16	(2.4)	25	(3.5)	22	(3.1)	32	(3.5)
Mathematics clubs	12	(1.7)	30	(3.9)	26	(3.0)	32	(3.3)
Participation in local or regional mathematics fair	11	(2.7)	16	(3.6)	18	(2.6)	18	(2.8)
Meetings with mentors who work in mathematics fields	10	(2.5)	10	(2.0)	8	(2.4)	14	(3.1)
Sponsors visits to business, industry, and/or research sites	19	(3.7)	12	(2.1)	10	(2.1)	13	(2.7)

† See Appendix E for a definition of the school size categories.

Extent of Influence of State Standards

School science and mathematics program representatives were given a series of statements about the influence of state standards in their school and district, and asked about the extent to which they agreed with each. A summary of responses is shown in Tables 7.8 and 7.9. It seems clear that state standards have a major influence at the school level. For example, 80 percent or more of program representatives agree that there is a school-wide effort to align instruction with the standards and that most teachers in the school teach to those standards. Similarly, the vast majority of representatives agree that the standards have been discussed by teachers in the school. It is somewhat surprising that in science, only about half of schools are in districts that organize professional development based on the standards. The proportion is somewhat higher for mathematics (66–70 percent depending on grade level), but still raises the question of how work to align instruction with standards is being done, if not in professional development.

Table 7.8
Respondents Agreeing† with Various Statements
Regarding State Science Standards, by School Type

	Percent of Schools					
	Elementary		Middle		High	
State science standards have been thoroughly discussed by science teachers in this school	69	(2.7)	77	(3.0)	83	(2.9)
There is a school-wide effort to align science instruction with the state science standards	80	(2.3)	83	(2.4)	82	(3.1)
Most science teachers in this school teach to the state standards	83	(2.6)	86	(2.5)	81	(3.8)
Your district/diocese organizes science professional development based on state standards	56	(2.7)	52	(3.0)	54	(2.4)

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

Table 7.9
Respondents Agreeing† with Various Statements
Regarding State Mathematics Standards, by School Type

	Percent of Schools		
	Elementary	Middle	High
There is a school-wide effort to align mathematics instruction with the state mathematics standards	91 (2.1)	91 (2.6)	85 (3.2)
Most mathematics teachers in this school teach to the state standards	91 (1.8)	90 (2.3)	84 (3.3)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school	85 (2.4)	86 (2.7)	83 (2.7)
Your district/diocese organizes mathematics professional development based on state standards	70 (3.1)	66 (3.4)	66 (2.9)

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

By combining these items in a composite variable, an overview of the influence of standards is possible. As can be seen in Table 7.10, attention to standards is generally greater in mathematics than in science. The greater weight given to mathematics in school accountability probably contributes to the attention mathematics standards receive.

Table 7.10
School Mean Scores on the Focus on State Standards Composite

	Percent of Classes	
	Science	Mathematics
Elementary School	69 (1.1)	80 (1.3)
Middle School	72 (1.3)	79 (1.6)
High School	74 (1.4)	77 (1.7)

Factors That Promote and Inhibit Instruction

School science and mathematics program representatives were given a list of factors that might affect science and mathematics instruction in their school and asked to indicate the influence of each. Results for individual science items are presented in Table 7.11 and those for mathematics in Table 7.12. As there is little variation by grade range, the results are presented for schools overall.[9]

Four factors are perceived by a majority of schools as promoting effective science instruction:

- Importance that the school places on science;
- District/Diocese science professional development policies and practices;
- Public attitudes toward science instruction; and

[9] Results are presented by grade range in the forthcoming *The 2012 National Survey of Science and Mathematics Education: Compendium of Tables* report.

- How science instructional resources are managed (e.g., distributing and refurbishing materials).

In addition, less than a fourth of schools see these as inhibiting science instruction. In contrast, time for professional development is seen as inhibiting effective science instruction in almost one-third of schools.

Table 7.11
Effect† of Various Factors on Science Instruction

	Percent of Schools					
	Inhibits		Neutral		Promotes	
Importance that the school places on science	18	(1.9)	21	(1.6)	60	(2.1)
District/Diocese science professional development policies and practices	14	(1.4)	35	(2.4)	52	(2.5)
Public attitudes toward science instruction	11	(1.7)	36	(2.3)	53	(2.5)
How science instructional resources are managed (e.g., distributing and refurbishing materials)	22	(2.0)	26	(2.2)	53	(2.5)
Time provided for teacher professional development in science	29	(2.2)	27	(1.9)	44	(2.3)
Conflict between efforts to improve science instruction and other school/district/diocese initiatives	32	(2.2)	41	(2.5)	27	(2.5)

† Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

The climate for mathematics instruction seems generally more supportive than that for science. For example, 82 percent of schools indicate that the importance the school places on the subject promotes effective mathematics instruction, compared to 60 percent for science. Similarly, professional development policies and practices, as well as time provided for professional development, are more likely to be viewed as promoting effective mathematics instruction.

Table 7.12
Effect† of Various Factors on Mathematics Instruction

	Percent of Schools					
	Inhibits		Neutral		Promotes	
Importance that the school places on mathematics	8	(1.2)	11	(1.5)	82	(1.8)
Equipment and supplies and/or manipulatives for teaching mathematics (for example: materials for students to draw, cut and build in order to make sense of problems)	13	(1.7)	19	(1.6)	69	(1.9)
District/Diocese mathematics professional development policies and practices	8	(1.4)	26	(1.9)	65	(2.1)
Public attitudes toward mathematics instruction	13	(1.5)	30	(2.1)	58	(2.3)
Time provided for teacher professional development in mathematics	20	(1.8)	23	(1.9)	56	(2.0)
Conflict between efforts to improve mathematics instruction and other school/district/diocese initiatives	23	(1.8)	39	(2.0)	37	(2.4)

† Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

Program representatives were also asked to rate each of several factors as either not a significant problem, somewhat of a problem, or a serious problem for instruction. In science, resource-related issues are most often cited as serious problems (see Table 7.13). Inadequate funds for purchasing equipment and supplies is perceived as a serious problem by 28–32 percent of the schools, lack of science facilities by 19–30 percent, and inadequate materials for individualized instruction by 17–21 percent. In the elementary grades, insufficient time to teach science is seen as a serious problem by 27 percent of schools, compared to 17 percent of middle schools and 10 percent of high schools. Inadequate science-related professional development opportunities are also more likely to be seen as a serious problem in elementary schools (23 percent) than in high schools (14 percent).

Table 7.13
Science Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Science Instruction in Their School, by Grade Range

	Percent of Schools					
	Elementary		Middle		High	
Inadequate funds for purchasing science equipment and supplies	30	(3.0)	32	(3.4)	28	(3.9)
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)	27	(3.3)	30	(4.0)	19	(4.3)
Low student reading abilities	16	(2.2)	19	(2.5)	19	(2.0)
Inadequate materials for individualizing science instruction	21	(2.6)	20	(3.0)	17	(3.1)
Large class sizes	13	(2.0)	15	(1.9)	16	(1.9)
Inadequate science-related professional development opportunities	23	(2.3)	20	(2.6)	14	(2.1)
Lack of opportunities for science teachers to share ideas	20	(2.5)	16	(2.5)	13	(2.3)
Inadequate supply of science textbooks/modules	14	(2.0)	13	(2.3)	13	(1.6)
High student absenteeism	8	(1.7)	13	(2.3)	13	(1.7)
Low student interest in science	5	(1.4)	11	(1.9)	13	(1.5)
Interruptions for announcements, assemblies, and other school activities	8	(1.5)	10	(1.6)	11	(1.6)
Insufficient time to teach science	27	(2.6)	17	(2.4)	10	(1.7)
Lack of parental support for science education	10	(1.8)	14	(2.2)	9	(1.3)
Inappropriate student behavior	9	(1.6)	15	(2.1)	8	(1.4)
Inadequate teacher preparation to teach science	11	(1.8)	9	(2.1)	3	(0.9)
Community resistance to the teaching of "controversial" issues in science (e.g., evolution, climate change)	3	(1.2)	6	(1.8)	2	(0.5)
Lack of teacher interest in science	4	(1.0)	3	(1.0)	2	(0.9)

In mathematics, only two factors are seen as a serious problem in a substantial proportion of schools: low student interest in the subject and low student reading abilities. Lack of student interest is more likely to be seen as a serious problem in middle and high schools than in elementary schools.

Table 7.14
Mathematics Program Representatives Viewing Each of a Number of Factors as a Serious Problem for Mathematics Instruction in Their School, by Grade Range

	Percent of Schools					
	Elementary		Middle		High	
Low student interest in mathematics	14	(2.0)	25	(2.1)	30	(2.7)
Low student reading abilities	22	(1.8)	24	(2.1)	20	(2.3)
Inadequate funds for purchasing mathematics equipment and supplies	12	(2.1)	18	(2.7)	16	(3.3)
High student absenteeism	8	(1.6)	13	(2.1)	16	(1.8)
Lack of parental support for mathematics education	15	(1.9)	17	(2.0)	15	(1.6)
Inadequate mathematics-related professional development opportunities	18	(2.1)	16	(2.8)	15	(2.9)
Inadequate materials for individualizing mathematics instruction	12	(1.8)	16	(2.5)	15	(3.2)
Large class sizes	15	(1.6)	15	(1.7)	13	(1.7)
Inadequate supply of mathematics textbooks/programs	9	(1.9)	13	(2.5)	11	(2.6)
Inappropriate student behavior	10	(1.7)	16	(1.9)	10	(1.3)
Insufficient time to teach mathematics	13	(2.1)	12	(2.4)	10	(2.0)
Lack of opportunities for mathematics teachers to share ideas	15	(2.1)	14	(2.3)	9	(2.5)
Interruptions for announcements, assemblies, and other school activities	7	(1.3)	8	(1.4)	9	(1.5)
Inadequate teacher preparation to teach mathematics	4	(0.9)	3	(0.9)	3	(1.0)
Lack of teacher interest in mathematics	2	(0.7)	1	(0.4)	2	(0.7)

Composite variables created from these items allow for a summary of the factors affecting science and mathematics instruction. One striking difference is the generally more supportive context for elementary mathematics instruction compared to the climate for elementary science instruction (see Table 7.15). The difference is evidenced by the lack of time (for instruction, professional development, and teaching sharing) and lack of materials, as well as the magnitude of problems presented by teacher-related issues. Although some of these disparities exist in the middle grades as well, they tend to narrow considerably in high school. Within science, some differences across grade ranges are apparent, most notably with regard to time and teacher-related issues. Within mathematics, the influence of factors across grade ranges is much more similar.

Table 7.15
School Mean Scores on Factors Affecting Instruction Composites, by Grade Range

	Mean Score		
	Elementary	**Middle**	**High**
Science			
Supportive Context for Science Instruction	61 (1.4)	61 (1.9)	65 (1.6)
Extent to which a Lack of Materials and Supplies is Problematic	42 (1.8)	43 (2.1)	38 (2.4)
Extent to which a Lack of Time for Science is Problematic	46 (1.8)	38 (1.9)	33 (1.6)
Extent to which Student Issues are Problematic	25 (1.4)	31 (1.7)	32 (1.6)
Extent to which Teacher Issues are Problematic	27 (1.7)	17 (2.0)	10 (1.6)
Mathematics			
Supportive Context for Mathematics Instruction	71 (1.4)	70 (1.4)	69 (1.5)
Extent to which a Lack of Materials and Supplies is Problematic	29 (1.8)	34 (2.0)	32 (2.3)
Extent to which a Lack of Time for Mathematics is Problematic	35 (1.8)	34 (2.1)	32 (2.3)
Extent to which Student Issues are Problematic	32 (1.3)	37 (1.5)	38 (1.9)
Extent to which Teacher Issues are Problematic	15 (1.2)	12 (1.2)	8 (1.0)

When disaggregated by various school factors, some differences in composite means emerge (see Tables 7.16 and 7.17). The mean score for the "Extent to Which Student Issues are Problematic" composite, which includes items such as low student interest, high absenteeism, and inappropriate behavior, varies considerably in science by the percentage of students eligible for free/reduced-price lunch (ranging from 17 for the lowest quartile to 44 for the highest) and to a lesser extent by school size (ranging from 26 to 34). Though not as pronounced, gaps related to the same equity factors also exist for the composite variable labeled "Extent to Which Teacher Issues are Problematic," which includes items about the teacher interest in the subject and teacher preparation to teach the subject. Similar disparities exist in mathematics.

Table 7.16
School Mean Scores for Factors Affecting
Science Instruction Composites, by Equity Factors

	Mean Score				
	Supportive Context for Science Instruction	**Extent to Which a Lack of Materials and Supplies is Problematic**	**Extent to Which Student Issues are Problematic**	**Extent to Which a Lack of Time for Science is Problematic**	**Extent to Which Teacher Issues are Problematic**
Percent of Students in School Eligible for FRL					
Lowest Quartile	65 (2.0)	36 (3.8)	17 (2.2)	40 (2.4)	16 (2.1)
Second Quartile	56 (2.0)	38 (2.8)	29 (2.0)	46 (2.6)	26 (2.8)
Third Quartile	61 (1.9)	42 (2.3)	35 (1.9)	45 (2.4)	23 (2.2)
Highest Quartile	59 (2.5)	42 (3.2)	44 (2.2)	45 (3.2)	26 (2.8)
School Size					
Smallest Schools	64 (2.1)	41 (2.4)	26 (1.9)	38 (2.4)	14 (2.1)
Second Group	56 (2.1)	40 (2.4)	32 (1.7)	48 (2.7)	27 (2.3)
Third Group	64 (1.8)	36 (2.4)	32 (2.0)	41 (2.1)	24 (2.3)
Largest Schools	62 (1.6)	37 (2.1)	34 (1.9)	48 (2.4)	29 (2.2)

Table 7.17
School Mean Scores for Factors Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score									
	Supportive Context for Mathematics Instruction		Extent to Which a Lack of Materials and Supplies is Problematic		Extent to Which Student Issues are Problematic		Extent to Which a Lack of Time for Mathematics is Problematic		Extent to Which Teacher Issues are Problematic	
Percent of Students in School Eligible for FRL										
Lowest Quartile	74	(2.4)	26	(2.9)	20	(2.1)	31	(2.0)	9	(1.2)
Second Quartile	70	(2.0)	31	(2.8)	39	(2.3)	37	(3.1)	15	(2.3)
Third Quartile	70	(1.7)	29	(2.6)	44	(2.2)	35	(2.0)	13	(1.8)
Highest Quartile	68	(1.8)	35	(2.8)	50	(1.8)	37	(2.4)	19	(1.8)
School Size										
Smallest Schools	70	(1.9)	31	(2.6)	33	(2.0)	34	(2.5)	11	(1.6)
Second Group	68	(2.0)	30	(2.3)	39	(2.1)	35	(2.4)	13	(1.6)
Third Group	71	(1.6)	31	(2.2)	41	(1.7)	36	(2.1)	16	(1.9)
Largest Schools	74	(1.7)	27	(2.6)	41	(2.0)	36	(2.8)	18	(2.4)

Teachers were asked about factors that affect instruction in their randomly selected class. Because responses did not vary by grade range in science, combined K–12 results are shown in Table 7.18. In almost three-fourths of science classes, teachers rate principal support as promoting effective science instruction. In addition, in the vast majority of science classes, teachers see their state standards as either promoting (63 percent) or neutral toward (27 percent) science instruction; in only 10 percent of science classes teachers indicate that their state standards inhibit effective instruction. The results for district curriculum frameworks are virtually identical to those for state standards. Factors seen as inhibiting science instruction in 20 percent or more of classes are:

- Time for planning;
- Student reading abilities;
- Time for professional development; and
- Testing/accountability policies (both district and state).

Table 7.18
Effect[†] of Various Factors on
Instruction in the Randomly Selected Science Class

	Percent of Classes					
	Inhibits		Neutral		Promotes	
Principal support	6	(0.7)	21	(1.4)	73	(1.4)
Students' motivation, interest, and effort in science	13	(1.1)	16	(1.1)	71	(1.3)
Current state standards	10	(1.0)	27	(1.2)	63	(1.5)
District/Diocese curriculum frameworks	10	(1.1)	28	(1.6)	62	(1.7)
Time for you to plan, individually and with colleagues	25	(1.7)	17	(1.3)	58	(1.7)
District/Diocese/School pacing guides	14	(1.3)	33	(1.7)	53	(1.7)
Students' reading abilities	26	(1.2)	21	(1.3)	53	(1.5)
Time available for your professional development	23	(1.7)	25	(1.4)	51	(1.6)
Teacher evaluation policies	10	(0.9)	41	(1.8)	49	(1.6)
Parent expectations and involvement	19	(1.4)	33	(1.7)	48	(1.7)
Textbook/module selection policies	19	(1.4)	34	(1.7)	47	(2.0)
Community views on science instruction	13	(1.0)	41	(1.6)	46	(1.7)
District/Diocese testing/accountability policies	21	(1.9)	40	(2.0)	39	(1.8)
State testing/accountability policies	25	(1.6)	39	(1.8)	36	(1.7)

[†] Respondents rated the effect of each factor on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those responding 1 or 2. The "Promotes" column includes those responding 4 or 5.

The results for mathematics vary considerably by grade level. As such, they are presented separately in Tables 7.19 (factors seen as promoting effective instruction, by grade range) and 7.20 (factors seen as inhibiting effective instruction, by grade range). In general, the context for mathematics instruction is more supportive in elementary classes than in middle and high school classes. For example, in 78 percent of elementary classes, teachers see their students' motivation, interest, and effort as promoting effective instruction, compared to 60 percent of middle grades classes and 55 percent of high school classes. Smaller, but still sizeable, gaps exist for parent expectations and involvement, community views on mathematics instruction, and both state and district testing/accountability policies. A similar image emerges when considering factors that inhibit mathematics instruction.

Table 7.19
Factors Seen as Promoting† Effective Instruction in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Principal support	82 (1.8)	80 (2.3)	75 (1.9)
District/Diocese curriculum frameworks	76 (2.2)	69 (2.8)	63 (2.0)
District/Diocese/School pacing guides	69 (2.3)	58 (3.1)	63 (2.2)
Time for you to plan, individually and with colleagues	66 (2.3)	67 (3.0)	61 (2.2)
Current state standards	76 (2.5)	71 (3.0)	59 (1.8)
Time available for your professional development	63 (2.3)	57 (2.7)	56 (1.9)
Students' motivation, interest, and effort in mathematics	78 (2.2)	60 (3.2)	55 (2.3)
Teacher evaluation policies	59 (2.5)	56 (2.6)	55 (2.0)
Textbook/program selection policies	58 (2.6)	44 (3.1)	53 (2.0)
Parent expectations and involvement	59 (2.8)	46 (2.9)	46 (2.1)
District/Diocese testing/accountability policies	59 (2.6)	45 (2.9)	46 (2.3)
Students' reading abilities	60 (2.6)	53 (3.4)	44 (2.3)
State testing/accountability policies	52 (2.6)	44 (3.0)	40 (1.9)
Community views on mathematics instruction	48 (2.6)	38 (3.2)	39 (2.2)

† Includes those responding 4 or 5 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

Table 7.20
Factors Seen as Inhibiting† Effective Instruction in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes		
	Elementary	Middle	High
Principal support	5 (1.1)	6 (1.9)	6 (1.0)
District/Diocese curriculum frameworks	7 (1.2)	9 (1.7)	8 (1.1)
District/Diocese/School pacing guides	13 (1.6)	17 (2.3)	10 (1.3)
Time for you to plan, individually and with colleagues	18 (1.8)	17 (2.2)	21 (1.8)
Current state standards	6 (1.1)	8 (1.4)	11 (1.1)
Time available for your professional development	15 (1.7)	17 (2.4)	16 (1.5)
Students' motivation, interest, and effort in mathematics	9 (1.2)	22 (2.1)	26 (2.0)
Teacher evaluation policies	9 (1.5)	11 (1.2)	12 (1.4)
Textbook/program selection policies	14 (1.6)	21 (2.7)	13 (1.4)
Parent expectations and involvement	15 (1.9)	25 (2.5)	25 (1.8)
District/Diocese testing/accountability policies	14 (1.8)	26 (2.4)	18 (1.8)
Students' reading abilities	18 (2.2)	29 (3.3)	27 (2.1)
State testing/accountability policies	19 (1.8)	27 (2.3)	25 (1.9)
Community views on mathematics instruction	11 (1.5)	17 (2.1)	22 (1.9)

† Includes those responding 1 or 2 on a 5-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

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 randomly selected class. As shown in Tables 7.21 and 7.22, these resources are generally not seen as problematic. In science, the age of and access to computers is most likely to be seen as a problem in middle grades classes, compared to elementary and high school classes. Otherwise, few between-grades differences are apparent. In mathematics, age of and access to computers are more likely to be seen as problematic in elementary classes than in high school classes, but the percentages are generally quite low.

Table 7.21
Extent to Which Technology Quality is a Serious Problem for Instruction in the Randomly Selected Science Class, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Old age of computers	11 (1.7)	25 (3.1)	14 (1.7)
Lack of access to computers	12 (1.5)	21 (2.9)	12 (1.6)
Slow speed of the Internet connection	7 (1.3)	15 (2.7)	12 (1.5)
Lack of availability of technology support	9 (1.4)	14 (2.0)	12 (1.5)
Lack of availability of appropriate computer software	12 (1.8)	15 (2.3)	10 (1.6)
Unreliability of the Internet connection	6 (1.2)	9 (2.0)	10 (1.5)
Lack of access to the Internet	5 (1.1)	11 (2.4)	7 (1.4)

Table 7.22
Extent to Which Technology Quality is a Serious Problem for Instruction in the Randomly Selected Mathematics Class, by Grade Range

	Percent of Classes		
	Elementary	**Middle**	**High**
Old age of computers	18 (2.0)	13 (1.9)	9 (1.4)
Lack of access to computers	13 (1.7)	9 (1.5)	8 (1.3)
Slow speed of the Internet connection	10 (1.4)	7 (1.0)	6 (1.2)
Lack of availability of technology support	11 (1.7)	8 (1.4)	8 (1.1)
Lack of availability of appropriate computer software	10 (1.4)	11 (1.6)	11 (1.4)
Unreliability of the Internet connection	6 (1.2)	6 (0.9)	5 (1.0)
Lack of access to the Internet	6 (1.0)	4 (0.9)	3 (0.8)

Composites from these teacher questionnaire items were created to summarize the extent to which various factors support effective science and mathematics instruction. The means for each subject and grade range are shown in Table 7.23. Two patterns are apparent in the results. First, when differences exist between subjects, they tend to show greater support for mathematics instruction. For example, in elementary grades, the extent to which school support and the policy environment promote effective instruction is greater for mathematics than for science. (Interestingly, in high school, the perception of stakeholder support is reversed, with science being higher.) Second, within mathematics, the data suggest that the climate is generally more supportive in elementary classes than in middle and high school classes. Note, for example, the relatively high mean for the Stakeholder variable in elementary grades (a mean score of 71) compared to middle school (61) and high school (59).

Table 7.23
Class Mean Scores on Factors Affecting Instruction Composites, by Grade Range

	Mean Score					
	Elementary		Middle		High	
Science						
Extent to which School Support Promotes Effective Instruction	62	(1.6)	66	(2.5)	65	(1.5)
Extent to which Stakeholders Promote Effective Instruction	69	(1.0)	63	(1.5)	65	(1.1)
Extent to which the Policy Environment Promotes Effective Instruction	65	(1.3)	64	(1.7)	62	(0.9)
Extent to which IT Quality is Problematic for Instruction	21	(1.3)	30	(1.9)	25	(1.3)
Mathematics						
Extent to which School Support Promotes Effective Instruction	71	(1.4)	69	(1.7)	67	(1.1)
Extent to which Stakeholders Promote Effective Instruction	71	(1.3)	61	(1.6)	59	(1.2)
Extent to which the Policy Environment Promotes Effective Instruction	72	(1.2)	65	(1.4)	66	(0.8)
Extent to which IT Quality is Problematic for Instruction	24	(1.2)	21	(1.2)	18	(1.0)

The means for some of these factors vary substantially by equity factors. As shown in Tables 7.24 and 7.25, the mean for the Stakeholder composite is substantially higher when classes are composed of mostly high-achieving students, compared to classes with average/mixed or mostly low-achieving students. There is also a large gap for this variable with regard to poverty; classes in schools with a high percentage of students eligible for free/reduced-price lunch have lower scores than classes in schools with the lowest percentage of these students. In both instances, the data suggest that students already at some disadvantage are in classroom and school settings that are less supportive. Results in mathematics mirror those for science.

Table 7.24
Class Mean Scores on Factors
Affecting Science Instruction Composites, by Equity Factors

	Mean Score			
	Extent to Which the Policy Environment Promotes Effective Instruction	**Extent to Which Stakeholders Promote Effective Instruction**	**Extent to Which School Support Promotes Effective Instruction**	**Extent to Which IT Quality is Problematic for Science Instruction**
Prior Achievement Level of Class				
Mostly High Achievers	67 (2.3)	76 (1.6)	70 (2.1)	22 (2.1)
Average/Mixed Achievers	64 (0.7)	66 (0.9)	64 (1.2)	23 (1.0)
Mostly Low Achievers	59 (2.6)	51 (2.0)	57 (4.0)	31 (3.5)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	61 (2.2)	68 (1.7)	63 (2.3)	22 (1.7)
Second Quartile	65 (1.3)	70 (1.4)	65 (2.7)	24 (1.7)
Third Quartile	64 (1.7)	66 (1.6)	63 (2.0)	22 (1.7)
Highest Quartile	65 (1.3)	60 (1.3)	64 (1.9)	28 (2.2)
Percent of Students in School Eligible for FRL				
Lowest Quartile	66 (1.7)	75 (1.6)	67 (2.1)	25 (1.8)
Second Quartile	62 (1.8)	66 (1.5)	61 (2.3)	23 (1.5)
Third Quartile	64 (2.3)	61 (1.5)	64 (2.6)	23 (1.7)
Highest Quartile	63 (1.4)	58 (1.5)	63 (2.2)	28 (2.4)
School Size				
Smallest Schools	64 (1.8)	66 (1.8)	59 (2.3)	24 (1.9)
Second Group	63 (1.5)	66 (1.5)	65 (1.9)	23 (1.7)
Third Group	66 (1.4)	66 (1.5)	65 (2.9)	23 (1.7)
Largest Schools	62 (1.3)	66 (1.4)	66 (2.0)	27 (2.1)

Table 7.25
Class Mean Scores on Factors
Affecting Mathematics Instruction Composites, by Equity Factors

	Mean Score			
	Extent to Which the Policy Environment Promotes Effective Instruction	**Extent to Which Stakeholders Promote Effective Instruction**	**Extent to Which School Support Promotes Effective Instruction**	**Extent to Which IT Quality is Problematic for Mathematics Instruction**
Prior Achievement Level of Class				
Mostly High Achievers	68 (1.9)	76 (1.7)	72 (1.7)	17 (1.3)
Average/Mixed Achievers	70 (0.8)	66 (1.1)	69 (1.0)	22 (0.9)
Mostly Low Achievers	65 (1.6)	52 (1.6)	68 (2.4)	25 (1.7)
Percent of Non-Asian Minority Students in Class				
Lowest Quartile	71 (1.1)	66 (1.6)	66 (1.9)	20 (1.2)
Second Quartile	69 (1.2)	70 (1.3)	69 (1.5)	19 (1.4)
Third Quartile	68 (1.3)	63 (1.6)	69 (2.1)	22 (1.7)
Highest Quartile	66 (1.6)	61 (1.8)	72 (2.0)	25 (1.4)
Percent of Students in School Eligible for FRL				
Lowest Quartile	70 (1.2)	72 (1.3)	70 (2.1)	19 (1.1)
Second Quartile	69 (1.2)	65 (1.3)	70 (1.6)	23 (1.9)
Third Quartile	69 (1.4)	63 (1.9)	68 (1.9)	23 (1.8)
Highest Quartile	66 (1.8)	57 (2.1)	69 (2.1)	24 (1.4)
School Size				
Smallest Schools	70 (1.4)	63 (1.5)	65 (2.4)	23 (1.4)
Second Group	69 (1.4)	62 (1.6)	68 (1.7)	20 (1.3)
Third Group	69 (1.4)	66 (1.5)	71 (1.7)	21 (1.4)
Largest Schools	66 (1.5)	68 (1.4)	73 (1.3)	24 (1.6)

Summary

The 2012 National Survey data suggest that the use of special instructional arrangements—e.g., subject matter specialists or pull-out instruction for enrichment and/or remediation—is much more prevalent in mathematics than in science, perhaps because of accountability pressures associated with mathematics. The availability of federal funds for mathematics instruction probably also plays a role. In contrast, programs to encourage student interest in mathematics are strikingly uncommon. For example, less than one-third of schools offer mathematics clubs. Such practices are more common in science and tend to increase with grade range. Further, in both subjects, the opportunities are not distributed evenly across types of schools, as they are more likely to occur in large schools than small ones.

In mathematics, the substantial influence of state standards is evident in multiple ways, among them school-wide efforts to discuss and align instruction with standards. And although science standards clearly exert their own influence, there is some evidence that standards play a larger role in mathematics instruction than in science, especially in the elementary grades.

Across the data in this chapter, there is an overall finding that the climate for mathematics instruction is generally more supportive than that for science. For example, in 82 percent of schools, the importance that the school places on mathematics is seen as supporting instruction, compared to only 60 percent of schools for science. Lack of time and materials for science instruction, especially in the elementary grades, is particularly problematic.